

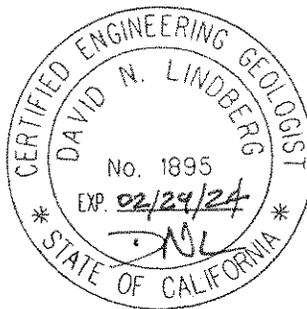
LINDBERG GEOLOGIC CONSULTING
David N. Lindberg, Certified Engineering Geologist

**ENGINEERING GEOLOGIC R-1
SOILS EXPLORATION REPORT**

Proposed New Residence
141 Cove Point East
Shelter Cove, California

Assessor's Parcel Numbers:
111-221-012, 111-221-038, & 111-161-068

Prepared for:
Mr. Tony Pisarski




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ENGINEERING GEOLOGIC R-1 SOILS REPORT

Proposed New Residence, 141 Cove Point East, Shelter Cove, Humboldt County
Assessor's Parcel Numbers: 111-221-012, 111-221-038, & 111-161-068

1.0 INTRODUCTION

1.1 Site and Project Description

This report presents the results of our engineering-geologic soils investigation conducted at the site of a proposed new residential development on three parcels at 141 Cove Point East, in Shelter Cove in Humboldt County, California (Figure 1). These parcels are all within Block 172 of the Shelter Cove Subdivision (Figures 2 and 3).

| TABLE 1 - PROJECT LOCATION INFORMATION | |
|---|--|
| Assessor's Parcel Numbers: 111-221-012, 111-221-038, & 111-161-068 | |
| Address | 141 Cove Point East |
| Latitude and Longitude* (111-221-012) | 40.0292° N, and -124.0604° W |
| Latitude and Longitude* (111-221-038) | 40.0285° N, and -124.0596° W |
| Latitude and Longitude* (111-161-068) | 40.0295° N, and -124.0608° W |
| Legal Description | NW ¼ Sec. 15, T5S, R1E, HB&M |
| Assessed Parcel Size | 0.31 + 2.49 + 0.45 = <u>3.25</u> GIS Acres |

* Centroids of parcels per Humboldt County Web GIS

Lindberg Geologic Consulting (LGC) was retained by the owner to prepare this Engineering-Geologic R-1 soils report for a proposed new residential development to be constructed on the property. This proposed project is on a small graded flat area within the steep slopes of the adjacent coast bluffs. This property has a generally west to southwest aspect (Figure 1). The property is served by the Shelter Cove Resort Improvement District for municipal water supply and sewage disposal.

Included in this report are assessments of potential soils and geologic hazards associated with the project site, and recommendations to help mitigate some of the potential effects of such hazards. Also provided in this report are relevant recommendations for design professionals (architects and engineers) to utilize for planning and designing site developments.

1.2 Scope of Work

Our Scope of Services included site exploration, and preparation of this engineering-geologic soils (Humboldt County R-1) report evaluating the suitability of the site for the proposed residential development. 141 Cove Point East is an existing, previously undeveloped parcel. Primary geologic hazards on the property appear to include, but may not be limited to, strong earthquake ground shaking, earthquake ground disruption, slope instability and erosion.

An environmental site assessment for the presence of any hazardous materials was excluded from our scope of work. We have explored site conditions; we have not conducted any analytical laboratory testing for the presence of hazardous material in any soil samples.

1.3 LIMITATIONS

This report was prepared for Mr. Tony Pisarski, for specific application to the proposed developments on 141 Cove Point East, and for the exclusive use of our client and the owner's agents, contractors, and appropriate public authorities. LGC has endeavored to comply with generally accepted engineering geologic practice common to the local area at the time this report was prepared. LGC makes no other warranty, express or implied.

Analyses and recommendations contained in this report are based on data obtained from limited subsurface exploration and published information. Our methods indicate subsurface conditions only at specific locations where explorations were conducted, and only at the time they were conducted. Subsurface exploration and observation of soil samples cannot always be relied on to reflect stratigraphic variations that may exist between sampling locations or across a parcel; 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 that may only be verified during actual earthwork for construction. 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 LGC is retained to observe the earthworks. We are available to discuss the costs, and a schedule of observations required to provide assurance of the validity of our recommendations.

Do not apply any of this report's conclusions or recommendations if the nature, design, or location of the proposed new residence is changed in any way. When, or if, any changes may be contemplated, LGC should be consulted to review their impact on the applicability of the recommendations in this report. LGC is not responsible for any claims, damages, or liability associated with any third party's interpretation of our subsurface data, or reuse of this report for any future project on this site, or at other locations, without our express written authorization.

2.0 FIELD EXPLORATION

2.1 Field Exploration Program

A Certified Engineering Geologist from our office visited this site on September 27, 2023. A field investigation was performed to assess the site slope stability, and its in-situ soil and groundwater conditions, and to estimate the engineering characteristics of the subsurface materials at the proposed location of the new residence. Materials exposed in nearby road cuts were examined. In addition, reports from previous investigations that we have conducted in the Shelter Cove subdivision were reviewed.

3.0 SITE AND SUBSURFACE CONDITION

3.1 Topography and Site Conditions

This subject property has an area of approximately 141,570 square feet, or 3.25 acres, (per Humboldt County WebGIS), and slopes to the southwest at approximately 50 percent. The "flat" area on the subject property lies at the terminus of Cove Point East on parcel 111-221-038, and along the northeast side of Cove Point East on parcels 111-221-012, and 111-161-068.

3.2 Geologic Setting

This parcel is located within the Coast Ranges Geologic Province of California, 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. On the Geologic Map of California, Redding Sheet (CDMG, 1962), the project area is mapped as Jurassic - Cretaceous Franciscan Formation (KJf).

Surficial deposits on the proposed building site consist of ancient landslide deposits derived from the mélange and folded argillite of the Miocene to Late Cretaceous King Range Terrane. King Range terrane is a sub-unit of the Coastal Belt of the Franciscan Complex (McLaughlin, *et. al.*, 2000).

3.3 In-Situ Soil Conditions

This proposed residence is sited on a flat on the slope above Shelter Cove and the Pacific Ocean. As observed in road cut exposures near this site, this, and other nearby lots in the Shelter Cove subdivision, are underlain by native bearing soils consisting primarily of loam. For engineering purposes, these soils are characterized as sandy clay with fine gravel (CL) with less than 10 percent (estimated), sandstone rock fragments in a matrix of clay with silty fine sand. Topsoil was observed to be thin (>1 ft.) on these southwest facing slopes. A thin prism of side cast fill from subdivision development and historic road construction can be anticipated along the edges of the flat area. Soil distribution is shown in Figure 7, and the soil map unit description is attached.

3.4 Slope Stability Features and Conditions

The subject property slopes southwest, with slopes of approximately 50 percent or less, based on the United States Geological Survey, and the Humboldt County WebGIS site. The subject property is in an area with a potential for slope instability. To the southwest of the parcel, beyond Cove Point East, the slopes become steeper on the face of the coastal bluff and show no evidence of past instability on-site. No active or dormant landslide features were observable on that portion of the subject parcel anticipated to be proposed for development.

As used in our report, the terms “active” and “dormant” landslide have specific meanings. An “active” landslide means a landslide which is presently moving or has recently moved. Distinct topographic slide features (i.e., sharp barren scarps, cracks, jackstrawed trees) are present. Major revegetation has not occurred. A “dormant” landslide, on the other hand, shows little evidence of recent movement, with features modified by weathering and erosion, and vegetation well established. Ancient, dormant landslides can be unrecognizable today. Some mass movements may have developed under climatic conditions different from today. Causes of, and the potential for, slope failures may remain, and movement could potentially be renewed.

Slopes in coastal Humboldt County often do show evidence of and can be susceptible to active landsliding. Slopes in the Shelter Cove subdivision may have a higher potential for slope failure, in general, than many areas of Humboldt County due to (among other factors) the steep slopes, high annual precipitation, and the fact that much of the Shelter Cove subdivision is underlain by erodible, ancient landslide deposits in a seismically active region.

3.5 Existing Fills

No fills were observable within the flat area on this site. Fills associated with the construction of Cove Point East may exist near the southwestern edges of the flat areas near the road. The earthwork contractor should report any fills uncovered during grading and excavation operations so that our recommendations may be reviewed for applicability.

3.6 Groundwater Conditions

Groundwater was not observed on this site or in the immediate vicinity at the time of our site observations in late September. Groundwater at the time of our fall explorations probably had not yet begun to rise from the dry-season low. Soil mottling was not observed, indicating that the groundwater probably does not rise to less than 10 feet below the ground surface during the wet season.

3.7 Surface Drainage Hazards

Provided that our recommendations and those of the design engineer are adhered to, potential surface drainage hazards may be mitigated on this proposed construction site. Our recommendations include provisions for grading the site so that storm water runoff drains away appropriately, and that runoff from sidewalks, driveways, parking areas, gutters and downspouts is conveyed to suitable and appropriate outlet points. Uncontrolled concentrated runoff from the property should never be allowed to flow down the steep slopes on-site. We will recommend draining runoff from this site to Cove Point East to drain by sheet flow to the subdivision storm drainage system to the extent feasible.

3.8 Flooding

This site is not within a flood prone area. Therefore, the hazard of flooding is considered low.

3.9 Tsunami

The site is 480 feet above sea level and is not within a Tsunami prone area as mapped by the state of California; thus the hazard of tsunami is considered low.

4.0 GEOLOGIC HAZARDS

There are two primary areas of concern for evaluation of the seismic hazards for a site. These are: (1) potential for ground rupture due to placement of the structure on or near an active fault, and (2) the anticipated magnitude and peak acceleration of the postulated seismic event.

4.1 Seismic Ground Shaking and Surface Fault Rupture

In response to the first area of concern, this site is located within the Fault Hazard (Special Studies) Zone associated with the northern San Andreas fault where surface rupture may be a hazard. The level of anticipated shaking at the site is a function of the magnitude of the postulated earthquake on a given fault system, and the shortest distance from the fault system to the site. A detailed discussion of this process has been presented by Seed and Idriss (1982).

The San Andreas fault is a significant seismic source which marks the boundary between the North American plate and the Pacific plate. It is well known that the San Andreas fault can

generate major earthquakes, and such an event would affect this site. The north coast segment of the San Andreas fault is considered capable of generating an upper bound earthquake with a moment magnitude (M_w) of 7.9 and a recurrence interval of approximately 200 years (CDMG, 1996).

It is believed that the north coast segment of the San Andreas fault moves in conjunction with events like the great San Francisco earthquake of 1906. Estimates of peak acceleration at this site are presented later in this report. The San Francisco earthquake of 1906 caused surface rupture nearby, on the north side of the subject property within the present-day Shelter Cove subdivision. The surface trace of the San Andreas fault is mapped northeast of the property between Cove Point East and Landis Road, as is the special studies zone designated by the State of California.

Given the level of potential ground shaking associated with Shelter Cove's seismo-tectonic setting, it is possible earthquake-induced landsliding could occur along the hillslopes around Shelter Cove and might occur on this parcel. The actual level of risk of earthquake-induced landsliding is dependent on several variables including proximity of the epicenter, depth of the hypocenter, duration of shaking, slope angle, soil type and density, soil loading, and soil moisture conditions at the time of the event. It is beyond the scope of this report to speculate on the potential for landslides to develop along the hill slope edge because of an earthquake in the region. The potential risk of strong earthquake ground motion and earthquake-induced landsliding are typically accepted by persons choosing to build or reside in the Shelter Cove subdivision.

4.2 Liquefaction

Liquefaction is a phenomenon involving loss of soil strength and resulting in fluid mobility through the soil. Liquefaction typically occurs when loose, uniformly sized, saturated sands or silts are subjected to repeated shaking in areas where the groundwater is less than 50 feet bgs. 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. The probability of liquefaction is low at the subject property; bearing soils are not saturated and do not consist of poorly graded sands or other soil types typically considered liquefiable.

5.0 CONCLUSIONS AND DISCUSSION

In our opinion, the subject parcel appears suitable for the proposed development and the project appears to be feasible from a strictly engineering-geologic perspective. Provided that our recommendations are adhered to, it is anticipated that the proposed grading and earthwork will not contribute to geologic, or soils engineering hazards associated with construction on moderately steep hillslopes in this area of the Shelter Cove subdivision. Our investigation and evaluation of this property indicates that this site is underlain by essentially undisturbed native soils developed on ancient, dormant landslide materials of Quaternary age.

The ground surface at this parcel slopes steeply to the southwest. The greatest geologic hazards on the subject parcel appear to be the hazards of earthquake ground shaking, earthquake-induced landsliding, and erosion. The crest of the actively eroding coastal bluff slope is more than 400

feet south of the end of Cove Point East; coastal bluff retreat is not anticipated to be a threat to the stability of the subject property during the typical life of the proposed site developments (~70 years).

Humboldt County classifies the slopes on the subject parcel to be of “Moderate Instability“ to “High Instability”. It is possible that dormant landslides may exist and not be readily observable on the slopes on and near this property. Intense rainfall events associated with the wet winter season often results in landslides in several areas in Humboldt County, but none were observable on the subject property. In many cases landslides develop in response to saturated soil conditions and erosion by uncontrolled runoff. Landslides may develop on steep slopes unpredictably from time to time in response to seismicity, or when conditions conducive to their formation occur.

The site of the earthwork proposed for this new residence appears to be underlain by suitable, undisturbed soils at a depth of approximately 24 inches as observed in nearby cut slopes. Site soils below that depth appear to be suitable to support the static foundation loads imposed by the proposed residence. For design purposes, we recommend that a conservative bearing value for undisturbed native soil of 1,500 pounds per square foot (psf) for dead load plus long-term live load should be used.

6.0 RECOMMENDATIONS

6.1 Setback Recommendations

From an engineering geologic viewpoint, we recommend that building foundations be set back from the steep slopes on the property. The proposed residence will be sited on a moderately-sloping portion of the property. To mitigate the potential slope stability hazards, ensure that the face of the footing at depth (24” minimum) is set back at least 10 feet from any break in slope. Similarly developed parcels are common in the Shelter Cove subdivision. Descending slopes, at approximately 30 percent and greater surround much of the flat to gently sloping areas of the property. In our opinion, slope setbacks are necessary for the long-term stability of the proposed project. Zoning setbacks remain applicable.

6.2 Site Preparation

Earthwork (grading and excavations) should be undertaken only after the wet winter rainy season. All debris and vegetation should be removed from within 5 feet of the footprint of the proposed residential development and disposed of or recycled appropriately. Topsoil and sod (if any) should be stripped from the building footprint and stockpiled on-site for later use as landscaping material and non-structural fill or disposed of appropriately. Following the work, topsoil should be replaced on bare soil areas and seeded to establish vegetation prior to the winter wet season.

6.3 Subgrade Preparation

Excavate the uppermost six inches of topsoil and sod from below the footprint of the proposed developments and from an area five feet beyond. As described above, segregate and stockpile topsoil for later use as non-structural or landscaping fill. Native soils exposed below the topsoil are anticipated to be suitably firm at approximately 2.5 feet below the existing ground surface. Subgrade at 2.5 feet is loamy and appeared to be suitable material in which to embed new

reinforced concrete foundations. If soft or disturbed materials are encountered below 2.5 feet, further excavate to expose more-competent native soils consisting of stiff loam.

Our explorations and professional experience suggest that suitably-firm, undisturbed native bearing soils occur at approximately 2.5 feet bgs at this anticipated residential development site. Excavations left by removal of any soft, unsuitable soils below this depth, may be backfilled with compacted aggregate base, concrete, or controlled low-strength material (CLSM), commonly referred to as "sand and concrete slurry". If needed, place CLSM (or other backfill) two-foot-wide footing trenches, to no less than 2.5 feet below existing grade, at the base of the spread footings.

6.4 Temporary Excavations

Temporary construction slopes are anticipated for this project as currently proposed. Temporary construction slopes, if proposed, should be designed, and excavated in strict compliance with applicable local, state, and Federal safety regulations including the current OSHA Excavation and Trench Safety Standards.

Construction equipment, building materials, excavated soil, and other similar loads should not be allowed near the top of unshored or unbraced excavations greater than four feet in height. Where the stability of adjoining developments is, or may be endangered by excavation operations, support systems such as shoring, bracing, or underpinning, may be required to provide structural stability and to protect personnel.

Excavation operations are dependent on construction methods and scheduling; therefore, the owner, designer, and contractor share responsibility for the design, installation, maintenance, and performance of all shoring, bracing, underpinning, and other similar systems. LGC assumes no responsibility for the safety of temporary excavations or shoring systems.

6.5 Cut and Fill Slopes

Fill embankments should be constructed with slopes not exceeding 2:1 horizontal to vertical (50% slope), maximum. If any new cut slopes are proposed, they should also be limited to a maximum slope of 2:1. Short-term construction (temporary) slopes may be steeper. Slope grades may be modified only if previously reviewed and approved in writing by our office. All new cut slopes, fill embankments and bare soil areas created in this development work should be re-vegetated promptly to minimize the potential for erosion.

6.6 Fill Materials

All structural fill materials should be suitable granular native material (if present), or well-graded imported granular material such as crushed quarry rock or river-run gravels (100 percent passing 3-inch sieve). Fill materials should be reviewed and approved for use by the project engineer prior to importing it to the site. Fill should be placed in loose lifts not exceeding 8 inches, on a suitably prepared (i.e., flat) surface, and should be compacted mechanically so that no settlement will occur. A suitably prepared surface should consist of native soil material scarified and compacted in-place. We recommend compaction to a minimum of 90 percent relative compaction

(RC) under foundations, driveways, sidewalks, and landscaped areas. Fill materials should be placed at a uniform moisture content, within three percent of optimum.

6.6.1 Aggregate Base

Aggregate base material (AB) may be used for pavement subgrade, placed beneath footings or floor slabs, or used as backfill. AB should meet the requirements in the Caltrans Specifications for Class 2 AB; 1.5-inch maximum particle size and should be compacted mechanically.

6.6.2 Select Fill

In the case of new construction requiring select fill, that select fill should consist of granular material that may be used as non-expansive fill beneath floor slabs and for the upper portion of the pavement subgrade. Select fill should be a well-graded soil/rock mixture free of organics and other deleterious material; on-site native soils may not be suitable for use as select fill.

Select fill material should contain low plasticity clay, well-graded sand, and/or gravel. The material should contain no more than three percent by weight of rocks larger than 3 inches in greatest dimension, or more than 15 percent larger than 2-inches. Additionally, the material should meet the following specifications:

| | |
|--------------------------------|-----------------------|
| Plasticity index (PI): | <12 |
| Liquid Limit (LL): | <30 |
| Percent passing No. 200 sieve: | 50 maximum, 5 minimum |

6.7 Compaction Standard

Where compacted fill is required, that structural fill should be compacted in accordance with the specifications listed in the table below. Place material in horizontal lifts not exceeding 8-inches in loose thickness. Retain a qualified field technician to be present to observe fill placement and to perform field density tests at random locations throughout each lift to verify that the specified compaction is being achieved by the contractor.

Where trenches closely parallel a footing and the trench bottom is within a two horizontal to one vertical plane, projected outward and downward from any structural element, concrete slurry should be utilized to backfill that portion of the trench below this plane. The use of slurry backfill is not required where a narrow trench crosses a footing at or near a right angle.

| Fill Placement Location | Compaction (ASTM D 1557) | Moisture % Optimum |
|---|--------------------------|--------------------|
| Roadways within 2.0' of Base of Pavement | 95% | -1 to +3 percent |
| Fill below Base of Pavement Subgrade | 90% | -1 to +3 percent |
| Utility trenches: Building/Pavement areas | 95% | -1 to +3 percent |
| Utility trenches: Landscape Areas | 90% | -1 to +3 percent |

6.8 Seismic Design Parameters

We recommend that designers utilize the following site-specific spectral response spectrum as obtained from the United States Geological Survey (USGS). The USGS ground motion parameter calculator uses spectral acceleration values (S_s and S_1) based on site-specific geographic coordinates, the seismic database maintained by the USGS, the site classification, site coefficients, and adjusted maximum considered earthquake values (F_a , F_v , SMS , and $SM1$).

Given the intended residential use, we assigned the site to Risk Category II (Table 1604.5, 2022 CBC). Because the site-specific spectral acceleration S_1 is greater than 0.75, the project parcel is assigned to Seismic Design Category E (Section 1613.2.5, 2022 CBC). Based on the site conditions observed, and assumptions about the soils within 100-feet of the ground surface, the site soil profile includes undisturbed native Quaternary landslide deposits to a depth of more than six feet. We classify the subgrade as Site Class D, consisting of a "stiff soil" profile (Section 1613.2.2, 2022 CBC). The parameters in Table 3 below are based on these classifications and Chapter 20, ASCE 7-16. For calculating spectral response, we used the centroid of parcel 111-221-038.

| | | |
|---|-------------------------|-------------------------------|
| Situation Information: 141 Cove Point East Shelter Cove | Latitude / Longitude | 40.0285° N, 124.0596° W |
| | Risk/Occupancy Category | II |
| | Seismic Design Category | E |
| | Site Class | D |
| Spectral Acceleration | S_s (Site Class B) | 2.167 |
| | S_1 (Site Class B) | 0.901 |
| Site Coefficients | F_a / F_v | 1.0 / null see section 11.4.8 |
| Response Accelerations (g) | SMS | 2.167 |
| | $SM1$ | null see section 11.4.8 |
| | S_{DS} | 1.445 |
| | S_{D1} | null see section 11.4.8 |

* Latitude and longitude of the centroid of Parcel 111221-038 per Humboldt County WebGIS.

6.9 Allowable Soil Bearing Pressures

Per Section 1806 of the 2022 CBC, for undisturbed native CL soils, 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 multiplied by the contact area, as limited by CBC Section 1806.3.2. An increase of one-third may be permitted where used with the alternate basic load combinations in CBC Section 1605.2 (2022) which includes wind or earthquake loads.

6.10 Foundation Design

No specific foundation plans were provided to us for the proposed development. The following foundation recommendations assume that a typical, lightly loaded, wood or steel framed, one- or

two-story residential structure will be constructed. In our opinion, such structures may be supported by foundations consisting of continuous reinforced concrete spread footings or a monolithic slab-on-grade with continuous concrete perimeter footings. Isolated interior spread footings may be included to support column loads where required. A foundation of the type described appears suitable for the site conditions. Foundations should be designed by an experienced civil engineer, in accordance with our recommendations, and the standards of the currently in-force edition of the CBC (2022).

Footings

Foundation systems for this site should be reinforced to limit potential structural damage due to differential settlement and strong seismic ground shaking. A representative from LGC should observe foundation excavations prior to the placement of any forms or rebar work to assure that the foundations are set in firm undisturbed native materials.

- If necessary to mitigate soft or undocumented fill soils, excavate and replace with suitable engineered fill, placed, and compacted as recommended, or CLSM (controlled low strength material) such as concrete sand slurry.
- Trenches backfilled with engineered fill or CLSM shall be 24 inches wide.
- Footings should be embedded a minimum of 2.5 feet below existing grade.
- Embed footings into firm undisturbed native soils below 2.5 feet of depth.
- Width of footings should be no less than 15 inches, per 2022 CBC Section 1808.
- Minimum thickness of footings should be 6 inches, for one- or two-story structures.
- Support any deck(s) on reinforced concrete drilled piers embedded at least five feet into firm undisturbed native soil below any loose topsoil, sod, and soft subsoils; approximately 7.5 feet below existing grade.

Floor Slab Design

- Where a concrete floor slab is proposed, we recommend a reinforced concrete floor slab-on-grade on one-foot of prepared Class 1, Type A gravel or Class-2 aggregate base, a vapor barrier, and a sand layer.
- Floor slabs should have a minimum thickness to be strong enough to bear the loads generated by the anticipated use.
- To reduce the possibility of moisture migration through the floor slab-on-grade, a minimum six-mil plastic membrane (vapor retarder) should be placed on the prepared subgrade.
- Joints between the sheets and utility piping openings should be lapped and taped.
- Care should be taken to protect the plastic membrane against punctures.
- To protect the membrane during steel and concrete placement, and to provide for a better concrete finish, cover the membrane with at least 1-inch of clean sand.

Any difference between the 12 inches of select fill and sand under the floor slabs, and the depth to stiff soil at 2.5 feet bgs, may be made up with additional select fill, or engineered fill placed and compacted as specified in the Structural Fill section of this report.

6.11 Settlement

The settlement which may occur on this parcel is a function of the foundation and earthquake loading, and the competence of the bearing soils. Settlement is expected to be minimal for engineered fill soils and foundations bearing on firm, undisturbed native soils and embedded as recommended. Settlement will primarily occur closely with the application of structural loads. If our recommendations and the engineer's design are adhered to, settlement is not anticipated to have detrimental effects on the new construction. New construction on this project site should not be placed on any undocumented or non-engineered fill, or on engineered fills which were not tested and approved by a qualified professional.

6.12 Grading and Drainage

Finished grading at this site should ensure positive drainage away from structure foundations. No runoff water should ever be allowed to pond anywhere on the site, nor to migrate beneath any structures.

- Never allow runoff to concentrate and flow over the slope crests surrounding the property.
- Runoff from the driveway should be drained to the street.
- Footings should be drained as described in CBC 1805.4.2, and 1805.4.3.
- Maintain a gradient of five percent away from foundations for landscaped areas within 10-feet of the residence.
- Maintain a gradient of two percent away from foundations for hardscaped areas within 10-feet of structures.
- Finished grading of the site should be designed and executed to avoid concentrating runoff.
- To the extent feasible, the grading design should promote drainage by sheet flow.
- Drainage should be contained and controlled with drains and drop inlets.
- Runoff from hardscaped areas should be contained and controlled.
- Runoff should be directed to discharge to Cove Point East so no erosion will occur.

6.13 Erosion and Sediment Control Recommendations

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 as soon as possible prior to the onset of the winter rains. Erosion Control Standards should be incorporated into the project design by the design engineer and should be adhered to during construction. At minimum, we recommend the following erosion and sedimentation control measures:

- Revegetate all disturbed areas as soon as possible following earthwork.
- Mulch exposed soil areas with punched straw and grass seed to protect against erosion.
- Cover soil stockpiles with plastic sheeting, anchored securely to prevent wind disturbance.
- Monitor the site before, during, and after runoff-generating rainfall events.
- Verify and document proper functioning of erosion control measures.
- Promptly repair erosion control measures when necessary.

7.0 ADDITIONAL SERVICES

7.1 Review of Grading, Foundation, and Drainage Plans

The conclusions and recommendations provided in this report assume that the soil conditions encountered during earthwork will be essentially the same as those observed during our explorations, and that the general nature of the grading, and use of the property will be as described above. LGC should provide grading observation services to assure conformance with the recommendations in this report including observation of the foundation excavations prior to placement of any fill, forms or reinforcing steel.

8.0 REFERENCES

- 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*.
- CBC [California Building Code], 2022 Edition, California Code of Regulations, Title 24, California Building Standards Commission.
- CDMG [California Division of Mines and Geology], 2000, *Digital Images of Official Maps of Alquist-Priolo Earthquake Fault Zones of California, Northern and Eastern Region*.
- CDMG, 1998, *State of California Special Studies Zones, Shelter Cove 7.5' Quadrangle, Humboldt County, California*.
- CDMG, 1995, *Planning Scenario in Humboldt and Del Norte Counties, California, for a Great Earthquake on the Cascadia Subduction Zone, Special Publication 115*.
- CDMG, 1996, *Probabilistic Seismic Hazard Assessment for the State of California*. Mark D. Petersen, William A. Bryant, Chris H. Cramer, Tianqing Cao, and Michael Reichle, California Department of Conservation, Division of Mines and Geology, Arthur D. Frankel, U.S. Geological Survey, Denver, Colorado. James J. Lienkaemper, Patricia A. McCrory, and David P. Schwarz, U.S. Geological Survey, Menlo Park, California, Open-File Report 96-08, *Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada*.
- 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.
- Seed, H.B. and Idriss, I.M. (1982) *Ground Motions and Soil Liquefaction during Earthquakes*. Earthquake Engineering Research Institute Monograph, Oakland.
- SEA (Structural Engineers Society of California) and OSHPD (*Office of Statewide Health Planning and Development*), 2023, *Seismic Design Maps*. <https://seismicmaps.org/>
- USGS, 1969, *Shelter Cove, Calif. 7.5' Quadrangle Map, Humboldt County, California*.

9.0 LIST OF FIGURES

- Figure 1: Topographic Project Location Map.
- Figure 2: Humboldt County Assessor's Parcel Map Book 111, Page 22.
- Figure 3: Humboldt County Assessor's Parcel Map Book 111, Page 16.

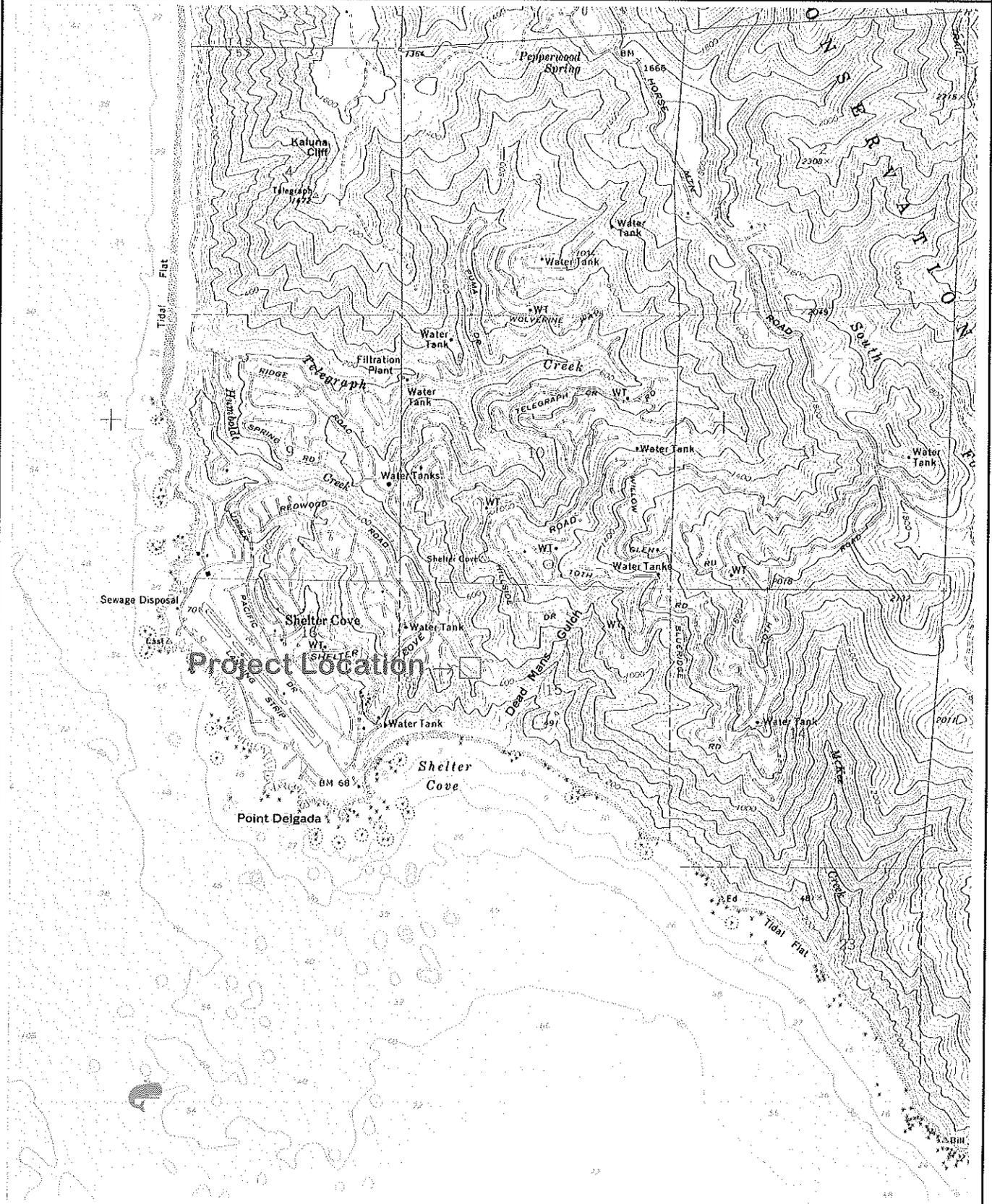
LINDBERG GEOLOGIC CONSULTING
(707) 442-6000

- Figure 4: Satellite Image of Project Location.
- Figure 5: Geologic Map.
- Figure 5a: Geologic Map Explanation.
- Figure 6: Shelter Cove Fault Zone Map.
- Figure 7: USDA – NRCS Soil Map.

Attachment

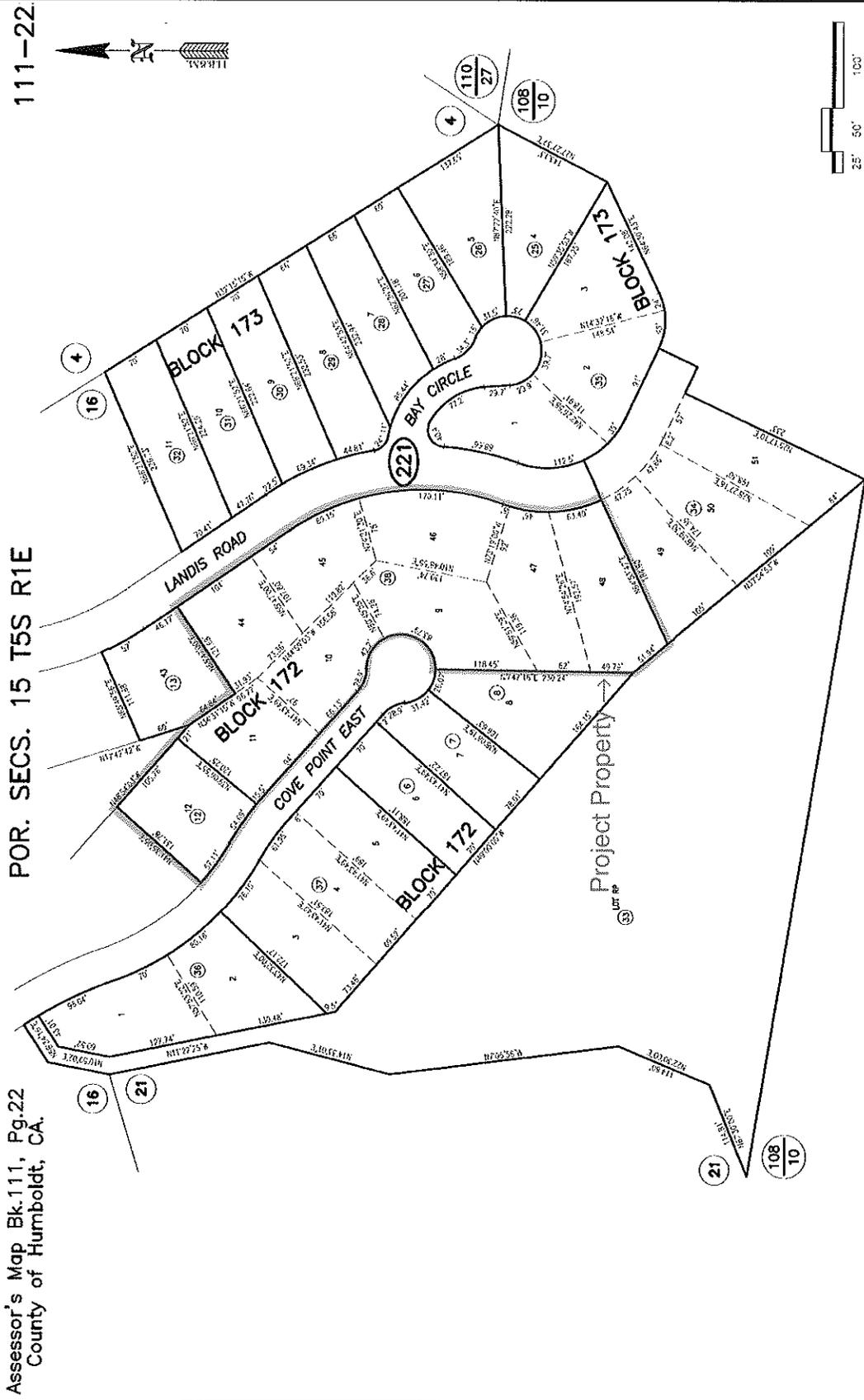
Map Unit Description: Northbear - Caperidge - Capetown complex, 5 to 30 percent slopes.
USDA Natural Resources Conservation Service, Web Soil Survey, National Cooperative Soil Survey.

| | | |
|------------------------------|--|-----------------|
| Lindberg Geologic Consulting | Engineering-Geologic R-1 Soils Report | Figure 1 |
| Post Office Box 306 | 141 Cove Point East, Shelter Cove, Humboldt County, California | October 4, 2023 |
| Cutten, CA 95534 | APN's 111-221-012, -038, & 111-161-068 Mr. Tony Pisarski, Client | Project 0518.00 |
| (707) 442-6000 | Topographic Project Location Map (all locations approximate) | 1" ≈ 2,600' |

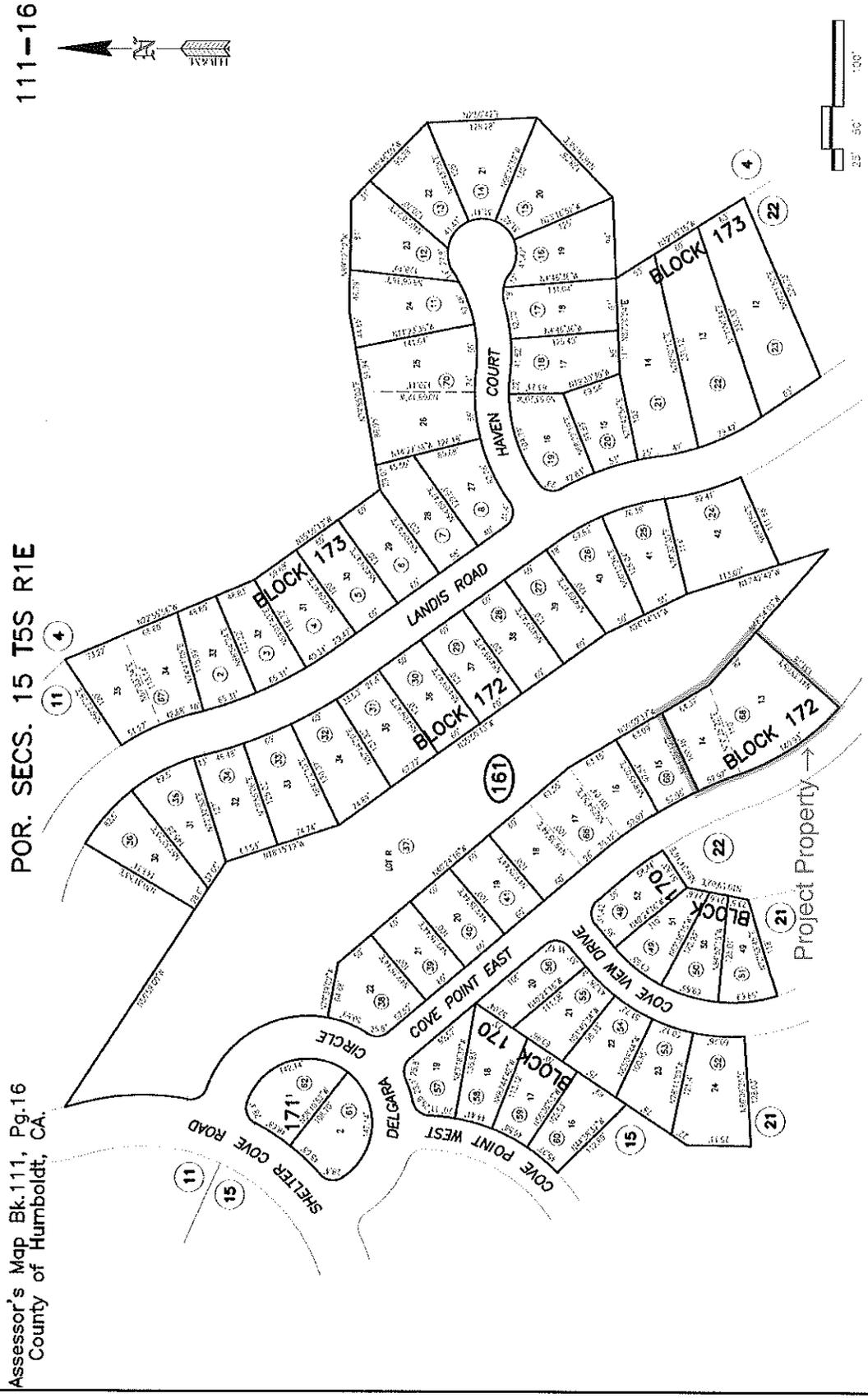


Modified from: "Shelter Cove, Calif", 7.5" Topographic Quadrangle Map, 1969. N ≈

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|------------------------------|--|-----------------|
| Lindberg Geologic Consulting | Engineering-Geologic R-1 Soils Report | Figure 2 |
| Post Office Box 306 | 141 Cove Point East, Shelter Cove, Humboldt County, California | October 4, 2023 |
| Cutten, CA 95534 | APN's 111-221-012, -038, & 111-161-068 Mr. Tony Pisarski, Client | Project 0518.00 |
| (707) 442-6000 | Assessor's Parcel Map, Book 111, Page 22 (all locations approximate) | Scale as Shown |



| | | |
|------------------------------|--|-----------------|
| Lindberg Geologic Consulting | Engineering-Geologic R-1 Soils Report | Figure 3 |
| Post Office Box 306 | 141 Cove Point East, Shelter Cove, Humboldt County, California | October 4, 2023 |
| Cutten, CA 95534 | APN's 111-221-012, -038, & 111-161-068 Mr. Tony Pisarski, Client | Project 0518.00 |
| (707) 442-6000 | Assessor's Parcel Map, Book 111, Page 16 (all locations approximate) | Scale as Shown |

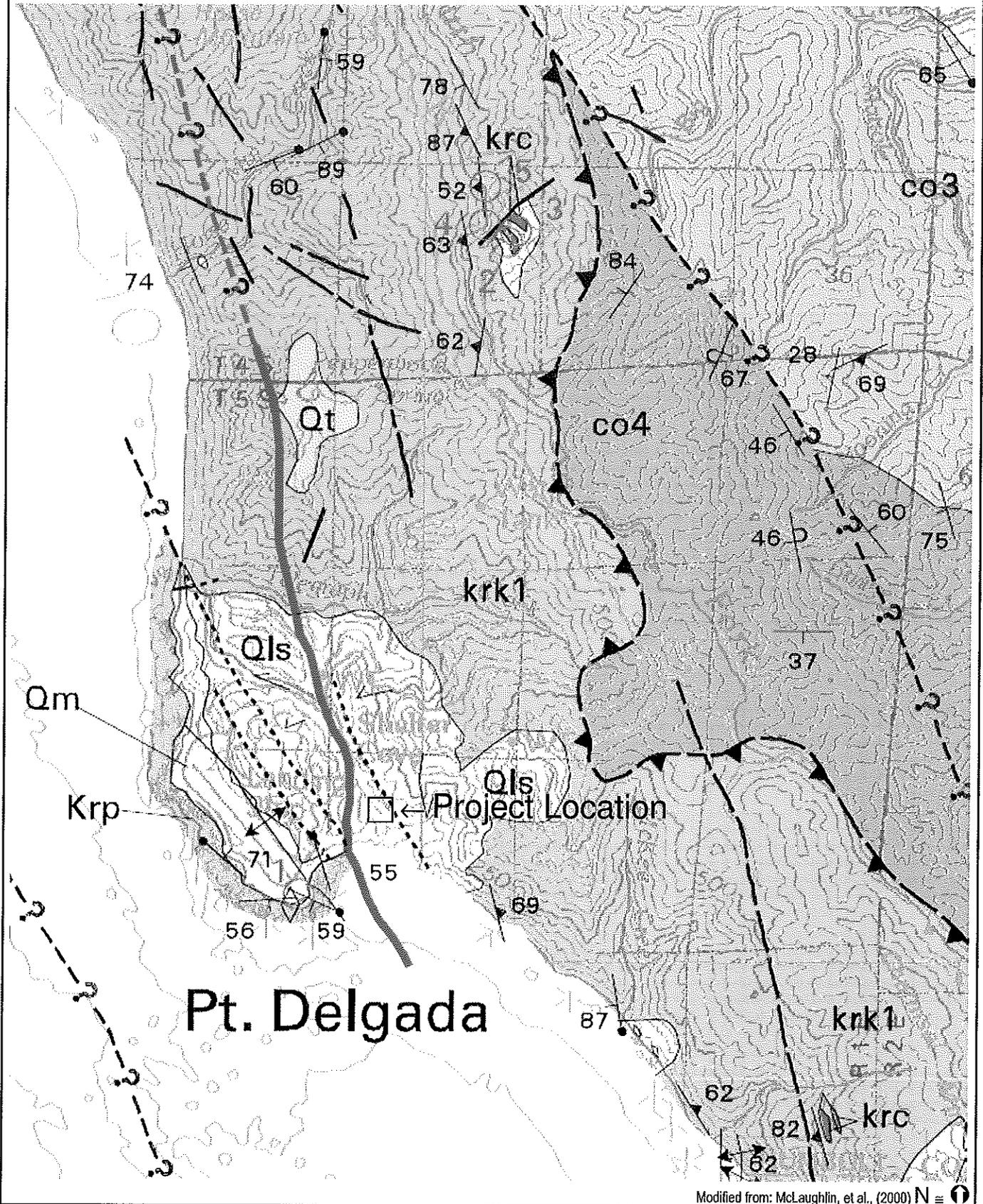


| | | |
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| Lindberg Geologic Consulting | Engineering-Geologic R-1 Soils Report | Figure 4 |
| Post Office Box 306 | 141 Cove Point East, Shelter Cove, Humboldt County, California | October 4, 2023 |
| Cutten, CA 95534 | APN's 111-221-012, -038, & 111-161-068 Mr. Tony Pisarski, Client | Project 0518.00 |
| (707) 442-6000 | Satellite Image of Project Location (all locations approximate) | 1" ≈ 150' |



Modified from: Google Earth Imagery of April 21, 2019. N ≈ 

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| Lindberg Geologic Consulting | Engineering-Geologic R-1 Soils Report | Figure 5 |
| Post Office Box 306 | 141 Cove Point East, Shelter Cove, Humboldt County, California | October 4, 2023 |
| Cutten, CA 95534 | APN's 111-221-012, -038, & 111-161-068 Mr. Tony Pisarski, Client | Project 0518.00 |
| (707) 442-6000 | Geologic Map (all locations approximate) | 1" ≈ 3,600' |



Modified from: McLaughlin, et al., (2000) N = [North Arrow]

| | | |
|------------------------------|--|-----------------|
| Lindberg Geologic Consulting | Engineering-Geologic R-1 Soils Report | Figure 5a |
| P. O. Box 306 | 141 Cove Point East, Shelter Cove, Humboldt County, California | October 4, 2023 |
| Cutten, CA 95534 | APN's 111-221-012, -038, & 111-161-068 Mr. Tony Pisarski, Client | Project 0518.00 |
| (707) 442-6000 | Geologic Map Explanation | No Scale |

DESCRIPTION OF MAP UNITS

QUATERNARY AND TERTIARY OVERLAP DEPOSITS

- Qal** Alluvial deposits (Holocene and late Pleistocene)
- Qm** Undeformed marine shoreline and aeolian deposits (Pliocene and late Pleistocene)
- Qt** Undifferentiated nonmarine terrace deposits (Holocene and Pleistocene)
- Qls** Landslide deposits (Holocene and Pleistocene)
- QTog** Older alluvium (Pliocene and [or] Pliocene)
- QJw** Marine and nonmarine overlap deposits (late Pleistocene to middle Miocene)
- T** Volcanic rocks of Fiddle 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)
 - col** Limestone (Late Cretaceous)
 - m** Undivided blueschist (Jurassic?)
- King Range terrane (Miocene to Late Cretaceous)*
- Krp** Igneous and sedimentary rocks of Point Delgada (Late Cretaceous)
 - n** 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
 - krf** 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
- Ycg** 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
- cwi** 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 metazoan rocks of the Pickett Peak terrane (Early Cretaceous or older):

- ppsm** South Fork Mountain Schist
- mb** Chiniquapin 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 metazoan rocks of the Yolla Bolly terrane (Early Cretaceous to Middle Jurassic?):

- ybt** Talasferro 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 Hammett Horn Ridge (Late Jurassic to Middle Jurassic)
- c** Metachert
- gs** Greenstone
- sp** Serpentinite
- ybd** Devil 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** Serpentine 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 keratophytic tuff (Jurassic?)
- dpc** Diabase (Jurassic?)
- dpsp** Serpentine 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 Bolly Meta-andesite of Irwin (1985), undivided (Middle Jurassic)
- whwg** Wildwood (Chanchelulla Peak of Wright and Fahn, 1988) pluton (Middle Jurassic)
- whwp** Clinopyroxenite
- whjl** Diorite and gabbro plutons (Middle Jurassic)

Rattlesnake Creek terrane

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

Western Klamath terrane

- Smith River subterrane:
- srs** Galice? formation (Late Jurassic)
- srv** Pyroclastic andesite
- sigb** 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
- Approximate
- Joint
- Strike and dip of cleavage
- Shear foliation:
- Inclined
- Vertical
- Folds:
- Synclinal or synformal axis
- Anticlinal or antiformal axis
- Overturned syncline
- Landslide
- Melange Blocks:
- △ Serpentinite
- Chert
- ◇ Blueschist
- Greenstone
- ¹⁰ 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)

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|------------------------------|--|-----------------|
| Lindberg Geologic Consulting | Engineering-Geologic R-1 Soils Report | Figure 6 |
| Post Office Box 306 | 141 Cove Point East, Shelter Cove, Humboldt County, California | October 4, 2023 |
| Cutten, CA 95534 | APN's 111-221-012, -038, & 111-161-068 Mr. Tony Pisarski, Client | Project 0518.00 |
| (707) 442-6000 | Shelter Cove Fault Zone Map (all locations approximate) | 1" ≈ 3,900' |

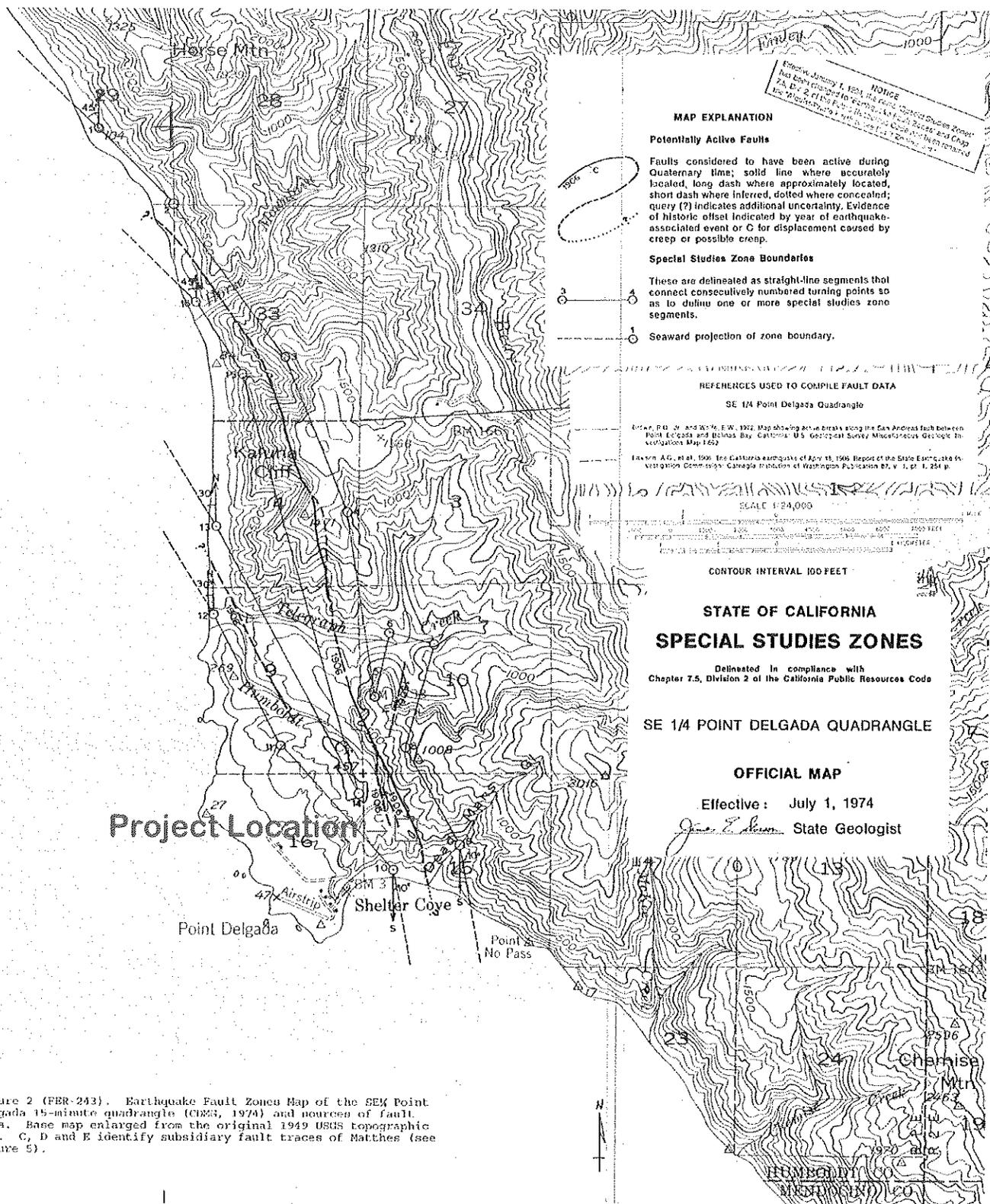


Figure 2 (FER-243). Earthquake Fault Zones Map of the SE 1/4 Point Delgada 15-minute quadrangle (CE83, 1974) and sources of fault data. Base map enlarged from the original 1949 USGS topographic map. C, D and E identify subsidiary fault traces of Matthes (see Figure 5).

Modified from: Fault Evaluation Report FER-243 San Andreas Fault, Shelter Cove Area, Humboldt County, California Division of Mines and Geology, Earl W. Hart, December 3, 1996.

| | | |
|------------------------------|--|----------------------|
| Lindberg Geologic Consulting | Engineering-Geologic R-1 Soils Report | Figure 7 |
| Post Office Box 306 | 141 Cove Point East, Shelter Cove, Humboldt County, California | October 4, 2023 |
| Cutten, CA 95534 | APN's 111-221-012, -038, & 111-161-068 Mr. Tony Pisarski, Client | Project 0518.00 |
| (707) 442-6000 | USDA-NRCS Soil Map (all locations approximate) | Scale not Determined |



Humboldt County, South Part, California

507—Northbear-Caperidge-Capetown complex, 5 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2mhfz
Elevation: 20 to 2,800 feet
Mean annual precipitation: 45 to 90 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 240 to 330 days
Farmland classification: Not prime farmland

Map Unit Composition

Northbear and similar soils: 40 percent
Caperidge and similar soils: 30 percent
Capetown and similar soils: 20 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Northbear

Setting

Landform: Benches, mountain slopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Center third of mountainflank, lower third of mountainflank
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from sandstone and mudstone

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A1 - 1 to 10 inches: loam
A2 - 10 to 21 inches: loam
AB - 21 to 28 inches: loam
Bw1 - 28 to 39 inches: loam
Bw2 - 39 to 49 inches: loam
C1 - 49 to 63 inches: loam
C2 - 63 to 79 inches: gravelly loam

Properties and qualities

Slope: 5 to 30 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Available water supply, 0 to 60 inches: High (about 10.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: B

Ecological site: F004BJ102CA - Dry, steep mountain slopes

Hydric soil rating: No

Description of Caperidge

Setting

Landform: Mountain slopes

Landform position (two-dimensional): Shoulder

Landform position (three-dimensional): Lower third of mountainflank

Down-slope shape: Convex

Across-slope shape: Linear

Parent material: Colluvium and residuum from sandstone, mudstone, and metasedimentary rock

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material

A1 - 1 to 8 inches: very gravelly loam

A2 - 8 to 15 inches: gravelly loam

AB - 15 to 28 inches: extremely gravelly sandy loam

Bt - 28 to 59 inches: extremely gravelly loam

BCt - 59 to 71 inches: extremely gravelly sandy loam

Properties and qualities

Slope: 5 to 30 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Capacity of the most limiting layer to transmit water

(Ksat): Moderately high to high (0.60 to 2.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: B

Ecological site: F004BJ102CA - Dry, steep mountain slopes

Hydric soil rating: No

Description of Capetown

Setting

Landform: Benches, mountain slopes

Hydric soil rating: No

Data Source Information

Soil Survey Area: Humboldt County, South Part, California

Survey Area Data: Version 12, Sep 2, 2022