TO: Board of Supervisors

FROM: Planning and Building Services

MEETING DATE: September 12, 2023

DEPARTMENT CONTACT:	Jessie Waldman	**PHONE:**	707-234-6650
DEPARTMENT CONTACT:	Julia Krog	**PHONE:**	707-234-6650

ITEM TYPE: Consent Agenda **TIME ALLOCATED FOR ITEM**: N/A

AGENDA TITLE:
Acceptance of Informational Report Regarding the Issuance of Emergency Coastal Development Permit EM_2023-0003 (McLellan) to Relocate the Single-Family Residence, Located at 34301 Pacific Reefs Road, Albion, APN: 123-340-19

RECOMMENDED ACTION/MOTION:
Accept the Informational Report Regarding the Issuance of Emergency Coastal Development Permit EM_2023-0003 (McLellan) to Relocate the Single-Family Residence, Located at 34301 Pacific Reefs Road, Albion, APN: 123-340-19

PREVIOUS BOARD/BOARD COMMITTEE ACTIONS:
In 1991 the Board adopted Division II of Title 20 of Mendocino County Code through Ordinance No. 3785. Included in Division II is Section 20.536.055 which allows Permits for Approval of Emergency Work. In cases of a verified emergency, temporary emergency authorization to proceed with remedial measures may be given by the Director or his or her designee until such time as a Coastal Development Permit application is filed. The Director shall report in writing to the Board of Supervisors at each meeting the emergency permits applied for or issued since the last report, with a description of the nature of the emergency and the work involved. The report of the Director shall be informational only. The decision to issue an emergency permit is solely at the discretion of the Director. Notice of emergency permits shall be provided by phone or letter to the California Coastal Commission within three (3) days, following issuance of the emergency permit.

SUMMARY OF REQUEST:
In early March 2023, approximately twenty-two (22) feet of the ocean bluff collapsed extending to the foundation of the existing single-family residence. On July 14, 2023, the current landowners submitted an emergency request application for the relocation of the existing single-family residence to Planning and Building Services. The application requests to relocate or re-construct the single-family residence to a new foundation within a stable building site on the subject parcel further away from the existing failed bluff edge, no less than sixty-six (66) feet east of the bluff top edge. Because of the structure's proximity to the blufftop, Planning Staff has determined the work is considered development and requires the issuance of a Coastal Development Permit

The emergency permit was issued on **August 2, 2023** and becomes null and void at the end of sixty (60) days. *Prior to expiration of this Emergency Permit, the applicant shall submit a standard Coastal Development Permit application for the work authorized by the permit.*

ALTERNATIVE ACTION/MOTION:
None, informational item.

DOES THIS ITEM SUPPORT THE GENERAL PLAN? Yes

STRATEGIC PLAN PRIORITY DESIGNATION: A Safe and Healthy County

SUPERVISORIAL DISTRICT: DISTRICT 5

VOTE REQUIREMENT: Majority

SUPPLEMENTAL INFORMATION AVAILABLE ONLINE AT: https://www.mendocinocounty.org/government/planning-building-services/public-notices

FISCAL DETAILS:

SOURCE OF FUNDING: N/A
CURRENT F/Y COST: N/A
ANNUAL RECURRING COST: N/A
BUDGET CLARIFICATION: N/A

BUDGETED IN CURRENT F/Y: N/A
IF NO, PLEASE DESCRIBE:
REVENUE AGREEMENT: N/A

AGREEMENT/RESOLUTION/ORDINANCE APPROVED BY COUNTY COUNSEL: N/A

CEO LIAISON: Steve Dunnicliff, Deputy CEO
CEO REVIEW: Choose an item.
CEO COMMENTS:

FOR COB USE ONLY

Executed By: Deputy Clerk
Date: Date Executed

Final Status:Item Status
Executed Item Type: item Number:

COUNTY OF MENDOCINO
DEPARTMENT OF PLANNING AND BUILDING SERVICES
860 NORTH BUSH STREET · UKIAH · CALIFORNIA · 95482
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COASTAL DEVELOPMENT PERMIT
AUTHORIZATION FOR EMERGENCY WORK
CASE FILE EM #2023-0003

OWNER/APPLICANT: RICHARD MCLELLEAN TTEE
2379 PANORAMA TERRACE
LOS ANGELES, CA 90039

AGENT: MALSOM CONSTRUCTION, KYLE MALSOM
420 N CORRY ST
FORT BRAGG, CA 95437

SITE ADDRESS/APN: 34301 Pacific Reefs Road, Albion, CA (APN: 123-340-19)

NATURE OF EMERGENCY: Approximately twenty-two (22) feet of the ocean bluff collapsed in early March 2023, extending to the foundation of the existing single-family residence.

CAUSE OF EMERGENCY: The emergency is the result of bluff erosion resulting in imminent failure of the single-family residence. A Geotechnical Investigation, prepared by Brunsing Associates, Inc. on June 28, 2023, determined the ocean bluff collapsed, extending to the foundation of the existing residence in early March 2023. The bluff top is currently at the landslide headscarp (top of landslide) along the southwest foundation line of the structure. The bluff top slideline extends from the southwest residence foundation to the bluff toe.

REMEDIAL ACTION: The existing single-family residence shall be relocated or re-constructed onto a new foundation within a stable building site on the subject parcel further away from the existing failed bluff edge, no less than sixty-six (66) feet east of the bluff top edge.

CIRCUMSTANCES TO JUSTIFY EMERGENCY: Failure to allow this emergency work may result in a risk to the property, residents, adjacent parcels and the environment.

This emergency permit is effective immediately and shall become null and void at the end of sixty (60) days. <u>Prior to expiration of this Emergency Permit, the applicant shall submit a standard Coastal Development Permit application for the work authorized by this permit.</u>

RECOMMENDED BY:

JWALDMAN
JESSIE WALDMAN, PLANNER II

8-2-2023
DATE

APPROVED BY:

Julia Krog
JULIA KROG, DIRECTOR

August 2, 2023
DATE

COUNTY OF MENDOCINO DEPT OF PLANNING & BUILDING SERVICES 120 WEST FIR STREET FORT BRAGG, CA 95437 Telephone: 707-964-5379	Case No(s) EM-2023-0003 CDF No(s) – Date Filed 7/14/2023 Fee $ $2,263.00 Receipt No. PRJ057572 Received by Sandy Arellano Office Use Only

EMERGENCY PERMIT APPLICATION FORM

Name of Applicant	Name of Owner(s)	Name of Agent
Malsom Construction	Richard Mclellan	
Mailing Address 420 N. Corry St Fort Bragg Ca. 95437	**Mailing Address** 834 1/4 Tularosa Dr. Los Angeles Ca. 90026	**Mailing Address**
Telephone Number 707-962-9231	**Telephone Number** 1-213-577-9754	**Telephone Number**

Project Description: Re-location of SFR due to bluff erosion on West Side of property

Driving Directions

The site is located on the W (N/S/E/W) side of Hwy 1 (name road) approximately 20 ft (feet/miles) S (N/S/E/W) of its intersection with at Salmon Creek Bridge (provide nearest major intersection).

Assessor's Parcel Number(s)

123-340-19

Parcel Size	Street Address of Project
.8 ☐ Square Feet ☒ Acres	34301 Pacific Reefs Rd. **Please note: Before submittal, please verify correct street address with the Planning Division in Ukiah.**

EMERGENCY PERMIT
APPLICATION QUESTIONNAIRE

The purpose of this questionnaire is to relate information concerning your application to the Planning & Building Services Department and other agencies who will be reviewing your project proposal. The more detail that is provided, the easier it will be to promptly process your application. Please answer all questions. For questions which do not pertain to your project, please indicate "Not Applicable" or "N/A".

1. **NATURE OF THE EMERGENCY NARRATIVE** (use additional pages if necessary).

a) Describe the nature, cause and location of the emergency.

Bluff erosion due to excessive rains resulting in immenent Failure to existing structure

b) Describe the remedial protective or preventive work required to deal with the emergency.

Re-location of residence eastward for proper setbacks according to recent Geology report

c) Describe the circumstances during the emergency that justify the course(s) of action taken, including the probable consequences of failing to take action.

Large landslide at west side of property up to existing building requiring imedient moving of building. Failure to move will result in structural Failure and major environmental cleanup if building falls into the Ocean after more heavy rains.

d) Describe any secondary improvements such as wells, septic systems, grading, vegetation removal, roads, etc. that are necessary to deal with the emergency.

Existing building site will be cleared of all Concrete and Foundation debris and graded, Seeded and necessary erosion methods applied, septic system to be evaluated by licensed Septic engineers and deferred submital.

2. Are there existing structures on the property? ☐ Yes ☒ No

	If yes, describe below and identify the use of each structure on the plot plan.
3.	Is any grading or road construction planned? ☐ Yes ☒ No Estimate the amount of grading in cubic yards ____________ c.y. If greater than 50 cubic yards or if greater than 2 feet of cut or 1 foot of fill will result, please provide a grading plan. Describe the terrain to be traversed (e.g., steep, moderate slope, flat, etc.). Slight Slope
4.	Will vegetation be removed on areas other than the building sites and roads? ☐ Yes ☒ No If yes, explain:
5.	Project Height. Maximum height of structure(s): 16 feet
6.	Describe all exterior materials and colors of all proposed structures that are visible beyond the boundaries of the subject parcel. Single Family Residence, Wood shingle Siding
7.	Are there any water courses, anadromous fish streams, ponds, lakes, sand dunes, rookeries, marine mammal haul-out areas, wetlands, riparian areas, pygmy vegetation, rare or endangered plants, animals or habitat which support rare and endangered species located on the project site or within 100 feet of the project site? No

CASE: EM 2023-0003
OWNER: MCLELLAN, Richard
APN: 123-340-19
APLCT: Malsom Construction
AGENT:
ADDRESS: 34301 Pacific Reefs Rd.

Public Roads
Private Roads
Assessors Parcels

0 225 450 Feet
0 0.04 0.08 Miles
N S E W
1:5,000

AERIAL IMAGERY

0 25 50 Feet
0 0.005 0.01 Miles
N S E W

CASE: EM 2023-0003
OWNER: MCLELLAN, Richard
APN: 123-340-19
APLCT: Malsom Construction
AGENT:
ADDRESS: 34301 Pacific Reefs Rd.

Private Roads

Assessors Parcels

1:600

AERIAL IMAGERY

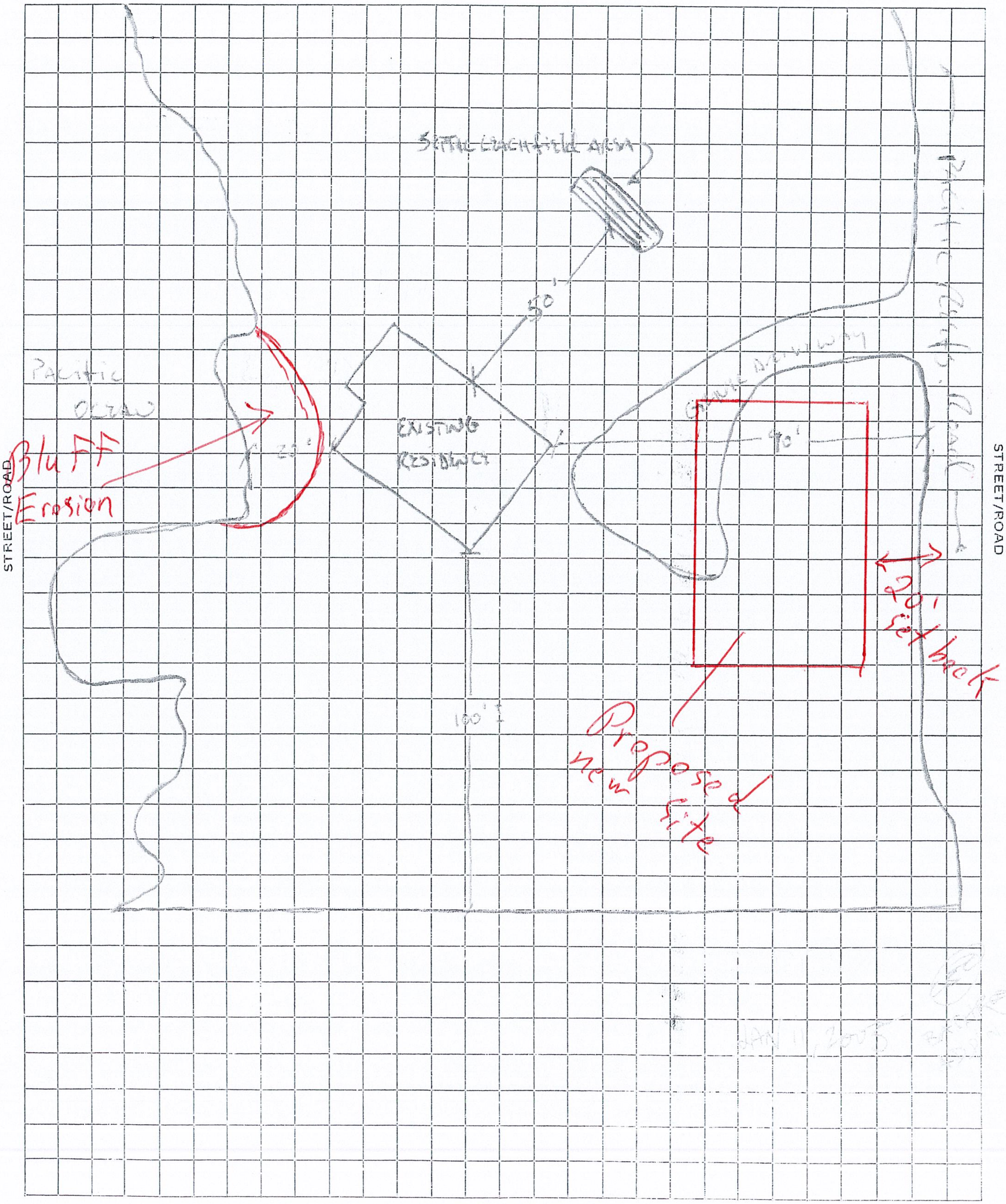
COUNTY OF
MENDOCINO

PLOT PLAN
BUILDING INSPECTION DIVISION

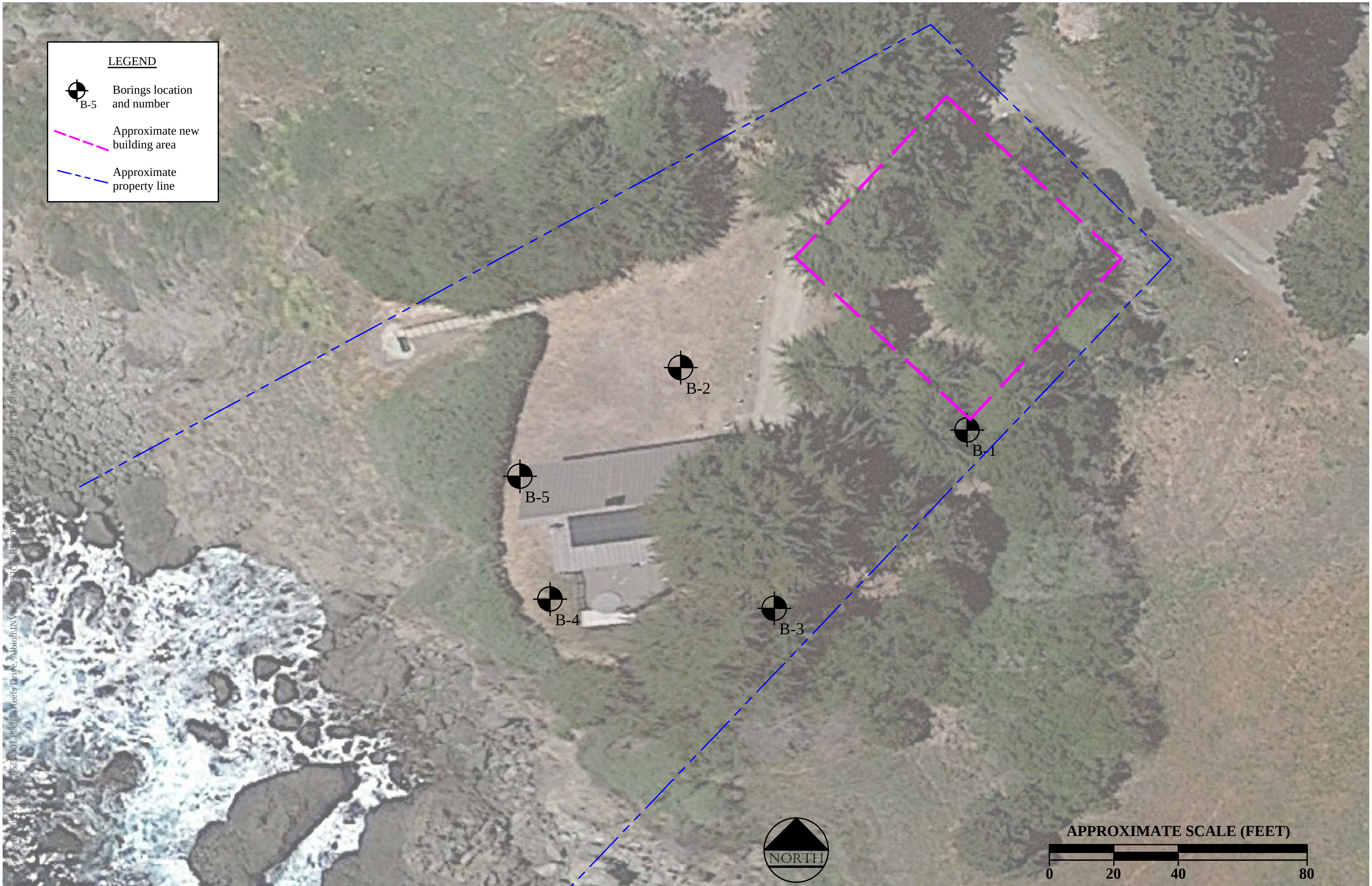
JOB ADDRESS 34301 Pacific Reef Rd   ASSESSOR'S PARCEL NO. 123-340-19   APPLICATION NO. [illegible]

TOWN or COMMUNITY Albion   OWNER'S (LEGAL) NAME Richard McLellan

Show all buildings, structures, mobile homes, septic tanks and leach fields, wells, streams, lakes, roads, streets, alleys, retaining walls, fences, easements, electrical power poles, and any other improvements and indicate all distances between. Specify whether existing or proposed. Draw to and show scale. Indicate orientation with a North Arrow.



BID FORM 300.16



REFERENCE:
Google Earth Pro, accessed 6/20/23.

Brunsing Associates, Inc.
5468 Skylane Blvd., Suite 201
Santa Rosa, California 95403
Tel: (707) 528-6108

Job No.: 11501.05
Appr.: KAC
Date: 06/29/23

SITE AERIAL PHOTOGRAPH
MCLELLAN RESIDENCE
34301 Pacific Reefs Road
Albion, California

PLATE
2

Brunsing Associates, Inc.

GEOTECHNICAL INVESTIGATION

MCLELLAN RESIDENCE
34301 PACIFIC REEFS ROAD
ALBION, CALIFORNIA

Project Number 11501.05

June 29, 2023

Engineers and Geologists

GEOTECHNICAL INVESTIGATION

MCLELLAN RESIDENCE
34301 PACIFIC REEFS ROAD
ALBION, CALIFORNIA

Project Number – 11501.05

prepared for

Dr. Richard McLellan
2379 Panorama Terrace
Los Angeles, CA 90039

prepared by

BRUNSING ASSOCIATES, INC.
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June 29, 2023

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1.0 INTRODUCTION

This report presents the results of our geotechnical investigation that Brunsing Associates, Inc. (BAI), performed for the planned McLellan residence, 34301 Pacific Reefs Road, Albion, Mendocino County, California. The existing residence was constructed prior to 1972, per California Coastline oblique aerial photographs. The project site is located on the southwest side of Pacific Reefs Road approximately one-third of a mile west of Highway 1, as shown on the Vicinity Map, Plate 1.

BAI initially performed a geotechnical investigation for planned additions to the existing residence. The results of our investigation were presented in a report dated August 14, 2000. BAI prepared two updates to our geotechnical investigation report dated December 3, 2009 and January 6, 2010 for planned deck additions to the existing residence. BAI also prepared a Final Report, dated May 6, 2013, summarizing the results of our observations and tests during the residence foundation upgrade operations.

The ocean bluff next to the residence collapsed in early March 2023. The bluff landslide headscarp extended to the residence foundations. Since a landslide "repair" is extremely difficult to nearly impossible to be permitted by coastal agency standards or performed economically, the house needs to be abandoned or moved back, away from the landslide, as recommended below. The intent of this investigation is to evaluate the site geologic conditions in order to determine the feasibility of moving the house away from the bluff landslide to a new, stable building site on the property. The proposed, new building site is shown on the Site Aerial Photograph, Plate 2.

Our approach to providing the geotechnical and geologic information necessary to perform this investigation and evaluation utilized our knowledge of the geologic conditions in the site vicinity and our experience with similar projects. Field exploration and laboratory testing for this investigation were directed towards confirming anticipated geotechnical and geologic conditions in order to provide the basis for our conclusions and recommendations.

The scope of our geotechnical services, as outlined in our Change Order No. 1, dated April 5, 2023 consisted of site observations, consultation and the preparation of this report.

2.0 INVESTIGATION AND LABORATORY TESTING

2.1 Research

As part of our investigation, we reviewed published geotechnical literature, including geologic, fault and seismic hazard maps for the site and vicinity. A list of selected published references reviewed for this investigation is presented in Appendix A.

2.2 Previous and Current Reconnaissance

BAI's principal engineering geologist performed geologic reconnaissance during BAI's 2000 and 2009 geotechnical investigations. The residence and ocean bluff in 2009 are shown in Oblique Aerial Photograph A, Plate 3 and Site Photographs A and B, Plate 4.

Olsborg, along with project engineering geologist Joshua Kilgore, returned to the site and met with contractor Jim Reynolds on March 24, 2023. They observed the landslide and Kilgore took photographs with a drone.

2.3 Aerial Photograph Studies

Our reconnaissance was augmented by studying vertical, black and white (b&w) aerial photographs of the site dated 1963 and 1981. The photographs were each enlarged from the vendors' negatives to an approximate scale of one-inch equals 200 feet. From Google Earth, we reviewed a black and white aerial photograph dated 1998 and color aerial photographs of the site dated 2004, 2005, 2009, 2010, 2012, 2016, 2018, 2019 and 2021.

In addition to reviewing vertical aerial photographs, we also obtained oblique-angle aerial photographs from the California Coastal Records Project (www.californiacoastline.org). We qualitatively compared oblique aerial photographs of the site from 1972, 1979, 2002, 2005, 2009, 2013 and 2019. The 1972 and 2019 photographs are presented herein as our 1972 and 2019 Oblique Aerial Photographs on Plate 5.

2.4 Subsurface Exploration

The initial field exploration consisted of drilling and logging two test borings on June 6, 2000 at the approximate locations shown on Plate 2. Boring B-1 was drilled near a planned building addition area, and boring B-2 was drilled within a planned lap pool area on the west side of the driveway. The test borings ranged from about 15.5 to 20 feet below the ground surface.

Our subsequent field exploration consisted of drilling and logging three test borings (borings B-3 through B-5) on May 10, 2001, at the approximate locations shown on Plate 2. Boring B-3 was drilled near the southeast corner of the existing residence, boring B-4 was drilled near a planned addition at the southwest corner of the existing residence, and boring B-5 was drilled near the northwest corner of the existing residence. The test borings ranged from about 11.75 to 15 feet below the ground surface.

The test borings were drilled with an all-terrain type drill rig using flight auger drilling equipment. Our Project Engineer logged the borings and obtained relatively undisturbed tube samples of the soil and bedrock materials encountered for visual classification and laboratory testing.

Relatively undisturbed samples were obtained with a three-inch, outside-diameter, modified California (CA) split-barrel sampler driven by a 140-pound drop hammer falling 30 inches per blow. Blows required to drive the sampler were converted to "Standard Penetration" blow counts for correlation with empirical test data using a factor of 0.64. Sampler penetration resistance (blow counts) provides a relative measure of soil and bedrock consistency and strength.

The logs of the test borings showing the various soil and bedrock types encountered and the depths at which samples were obtained, are presented in Appendix B, Plates B-1 through B-5. The soil classification system used to describe the soils is outlined on Plate B-6. The soil and bedrock descriptive properties are presented on Plates B-7 and B-8, respectively.

2.5 Laboratory Testing

Soil and bedrock samples obtained during our subsurface exploration were transported to our laboratory and examined to confirm field classifications. Laboratory tests were performed on selected samples to estimate their pertinent geotechnical engineering characteristics. Laboratory testing consisted of moisture content, dry density, sieve, and unconsolidated-undrained triaxial compression tests.

The laboratory test results are presented opposite the samples tested on the test borings. A key to test data is provided on Plate B-6. Laboratory test results are presented in Appendix C.

3.0 SITE CONDITIONS

The property is situated near the southwest edge of a near-level, elevated, marine terrace that projects westward, forming Salmon Point. The terrace was created during the Pleistocene Epoch, when glaciation caused sea level fluctuations which created a series of steps or terraces cut into the coastal bedrock by wave erosion. The terrace is bordered by a steep ocean bluff that is approximately 100 feet high in the property vicinity, per Google Earth Pro. The bluff slope gradient varies from about one-half horizontal to one vertical (1/2H:1V) to near vertical. The existing upper bluff is shown in Drone Photograph A, Plate 6.

One sea cave exists at the bluff toe within the property. The cave entrance is approximately 30 feet wide by about 20 feet high. The cave extends northeasterly, into the bluff about 30 feet, then turns and extends another 30 feet to the east. The cave continually gets smaller toward the back of the cave, where the cave is approximately 15 feet wide by about 3 feet high.

The existing residence is located at the bluff edge on the southwest end of the property. The southeast and southwest corners of the residence were approximately 22 and 20 feet from the bluff edge, respectively; as measured by Olsborg and Jim Reynolds with a 25-foot measuring tape on September 3, 2009. The bluff is currently at the landslide headscarp along the residence southwest foundation line (Site Photographs C and D, Plates 7 and 8, respectively).

Access to the residence is provided by a graveled driveway southwest of Pacific Reefs Road. The driveway leads to a partially graveled parking area at the northeast end of the residence, which does not have a garage. The existing leach field is located in the grassy field north of the residence.

Site vegetation consists of a dense cover of grass and weeds with clumps of cypress trees, mostly on the east-northeast side of the property. Elsewhere in the site vicinity, the grass and weeds extend down the bluff, almost to the bluff toe.

No surface water was observed in the residence vicinity during either our current or previous field explorations. Groundwater was encountered in borings B-1, B-2 and B-3 at 8, 7 and 10 feet, respectively, below the ground surface. Groundwater seepage was observed emanating from bedrock fractures in the middle and lower bluff faces at the property.

4.0 SITE GEOLOGY AND SOILS

Site bedrock consists of sedimentary bedrock of the Cretaceous-Tertiary Franciscan Complex Coastal Belt. These sedimentary bedrock in the site vicinity consist of dark gray to brown sandstone with minor shale. The sandstone with shale and siltstone were encountered between 9 and 14 feet below ground surface in our borings. This bedrock encountered in our borings were crushed to closely fractured, friable to moderate in hardness, and moderately to deeply weathered. The bedrock exposed in the lower three quarters of the bluffs were occasionally fractured, hard to very hard, and little weathered. No bedding orientation was observed in the site vicinity.

The bluff landslide extends from the southwest house foundation down to the bluff toe, as shown in Drone Photograph A, Plate 6. The landslide was a large rock fall that dropped catastrophically to the surf zone below. The landside was comprised of Franciscan bedrock and terrace soils from the upper bluff.

Bedrock remaining on the bluff face, exposed by the rock fall movement, consists of large blocks of hard sandstone in friable rock matrix.

Pleistocene terrace deposits overlie the bedrock within the marine terrace in the property vicinity. The terrace deposits are comprised of medium dense to dense silty sand with some sand (little or no clay or silt) and sand with silt. While dense sand with a few gravels was encountered in test boring B-2 at 9.5 to 14 feet in depth during our June 2000, investigation. Topsoils, which are approximately 2.5 to 3.5 feet thick, consist of loose to medium dense silty sand. The upper one to one- and one-half feet of the topsoils are loose and porous. The silty sands appear very low in expansion potential (tendency to change volume with changes in moisture content).

The slope west of the leach field appears to have a potential for minor creep; however, no evidence of landsliding was observed in that area of the property. No evidence of faulting was found at the property; although some of the fracture zones observed within the bedrock on the bluff face (and in the sea cave) may be ancient (presently inactive), faults. Neither of the published geologic maps that we received show faults on, or trending towards the site.

The site, as is typical of Mendocino County, will be subject to strong ground shaking due to future, nearby earthquakes. The active San Andreas Fault is located offshore, approximately 2.5 miles to the southwest. Future damaging earthquakes could occur on this fault during the lifetime of the proposed new residence location. In general, the intensity of ground shaking at the site will depend on the distance to the causative earthquake epicenter, the magnitude of the shock, and the response characteristics of the underlying earth materials.

5.0 CONCLUSIONS

5.1 General

We conclude that the house can be moved back or re-constructed onto a new foundation within a stable building site at the property. This should be done as soon as possible since further damage or loss of the house is imminent.

5.2 Bluff Retreat

Our August 14, 2000 geotechnical investigation report determined that the bluff is eroding at an average rate of approximately two inches per year. This was accurate from the time of the house construction prior to 1972 (see Plate 5) up to early March 2023 (more than 51 years). Approximately 22 feet of the bluff, from the residence out to the bluff edge, failed in early March 2023. The landslide/bluff toe may have been weakened by the exceptionally strong storm waves in early January 2023. Those storm waves hit the Point Cabrillo Light House and at least two bluff houses in Little River. BAI observed evidence of January storm wave debris (rock fragments, ice plant, etc.) thrown up from the bluff faces onto terraces at project locations ranging from Westport to The Sea Ranch in Sonoma County. Factoring the 22 feet (rounding up to 25 feet) bluff loss over 50 years, the resulting bluff retreat rate is approximately 6 inches per year.

5.3 Bluff Stability

Large blocks of hard bedrock could continue to periodically fall down the bluff face as the friable bedrock matrix erodes. This type of erosion/rock fall was considered in the preparation of our bluff edge setback.

5.4 Sea Level Rise Effects on Bluff Retreat

Rapid sea-level rise of approximately 400 - 450 feet occurred between 18,000 and 8,000 years before present, according to "Rising Seas in California", Griggs, et al, 2017. Sea levels have remained relatively constant since that time. However, sea levels have started rising again. The California Coastal Commission (CCC) recently adopted the Science Update, dated November 7, 2018 to the 2015 Interpretive Guidelines for addressing Sea Level Rise in Local Coastal Programs and Coastal Development permits. The Science Update provides sea-level rise projections for the San Francisco coastal area, as follows in Table 1:

Table 1: Sea Level Rise Projections*				
(Medium-High Risk Aversion)			Documented Rise	Likely Rise
Time Period	Sea Level Rise (Feet)	Inches	Inches	Inches
2000	0	0		
2023**	0.6	7.4	1.8	
2030	0.8	9.6		3.4***
2040	1.3	15.6		4.6****
2050	1.9	22.8		
2060	2.6	31.2		
2070	3.5	42.0		
2080	4.5	54.0		
2090	5.6	67.2		
2098**	6.6	79.7		
2100	6.9	82.8		

*California Coastal Commission, Sea Level Rise Policy Guidance, 2018
**BAI interpolated
***Assumes little or no increase to the rate of sea level rise over the next 7 years
****Assumes little or no increase to the rate of sea level rise over the next 17 years

Recent sea level rise projections by the California Coastal Commission show that by 2098, the sea level will be as much as approximately 79.7 inches higher than the baseline of 2000. However, according to the National Oceanic and Atmospheric Administration (NOAA) San Francisco tide gauge, sea level rise of just 1.8 inches has occurred since 2000, rather than the 7.4 inches, projected.

Based upon historic aerial photographs and site observations, the current average bluff retreat rate appears to be six inches per year (Table 2). The hard bedrock within the lower bluffs is relatively erosion resistant. Even with a 25-inch sea level rise by 2061, from 2023 elevations, the ocean wave erosion will still be resisted by hard bedrock.

Table 2: Bluff Retreat Rate				
Years	Span (years)	Cumulative Sea Level Rise (inches)*	Retreat Rate (inches per year)	Amount of Retreat (inches)
2023-2038	15	14.2	6”/yr.	90
2038-2053	15	23.6	6.5”/yr.	97.5
2053-2068	15	39.6	7.0”/yr.	105
2068-2083	15	61.7	7.5”/yr.	112.5
2083-2098	15	79.7	8.0”/yr.	120
				525”=43.75’

* Projected per California Coastal Commission (approximate)

5.5 Tsunami Hazard

As typical of the Mendocino County coastal area, the site could be subject to large storm waves or tsunami waves. In February 1960, the Point Cabrillo Light House, located approximately 42 miles north-

northwest of the subject property, was damaged by an approximately 65 feet high storm wave (meteorological tsunami, or “meteotsunami”). No such waves are recorded at the light house from 1909, the year it was built, to 1960. The 1960 wave broke over the lighthouse building, but not the light tower. The wave picked up large, offshore rocks and threw them onto the bluffs and into the building. A tractor was needed to pull the rocks out of the building. Recently, on January 5, 2023, the lighthouse building was again hit by a storm wave which broke open the back doors and flooded the interior to a depth of about 2 feet. Despite the future potential for future large waves, since the property bluffs are approximately 85 feet in vertical height, impact or inundation from a severe storm surge or tsunami event is a relatively low, but possible risk for the site.

Tsunamis are caused by large-scale sea floor elevation changes resulting from earthquakes on thrust faults associated with tectonic subduction zones. Major earthquakes have occurred along these Pacific Rim subduction zones in recent times; however, no significant tsunami in the Mendocino coastal zone has resulted from these earthquakes. Tsunami damage has been limited to moored boats and docks within the coves and harbors in Mendocino County.

5.6 Seismicity and Faulting

As is typical of the Mendocino County area, the site will be subject to strong ground shaking during future, nearby, large magnitude earthquakes originating on the active San Andreas fault, Maacama fault, or possibly other, more distant fault systems. The intensity of ground shaking at the site will depend on the distance to the causative earthquake epicenter, the magnitude of the shock, and the response characteristics of the underlying earth materials. Generally, engineered structures founded in supporting materials and designed in accordance with current building codes are well suited to resist the effects of ground shaking.

As discussed in the previous section, the main geotechnical concern at a bluff-top property containing ancient bedrock faults is the potential for increased erosion along the faults. No evidence of recent faulting was observed shown in the site vicinity on the published geologic maps that we reviewed for this investigation. The presence of ancient faults within the coastal bluffs is common and should not impact the proposed residence due to their inactivity. Therefore, the potential for fault rupture at the site is considered low.

5.7 Liquefaction and Densification

Liquefaction results in a loss of shear strength and potential soil volume reduction in saturated sandy, silty, silty/clayey, and also coarse gravelly soils below the groundwater table from earthquake shaking. The occurrence of this phenomenon is dependent on many factors, including the intensity and duration of ground shaking, the soil age, density, particle size distribution, and position of the groundwater table.

We have evaluated the liquefaction potential for the site using site modified peak ground acceleration. The results of our analysis indicate the site has a minor potential for liquefaction during a design earthquake.

Where the probability of liquefaction, factor of safety, was 1.3 or less, we performed an analysis to estimate induced vertical settlement due to liquefaction. This analysis was based on procedures by Idriss and Boulanger, 2008, with a 2014 update. BAI has performed an evaluation of earthquake induced settlement in dry sand. The analysis was based on procedures by Pradel, D.J., 1998, “Procedure to

Evaluate Earthquake-Induced Settlements in Dry Sandy Soils". The results of our analysis are shown in Table 3 below. Liquefaction analysis results are presented in Appendix D.

Table 3: Liquefaction Settlement, Densification and Lateral Displacement			
Boring	Settlement (inches)	Lateral Displacement (inches)	Settlement in Dry Sand (inches)
B-1	0	0	0.6
B-2	0	0	0.2
B-3	0	0	0.1
B-4	0	0	0.2
B-5	0	0	0.4

Lateral spreading is generally caused by liquefaction of marginally stable soils underlying gently to steeply-inclined slopes. In these cases, the saturated soils move toward an unsupported face, such as an ocean bluff. Based on review of our borings and nearby unsupported slope faces, we conclude that the potential for lateral spreading on the property in nil.

6.0 RECOMMENDATIONS

6.1 Bluff Edge Setbacks

Based upon our observations and analyses, we have determined a further bluff retreat potential of 44 feet over the next 75 years. Adding a safety factor of 1.5, we recommend a bluff setback of 66 feet for a "moved" or replacement residence.

6.2 Site Grading

6.2.1 Clearing and Stripping

Areas to be graded should be cleared of existing vegetation, rubbish, existing structures, and debris. After clearing, surface soils that contain organic matter should be stripped. In general, the depth of required stripping will be about 2 to 4 inches; deeper stripping and grubbing may be required to remove isolated concentrations of organic matter or roots. The cleared materials should be removed from the site or stockpiled for later use in landscape areas, as appropriate.

6.2.2 Structural Area Preparation

As used in this report, "Structural Areas" refers to the foundation envelopes and the areas extending five feet beyond the foundations, and to exterior concrete slabs areas and the areas extending three feet beyond their edges.

Within building and exterior concrete areas, existing weak soils should be removed to a depth of at least 2 feet below existing grades. Deeper excavating may be necessary to remove isolated very weak soils.

After the recommended excavations are complete, BAI should observe the soils exposed to confirm suitable materials are present. The exposed soils should then be scarified to about six inches deep, moisture conditioned to at least optimum moisture content and compacted to at least 90 percent relative compaction as determined by the ASTM D 1557 test procedure, latest edition. These moisture conditioning and compaction procedures should be observed by BAI to check that the soil is properly moisture conditioned and the recommended compaction is achieved.

The site soils encountered in the test borings are suitable for re-use as compacted fill. Fill material, on-site or imported, should be free of perishable matter and rocks greater than three inches in largest dimension, have an expansion index less than 30 and be approved by BAI before fill placement. Fill should be placed in thin lifts (six to eight inches depending on compaction equipment), moisture conditioned to near optimum moisture content, and compacted to at least 90 percent relative compaction, to achieve planned grades.

6.2.3 Finish Grading

Finished surfaces should be graded to drain away from structures and foundations. A minimum surface drainage gradient of five percent is recommended. Subgrade soil should be finished true to line and grade to present a smooth, firm, and unyielding surface. Finished surfaces should be maintained moist and free of shrinkage cracks until covered by permanent construction. Fill surfaces allowed to dry out and crack should be re-moisture conditioned to at least optimum moisture content and re-compacted prior to pavement installation.

6.3 Foundation Support

6.3.1 Drilled Piers

The structure can be supported on a system of drilled cast in place concrete piers interconnected with grade beams. Drilled piers should be at least 12 inches in diameter and should be embedded a minimum of five feet into supporting bedrock, as determined by BAI. The supporting bedrock was encountered at approximately 14 feet below the ground surface in borings B-1 and B-2. Therefore, the drilled piers should be at least 19 feet in length. Pier length and diameter should be determined by a structural engineer based on our recommendations.

Pier spacing should be no closer than 3 pier diameters, center to center. The drilled piers should be designed to gain support from skin friction. A skin friction value of 600 pounds per square foot (psf) of shaft area may be used in the supporting bedrock, for dead loads plus live loads. For total downward loads due to wind or seismic forces, the pier capacity can be increased by one third. Uplift frictional capacity for piers should be limited to 2/3 of the allowable downward capacity. When final pier depths have been achieved, as determined by BAI, the bottoms of the pier holes should be cleaned of loose materials. BAI should observe the drilling and final clean out of the pier holes, prior to the placement of reinforcing steel.

Resistance to lateral loads can be obtained using passive earth pressure against the face of the foundations. An allowable passive pressure of 400 psf (rectangular distribution) can be used within the bedrock. Passive pressure should be neglected within the weak terrace deposits. Passive pressure can be projected over two pier diameters.

If groundwater is encountered during construction, the pier holes should be dewatered prior to placement of reinforcing steel and concrete. Alternatively, if more than six inches of groundwater has entered the pier hole, concrete can be tremied into place with an adequate head to displace water or slurry. Concrete should not be placed by freefall in such a manner as to hit the sidewalls of the excavation.

Caving soils may be encountered. The driller should be prepared to case pier holes where caving occurs. If used, the casing would need to be withdrawn from the pier holes as the pier concrete is placed. Difficult drilling conditions were encountered with the light drilling equipment used for this investigation within hard bedrock. The drilling contractor should be prepared to use rock-coring equipment.

6.3.2 Spread Footings

Alternatively, the proposed structure can be supported on reinforced concrete footings founded in supporting soil or compacted fill. Footings can be designed using an allowable soil bearing pressure of 2,500 pounds per square foot (psf) for dead plus live loads. A 33 percent increase in bearing pressure is allowable for total loads, including wind or seismic loads. Footing elements within compacted fill pad should be founded at least 18 inches below lowest adjacent finish grade with at least 12-inches of compacted fill below the footing. Where weak soils are not removed, footing excavations should extend at least 36 inches below existing grade. Wall footings should be no less than 12 and 15 inches wide for one and two-story construction, respectively

No subsurface structures (such as subsurface walls, tanks, other foundations, or utility lines) should extend below the footings, or within a zone defined by a 45-degree angle projected downward from the outside, bottom edges of the footings. Completed foundation excavations should be observed by a representative from BAI prior to the placement of reinforcing steel.

Resistance to lateral loads can be obtained using passive earth pressure against the face of the foundations. An allowable passive pressure of 250 psf per foot of depth below subgrade and frictional resistance of 0.30 times net vertical dead load, are appropriate for footing elements poured neat against approved engineered fill soils. Passive pressure should be neglected within the upper 6 inches of subgrade soil, unless slabs or pavements confine the surface.

6.4 Seismic Design Criteria

The structure should be designed and/or constructed to resist the effects of strong ground shaking (on the order of Modified Mercalli Intensity IX) in accordance with current building codes. The California Building Code (CBC) 2022 edition indicates that the site classification for the property is Site Class C. CBC indicates that the following seismic design parameters are appropriate for the site:

Table 4: Seismic Design Parameters		
Site Class	=	C
Mapped Spectral Response Acceleration at 0.2 sec	S_S =	2.048g
Mapped Spectral Response Acceleration at 1.0 sec	S_1 =	0.847g
Modified Spectral Response Acceleration at 0.2 sec	S_{MS} =	2.457g
Modified Spectral Response Acceleration at 1.0 sec	S_{M1} =	1.186g
Design Spectral Response Acceleration at 0.2 sec	S_{DS} =	1.638g
Design Spectral Response Acceleration at 1.0 sec	S_{D1} =	0.790g
Site Coefficient	F_a =	1.2
Site Coefficient	F_v =	1.4
Long-period transition period	T_L =	12
Seismic Design Category	=	E

6.5 Concrete Slab Support

If a structural-supported concrete slab is used (i.e., the slab is supported by and able to span between, interconnecting foundation elements without gaining support from underlying soil), then over-excavation of the near-surface weak and porous soil zone is not required. However, topsoil's containing organics should be removed beneath the planned slab (as much as four inches to 12 inches in depth below existing ground surface).

Concrete slabs on grade not supported by foundation elements should be supported on properly compacted fill placed in accordance with our recommendations previously presented in 6.2 Site Grading. The compacted fill can be crushed drain rock or native soils placed in thin lifts and in a manner to prevent segregation; moisture conditioned to near optimum moisture content and compacted to 90 percent relative compaction to provide a firm unyielding surface. The drain rock should not be loose but vibrated in place to ensure a tight inter-locking of the rocks.

Regardless of means of support, interior concrete slab floors should be underlain by at least four inches of clean, free draining ¾ inch crushed rock, to act as a capillary moisture break. An underslab drain should be constructed, as shown on the attached Plate 9. If a soil-supported slab is used, shrinkage cracks within the subgrade soils should be closed by wetting before crushed rock placement.

Where migration of moisture through the floor slab would be detrimental to its intended use, the installation of a vapor retarder membrane should be considered. The moisture/vapor retarder geomembrane, placed upon the gravel layer, should be at least 15 mils thick (i.e., Stego ® Wrap 15-mil Class A, Carlisle RMB 400 15-mil Class A, or equivalent), installed in accordance with the manufacturer's specifications to prevent moisture migration through the seams. With a 15-mil minimum thickness membrane, the 2 inches of wetted sand typically placed upon the membrane may be omitted. Construction of moisture/vapor retarders does not guarantee the prevention of moisture moving through the floor slab. However, this provision should substantially reduce the potential for moisture-vapor problems on the floors and/or future mold and mildew problems.

6.6 Retaining Walls

If retaining walls are utilized, they should be provided with permanent back drainage to prevent buildup of hydrostatic pressure or designed to resist hydrostatic pressures. Drainage and backfill details are presented on Plate 10. In areas where movement of moisture vapor through the wall would be detrimental to its intended use, installation of a vapor retarder membrane should be considered. Construction of vapor retarders does not guarantee the prevention of moisture moving through concrete walls. Quality, placement, and compaction requirements for backfill behind subsurface walls are the same as previously presented for fill. Light compaction equipment should be used near the wall to avoid overstressing the walls. Retaining walls should be designed to resist the lateral earth pressures presented on Plate 11.

In addition to static loads, the retaining walls should also be designed to resist potential seismic loads, in accordance with CBC requirements. For seismic loads, a pressure increment equivalent to a triangular distribution is recommended, varying from 0 (zero) pounds per square foot (psf) at the top of the retaining portion of the wall to 29H psf at the bottom of the retaining portion, where "H" is the height of the retaining portion (resultant dynamic thrust act at 0.33H above the base of the wall).

6.7 Site Drainage

Because surface and/or subsurface water is often the cause of foundation or slope stability problems, care should be taken to intercept and divert concentrated surface flows and subsurface seepage away from the building foundations. Drainage across the lot should be by sheet-flow. Surface grades should maintain a recommended five percent gradient away from building foundations.

Concrete interior slabs should be provided with underslab drainage as shown on Plate 9 and retaining walls should be provided with drainage as shown on Plate 10.

If a raised wood floor is used, the area under the floor should be graded to drain towards an under house drain with a conduit outlet(s) through the footings/stem walls. Two-inch or four-inch PVC sleeves, or equivalent should be placed within the forms, at the lowest grade within the crawl space and outlet to an approved area, prior to concrete placement.

7.0 ADDITIONAL SERVICES

BAI should review and provide consultation during preparation of final development plans. Prior to construction, BAI should review the final grading plans, and soil related specifications for conformance with our recommendations. During construction, BAI should be retained to stake the bluff edge and observe residence locations ensure the proper setback. During construction, BAI should be retained to provide periodic observations, together with field and laboratory testing, during site preparation, placement and compaction of fills, if required. Our reviews and tests would allow us to verify conformance of the work to project guidelines, determine that soil conditions are as anticipated, and to modify our recommendations, if necessary.

8.0 LIMITATIONS

This geotechnical investigation was performed in accordance with the usual and current standards of the profession, as they relate to this and similar localities. No other warranty, expressed or implied, is provided as to the conclusions and professional advice presented in this report. Our conclusions are based upon reasonable geological and engineering interpretation of available data.

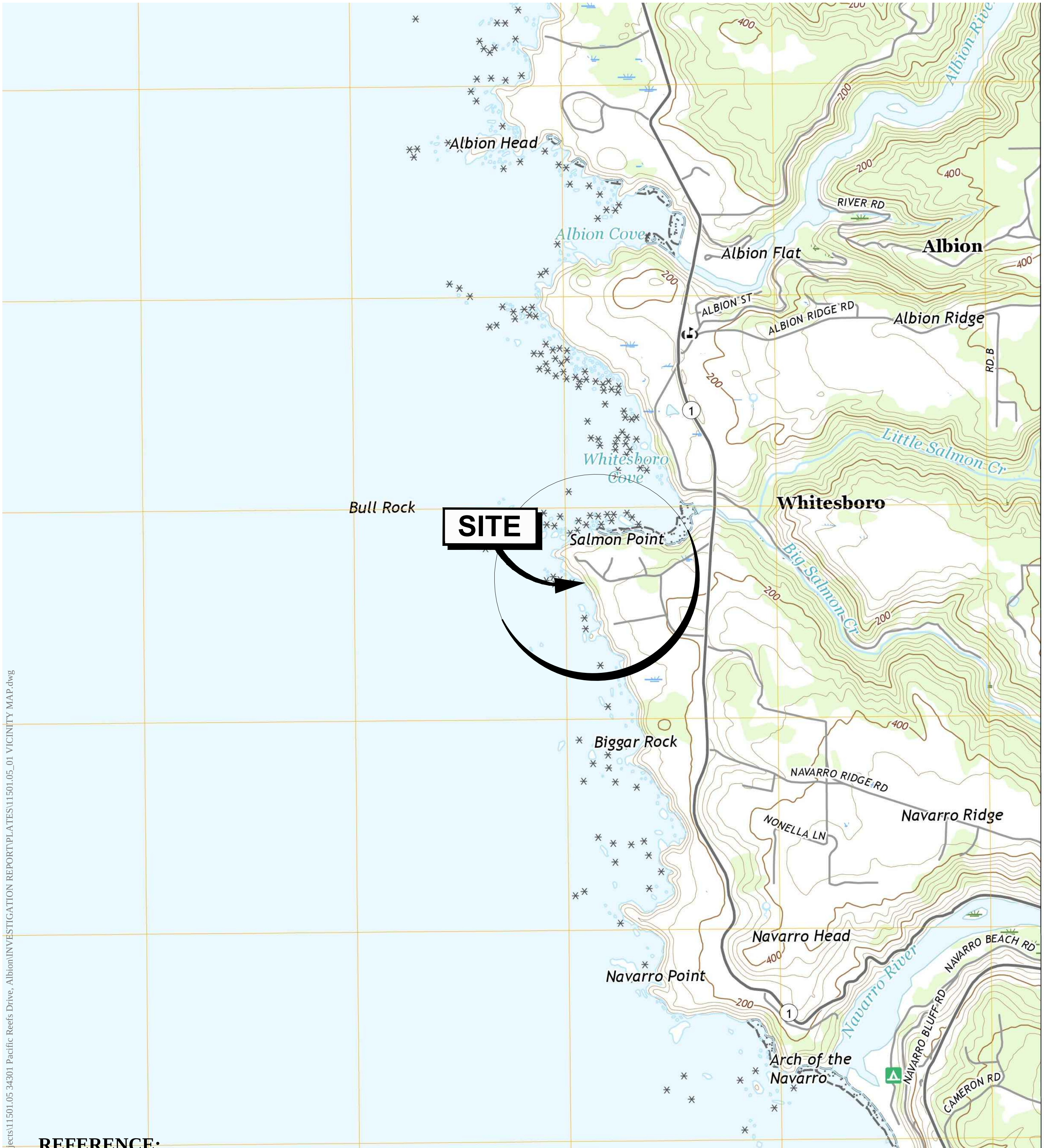
The samples taken and tested, and the observations made, are considered to be representative of the site; however, soil and geologic conditions may vary significantly between test borings and across the site. As in most projects, conditions revealed during construction excavation may be at variance with preliminary findings. If this occurs, the changed conditions must be evaluated by BAI, and revised recommendations be provided as required.

This report is issued with the understanding that it is the responsibility of the Owner, or his/her representative, to ensure that the information and recommendations contained herein are brought to the attention of all other design professionals for the project, and incorporated into the plans, and that the Contractor and Subcontractors implement such recommendations in the field. The safety of others is the responsibility of the Contractor. The Contractor should notify the owner and BAI if he/she considers any of the recommended actions presented herein to be unsafe or otherwise impractical.

Changes in the condition of a site can occur with the passage of time, whether they are due to natural events or to human activities on this, or adjacent sites. In addition, changes in applicable or appropriate codes and standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, this report may become invalidated wholly or partially by changes outside of our control. Therefore, this report is subject to review and revision as changed conditions are identified.

The recommendations contained in this report are based on certain specific project information regarding type of construction and current improvement locations, which have been made available to us. If conceptual changes are undertaken during final project design, we should be allowed to review them in light of this report to determine if our recommendations are still applicable.

PLATES



REFERENCE:
US Topo
Albion Quadrangle, California - Menocino County
7.5-Minute Series, USGS, 2018

Latitude: 39.212630
Longitude: -123.774499

NORTH

APPROXIMATE SCALE (FEET)
0 1000 2000 4000

L:\Geotech Projects\11501.05 34301 Pacific Reefs Drive, Albion\INVESTIGATION REPORT\PLATES\11501.05_01 VICINITY MAP.dwg

Brunsing Associates, Inc. 5468 Skylane Blvd., Suite 201 Santa Rosa, California 95403 Tel: (707) 528-6108	**Job No.:** 11501.05 **Appr.:** EEO **Date:** 06/29/23	**VICINITY MAP** MCLELLAN RESIDENCE 34301 Pacific Reefs Road Albion, California	**PLATE** **1**

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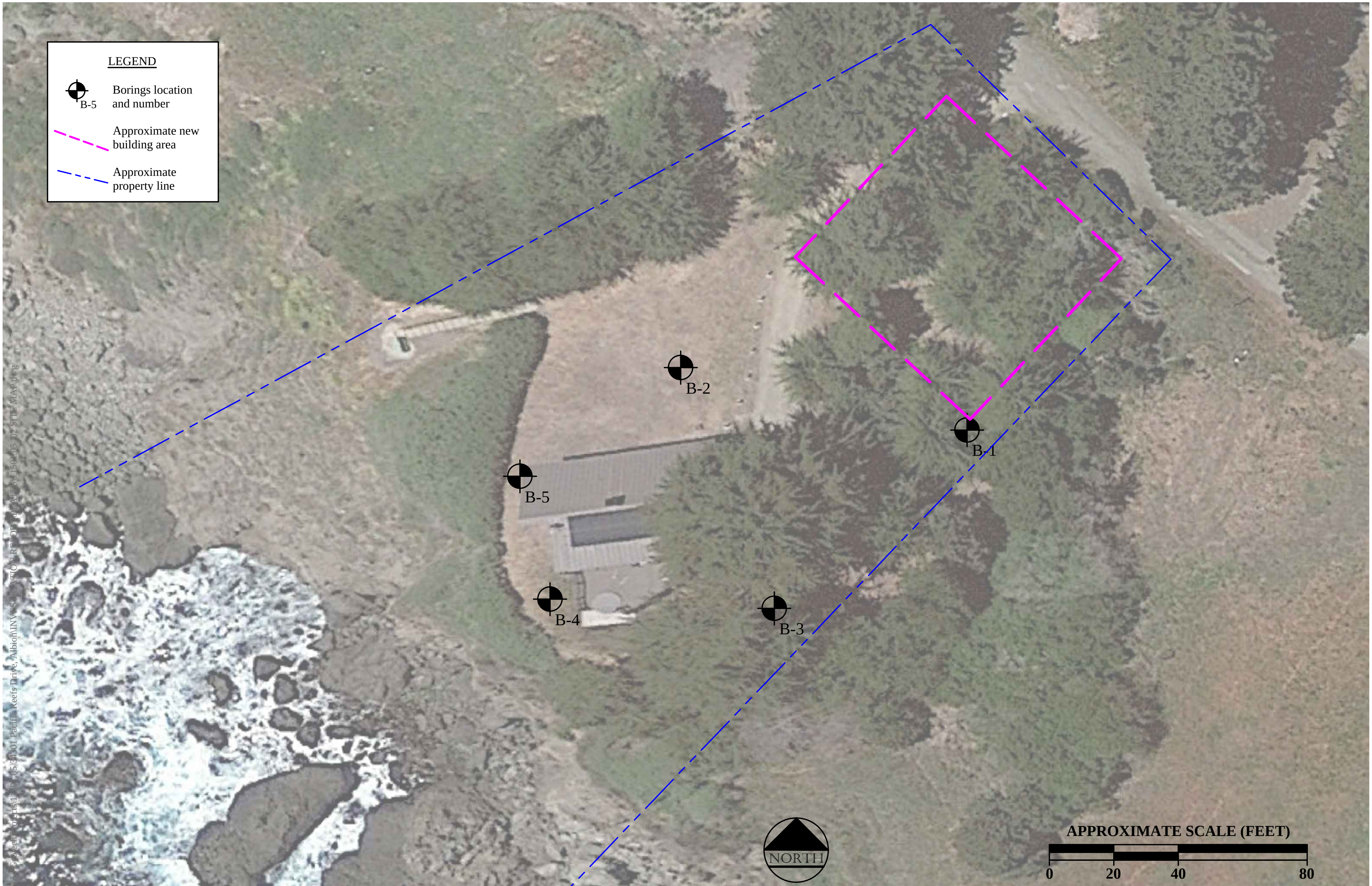

REFERENCE:
Google Earth Pro, accessed 6/20/23.

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Job No.: 11501.05

Appr.: KAC

Date: 06/29/23

SITE AERIAL PHOTOGRAPH

MCLELLAN RESIDENCE
34301 Pacific Reefs Road
Albion, California

PLATE
2

REFERENCE:
California Coastal Records Project,
https://www.californiacoastline.org/, by permission

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Appr.: EEO

Date: 06/29/23

2009 OBLIQUE AERIAL PHOTOGRAPH A
MCLELLAN RESIDENCE
34301 Pacific Reefs Road
Albion, California

PLATE
3

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6/29/2023 2:53:52 PM plot date

SITE PHOTOGRAPH A
Looking west, 9/4/09

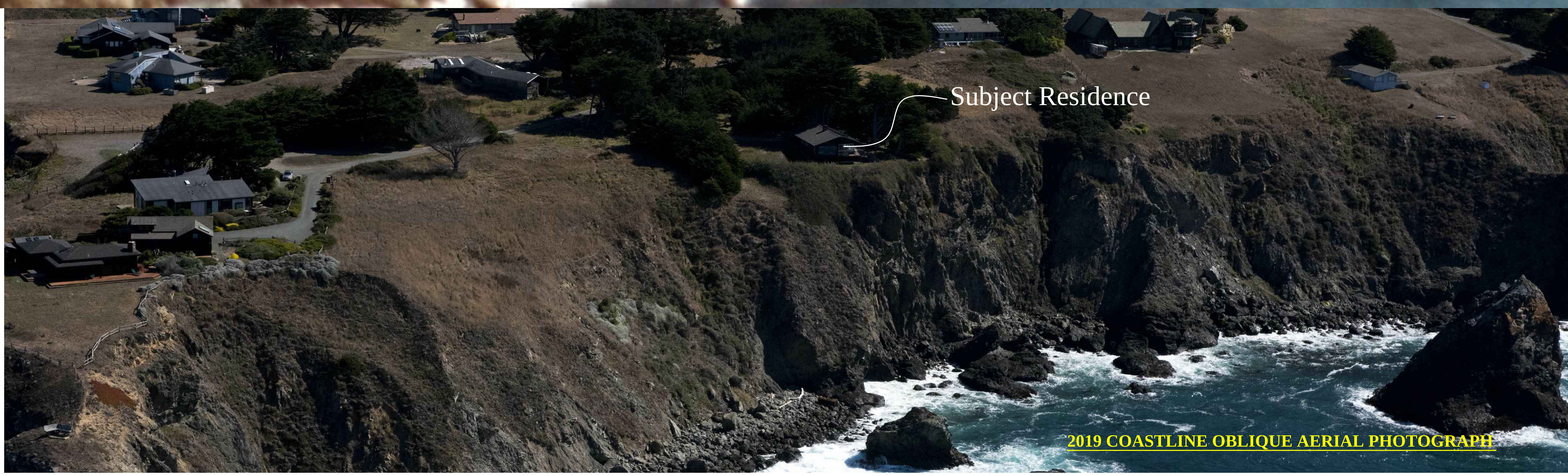
Observation Point 'A'

SITE PHOTOGRAPH B
Looking southeast, view down the bluff from Point 'A'
9/4/09

Brunsing Associates, Inc. 5468 Skylane Blvd., Suite 201 Santa Rosa, California 95403 Tel: (707) 528-6108	**Job No.:** 11501.05 **Appr.:** EEO **Date:** 06/29/23	**2009 SITE PHOTOGRAPHS A and B** MCLELLAN RESIDENCE 34301 Pacific Reefs Road Albion, California

PLATE
4

1972 COASTLINE OBLIQUE AERIAL PHOTOGRAPH



2019 COASTLINE OBLIQUE AERIAL PHOTOGRAPH

Reference:
California Coastal Records project, www.californiacoastline.org, by permission.

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1972 and 2019 COASTLINE OBLIQUE AERIAL PHOTOGRAPHS
MCLELLAN RESIDENCE
34301 Pacific Reefs Road
Albion, California

PLATE
5

L:\Geotech Projects\11501.05 34301 Pacific Reefs Drive, Albion\INVESTIGATION REPORT\PLATES\11501.05_06 Drone Photograph A.dwg

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6/29/2023 2:56:48 PM plot date

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DRONE PHOTOGRAPH A
MCLELLAN RESIDENCE
34301 Pacific Reefs Road
Albion, California

PLATE
6

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SITE PHOTOGRAPH C

MCLELLAN RESIDENCE
34301 Pacific Reefs Road
Albion, California

PLATE
7

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6/29/2023 2:57:38 PM plot date

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SITE PHOTOGRAPH D
MCLELLAN RESIDENCE
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PLATE
8

L:\Geotech Projects\11501.05 34301 Pacific Reefs Drive, Albion\INVESTIGATION REPORT\PLATES\11501.05_08 Site Photograph D.dwg

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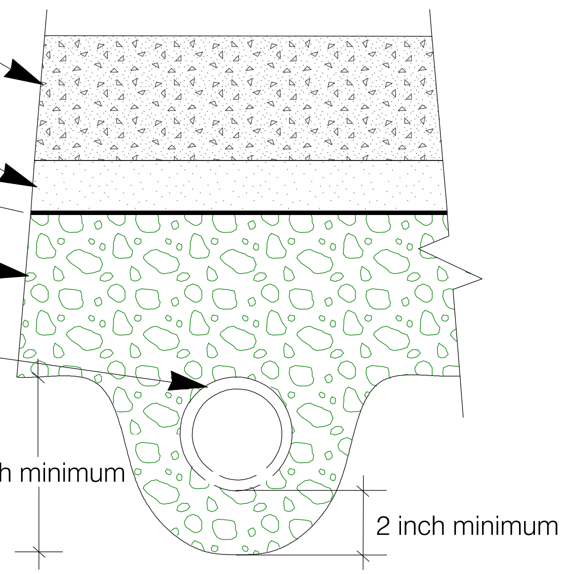

NOT TO SCALE

NOTES:

1. Drain rock should be clean, free-draining 3/4-inch crushed rock.
2. Pipe should be SDR 35 or equivalent, perforations placed down, sloped at least 1 percent to gravity outlet, or sump with automatic pump.
3. A clean-out pipe with cap should be installed at the up-slope end of perforated pipe.
4. Vapor retarder should be at least 15-mils thick and installed in accordance with the manufacturer's specifications.

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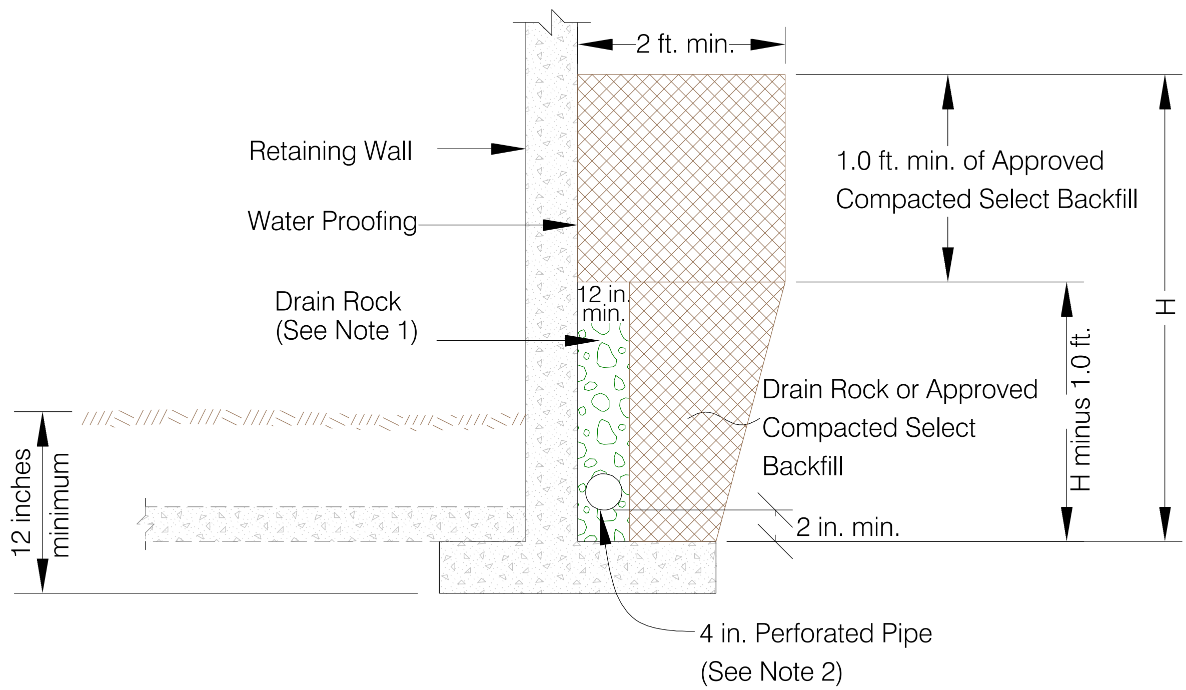
UNDERSLAB DRAINAGE DETAILS
MCLELLAN RESIDENCE
34301 Pacific Reefs Road
Albion, California

PLATE 9



RETAINING WALL DRAINAGE DETAIL
(Not to Scale)

NOTES:

(1) Drain rock should be clean, free-draining material graded in size between the No. 4 and 3/4 inch sieves and should be wrapped in a non-woven geotextile filter fabric (Mirafi 140N or equivalent), or Class 2 permeable material, without filter fabric, per Caltrans standard specifications, latest edition.

(2) Pipe should be SDR 35 or equivalent, placed with perforations down, and sloped at 1 percent to drain to gravity outlet or sump with automatic pump.

(3) A clean-out pipe with cap should be installed at the up-slope end of perforated pipe, and pipe elbows should be 45 degrees or less (for "snake" access).

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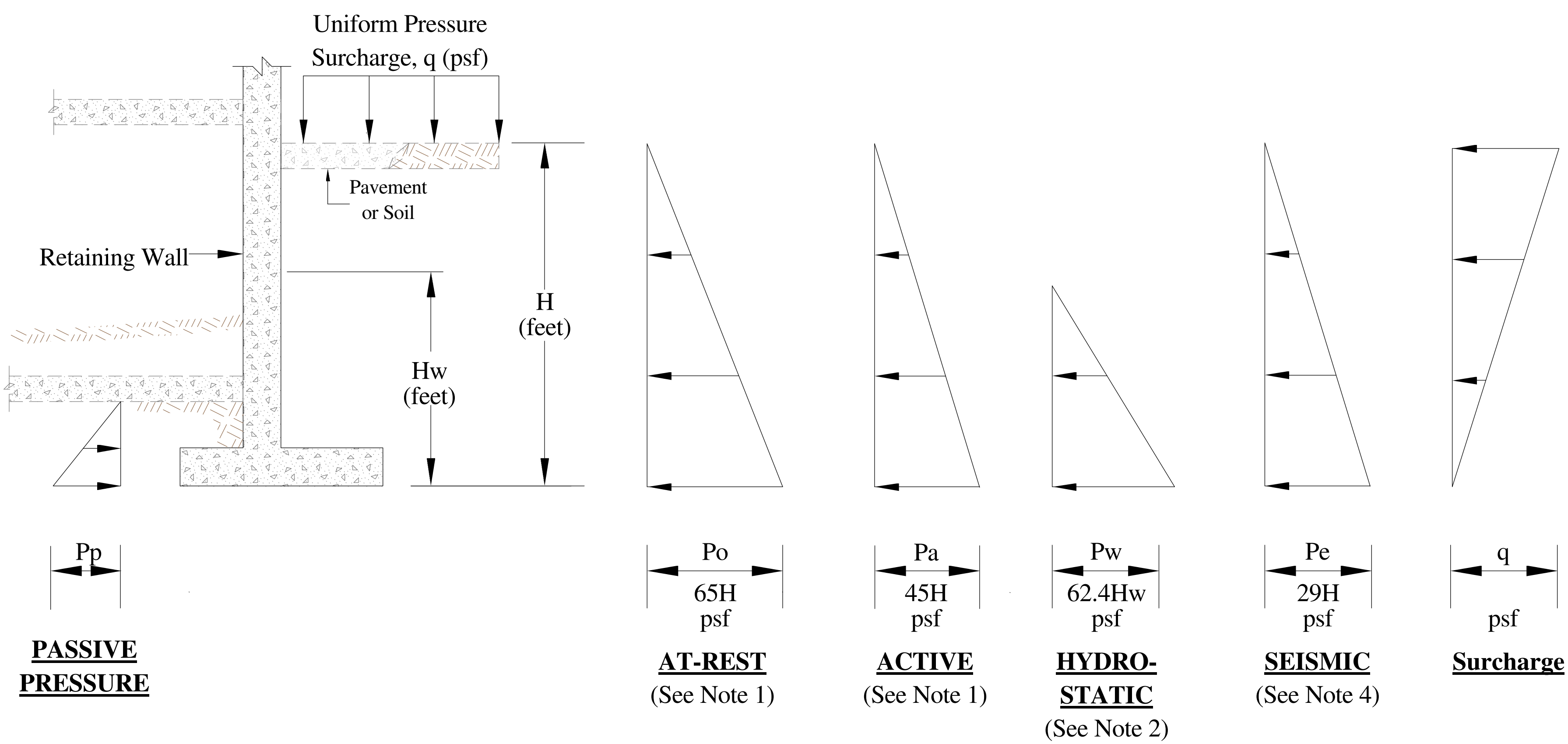
RETAINING WALL DRAINAGE DETAIL
MCLELLAN RESIDENCE
34301 Pacific Reefs Road
Albion, California

PLATE 10



NOTES:

(1) If the wall at the surface of the backfill cannot move more than about 0.1 percent of its' height, at-rest soil pressures should be used.

(2) If the wall is drained the above hydrostatic pressure does not have to be used. See Plate 10 for drainage and backfill details.

(3) The above pressures should be used where backfill slope is flatter than 3 horizontal to 1 vertical (3H:1V). Where backfill slope is between 3H:1V and 1.5H:1V, use active pressure of 55H psf and at-rest pressure of 87H psf, respectively.

(4) For additional design seismic pressures see the Retaining Walls section of this report.

APPENDIX A

References

- Hapke, C. J., and Reid, D., 2007, National Assessment of Shoreline Change, Part 4: Historical Coastal Cliff Retreat along the California Coast: United States Geological Survey (USGS) Open File Report (OFR) 2007-1133.
- Jennings, C.W., 1960, Geologic Map of California, Ukiah Sheet: California Division of Mines and Geology (CDMG).
- Jennings, C.W., and Bryant, W.A., 2010, Fault Activity Map: California Geologic Survey, California Geologic Data Map Series, Map No. 6, Scale 1:750,000.
- Johnsson, Mark J. Establishing Development Setbacks from Coastal Bluffs. Proceedings of California and the World Ocean '02. Santa Barbara, 2002.
- Kilbourne, R.T., 1983, Geology and Geomorphic Features Related to Landsliding, Mendocino 7.5 Minute Quadrangle, Mendocino County, California: California Division of Mines and Geology (CDMG), Open File Report 83-15.
- Update to the Sea-level Rise Guidance Document, 2013, Coastal and Ocean Working Group of the California Climate Action Team.
- California Division of Mines and Geology, 1983, Geology and Geomorphic Features Related to Landsliding, Fort Bragg 7.5 Minute Quadrangle, Mendocino County, California, Open File Report (OFR) 83-5 SF.
- California Division of Mines and Geology with the Structural Engineers Association of California Seismology Committee, 1998, Maps of Active Fault Near-Source Zones in California and Adjacent Parts of Nevada: International Conference of Building Officials.
- California Division of Mines and Geology, 1960, Ukiah Sheet: Geologic Map of California.
- Dickinson, W. R., et. al., 2005, Net Dextral Slip, Neogene San Gregorio – Hosgri Fault Zone, Coastal California: Geologic Evidence and Tectonic Implications" Geological Society of America (GSA), Special Paper 391.
- Ted W. Trinkwalder and Ward L. Stover, The March 2011 Tsunami and its Impact on Crescent City Harbor, November/December 2011, Geo Strata.

APPENDIX B

Boring Logs

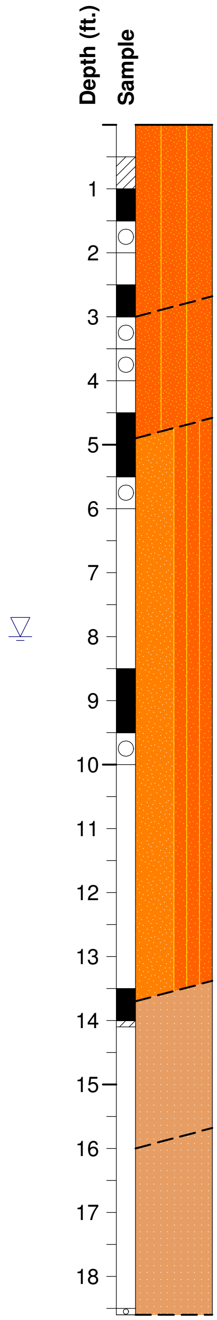
Log of Boring B-1

Equipment: All Terrain: B-40, 6 inch flight auger

Date: 6/6/00 **Logged By:** LAB

Elevation: Not Surveyed **Latitude:** 39.212619 **Longitude:** -123.774404

Laboratory Tests	Sampler Type*	Moisture Content (%)	Dry Density (pcf)	Blows/foot
Tx 1363 (864)	CA	14.9	98	16 **
25% Passing #200	CA			13 **
Tx 1381 (1008) 6% Passing #200	CA	18.8	107	22 **
	CA	18.2	106	40 **
	CA			16/1" **
	CA			32/1" **



DARK BROWN SILTY SAND (SM)
loose to medium dense, moist
with few rootlets
upper 1 foot is porous

MOTTLED BROWN AND GRAY SILTY SAND (SM)
medium dense, wet

BROWN AND GRAY POORLY GRADED SAND (SP-SM) with silt
medium dense to dense, saturated

GRAY-BROWN SANDSTONE
intensely fractured, friable, deeply weathered

GRAY SANDSTONE with minor shale
intensely to closely fractured, low to moderate hardness, deeply to moderately weathered

NOTES
(1) No caving
(2) Free water encountered at 8 feet during drilling

* See Soil Classification Chart & Key to Test Data
Latitude/Longitude estimated from Google Earth.

** Equivalent "Standard Penetration" Blow Counts.

Scale: 1" = 3'

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Job No.: 11501.05
Appr.: EEO
Date: 06/29/23

LOG OF BORING B-1
MCLELLAN RESIDENCE
34301 Pacific Reefs Road
Albion, California

PLATE B-1
SHEET 1 of 1

Log of Boring B-2

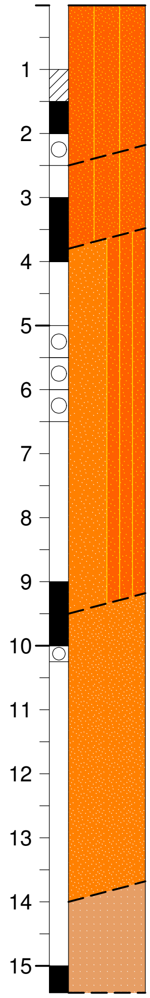
Equipment: All Terrain: B-40, 6 inch flight auger

Date: 6/6/00 **Logged By:** LAB

Elevation: Not Surveyed **Latitude:** 39.212669 **Longitude:** -123.774699

Laboratory Tests	Sampler Type*	Moisture Content (%)	Dry Density (pcf)	Blows/foot	Depth (ft.)
Tx 836 (576)	CA	13.9	93	19 **	2
Tx 1807 (720) 5% Passing #200	CA	15.0	111	30 **	3
	CA			24 **	6
	CA			33/9" **	10
	CA	14.2	110	48/5" **	15

Sample



MOTTLED BROWN AND GRAY SILTY SAND (SM)
loose to medium dense, moist to wet
with few tootlets
upper 1 to 1.5 feet is porous

BROWN SILTY SAND (SM)
medium dense, wet

MOTTLED BROWN AND GRAY POORLY GRADED SAND (SP-SM) with silt
medium dense, wet to saturated

BROWN AND GRAY SAND (SP)
dense, saturated
few gravels

GRAY AND BROWN SANDSTONE
intensely fractured, friable, deeply weathered

NOTES
(1) Moderate caving below 7.5 feet
(2) Free water encountered at 7 feet during drilling

* See Soil Classification Chart & Key to Test Data
Latitude/Longitude estimated from Google Earth.

** Equivalent "Standard Penetration" Blow Counts.

Scale: 1" = 3'

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Tel: (707) 528-6108

Job No.: 11501.05
Appr.: EEO
Date: 06/29/23

LOG OF BORING B-2
MCLELLAN RESIDENCE
34301 Pacific Reefs Road
Albion, California

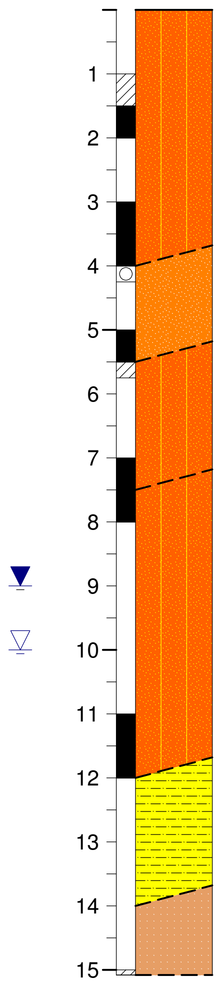
Log of Boring B-3

Equipment: Track-Mounted Drill Rig with 5" Flight Auger

Date: 5/10/01 **Logged By:** LAB

Elevation: Not Surveyed **Latitude:** 39.212474 **Longitude:** -123.774565

Laboratory Tests	Sampler Type*	Moisture Content (%)	Dry Density (pcf)	Blows/foot
	CA			19/6" **
Tx 1981 (720)	CA	12.0	106	29/9" **
	CA			21/3" **
	CA			22/6" **
Tx 3731 (1296)	CA	13.1	120	29/6" **
	CA			26/1" **



BROWN AND GRAY SILTY SAND (SM)
medium dense to dense, moist
with roots

GRAY SAND (SP)
dense to very dense, moist
with roots

BROWN AND GRAY SILTY SAND (SM)
very dense to dense, wet
with roots

BROWN AND GRAY SILTY SAND (SM)
dense to very dense, wet
with few small gravels

BROWN SILTSTONE
intensely fractured, friable, deeply weathered

GRAY SANDSTONE WITH SHALE
intensely fractured, low hardness, moderately weathered

NOTES:
(1) No caving
(2) Free water encountered at 10 feet during drilling
(3) Water measured at 9 feet 1.5 hours after completion of drilling

* See Soil Classification Chart & Key to Test Data
Latitude/Longitude estimated from Google Earth.

** Equivalent "Standard Penetration" Blow Counts.

Scale: 1" = 3'

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LOG OF BORING B-3
MCLELLAN RESIDENCE
34301 Pacific Reefs Road
Albion, California

PLATE B-3
SHEET 1 of 1

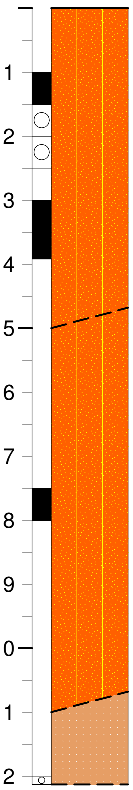
Log of Boring B-4

Equipment: Track-Mounted Drill Rig with 5" Flight Auger

Date: 5/10/01 **Logged By:** LAB

Elevation: Not Surveyed **Latitude:** 39.212482 **Longitude:** -123.774841

Laboratory Tests	Sampler Type*	Moisture Content (%)	Dry Density (pcf)	Blows/foot	Depth (ft.)
	CA			23 **	2
	CA	19.2	107	19/5" **	3.5
Tx 1914 (1008)		17.1	108		5.5
	CA			32/6" **	7.5
	CA			26/1.5" **	12



BROWN AND GRAY SILTY SAND (SM)
dense to dense, moist
with roots

BROWN AND GRAY SILTY SAND (SM)
dense to very dense, moist to wet

GRAY SANDSTONE WITH SHALE
intensely fractured, low hardness, moderately weathered

NOTES:
(1) No caving
(2) No free water encountered

* See Soil Classification Chart & Key to Test Data
Latitude/Longitude estimated from Google Earth.

** Equivalent "Standard Penetration" Blow Counts.

Scale: 1" = 3'

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LOG OF BORING B-4
MCLELLAN RESIDENCE
34301 Pacific Reefs Road
Albion, California

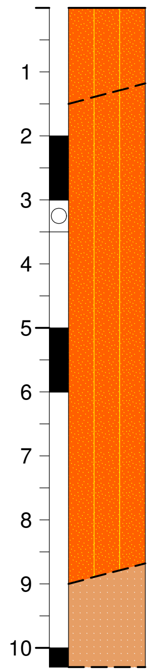
PLATE B-4
SHEET 1 of 1

Log of Boring B-5

Equipment: Track-Mounted Drill Rig with 5" Flight Auger

Date: 5/10/01 **Logged By:** LAB

Elevation: Not Surveyed **Latitude:** 39.212603 **Longitude:** -123.774858



Sampler Type*	Blows/foot	Depth (ft.)	Description
		0–1.5	DARK BROWN SILTY SAND (SM) medium dense, moist with roots
		1.5	BROWN AND GRAY SILTY SAND (SM) medium dense to dense, moist
CA	24 **	3	
CA	19/6" **	5.5	
		9	GRAY SANDSTONE intensely fractured, friable, moderately weathered
CA	26/6" **	10	

NOTES:
(1) No caving
(2) No free water encountered

* See Soil Classification Chart & Key to Test Data
Latitude/Longitude estimated from Google Earth.

** Equivalent "Standard Penetration" Blow Counts.

Scale: 1" = 3'

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LOG OF BORING B-5
MCLELLAN RESIDENCE
34301 Pacific Reefs Road
Albion, California

PLATE B-5

SHEET 1 of 1

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

MAJOR DIVISIONS			SYMBOLS: LETTER	TYPICAL DESCRIPTIONS
COARSE-GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVELS AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (Less than 5% fines)	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (Greater than 12% fines)	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS 50% OR MORE OF COARSE FRACTION PASSING THROUGH NO. 4 SIEVE	CLEAN SANDS (Less than 5% fines)	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES (Greater than 12% fines)	SM	SILTY SANDS, SAND-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE-GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	MH	INORGANIC SILT, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			PT	PEAT, HUMOUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

KEY TO TEST DATA

LL - Liquid Limit
PI - Plasticity Index
Sample Retained
Sample Recovered, Not Retained
Bulk Sample
Sample Not Recovered
CA - California Modified Split Barrel Sampler 3.0-inch O.D.
CM - California Modified Split Barrel Sampler 2.5-inch O.D.
SPT - California Split Barrel Sampler 2.0-inch O.D.
SH - Shelby Tube
RC - Rock Coring
Recovery - Percent Core Recovered
RQD - Rock Quality Designation (length of core pieces >= 4-inches / core length)

Consol - Consolidation
EI - Expansion Index
SA - Sieve Analysis

Shear Strength, psf **Confining Pressure, psf**

Tx	1564	(1440)	- Unconsolidated Undrained Triaxial
TxCU	1564	(1440)	- Consolidated Undrained Triaxial
DS	2020	(1440)	- Consolidated Drained Direct Shear
FVS	520		- Field Vane Shear
UC	1500		- Unconfined Compression
PP	1500		- Field Pocket Penetrometer
Sat			- Sample saturated prior to test

Initial Groundwater Level Reading
Second Groundwater Level Reading

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SOIL CLASSIFICATION CHART & KEY TO TEST DATA
MCLELLAN RESIDENCE
34301 Pacific Reefs Road
Albion, California

PLATE B-6

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Relative Density	Standard Penetration Test Blow Count (blows per foot)
Very loose	4 or less
Loose	5 to 10
Medium dense	11 to 30
Dense	31 to 50
Very dense	More than 50

CONSISTENCY OF FINE-GRAINED SOILS

Consistency	Identification Procedure	Approximate Shear Strength (psf)
Very soft	Easily penetrated several inches with fist	Less than 250
Soft	Easily penetrated several inches with thumb	250 to 500
Medium stiff	Penetrated several inches by thumb with moderate effort	500 to 1000
Stiff	Readily indented by thumb, but penetrated only with great effort	1000 to 2000
Very stiff	Readily indented by thumb nail	2000 to 4000
Hard	indented with difficulty by thumb nail	More than 4000

NATURAL MOISTURE CONTENT

Dry	**No noticeable moisture content. Requires considerable moisture to obtain optimum moisture content* for compaction.**
Damp	**Contains some moisture, but is on the dry side of optimum.**
Moist	**Near optimum moisture content for compaction.**
Wet	**Requires drying to obtain optimum moisture content for compaction.**
Saturated	**Near or below the water table, from capillarity, or from perched or ponded water. All void spaces filled with water.**

* Optimum moisture content as determined in accordance with ASTM Test Method D1557, latest edition.

Where laboratory test data are not available, the above field classifications provide a general indication of material properties; the classifications may require modification based upon laboratory tests.

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Date: 06/29/23

SOIL DESCRIPTIVE PROPERTIES
MCLELLAN RESIDENCE
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Albion, California

PLATE
B-7

Generalized Graphic Bedrock Symbols

Claystone	Siltstone	Tuff (Volcanic Ash)
Shale	Chert	Andesite
Sandstone	Serpentine	Basalt
Conglomerate	Greenstone	Schist

Stratification

Bedding of Sedimentary Rocks	Thickness of Beds
Massive	No apparent bedding
Very thick bedded	Greater than 4 feet
Thick bedded	2 feet to 4 feet
Thin bedded	2 inches to 2 feet
Very thin bedded	0.5 inches to 2 inches
Laminated	0.125 inches to 0.5 inches
Thinly laminated	less than 0.125 inches

Fracturing

Fracturing Intensity	Fracture Spacing
Little	Greater than 4 feet
Occasional	1 foot to 4 feet
Moderate	6 inches to 1 foot
Close	1 inch to 6 inches
Intense	0.5 inches to 1 inch
Crushed	less than 0.5 inches

Strength

Soft	Plastic or very low strength.
Friable	Crumbles by hand.
Low hardness	Crumbles under light hammer blows.
Moderate hardness	Crumbles under a few heavy hammer blows.
Hard	Breaks into large pieces under heavy, ringing hammer blows.
Very hard	Resists heavy, ringing hammer blows and will yield with difficulty only dust and small flying fragments.

Weathering

Deep	Moderate to complete mineral decomposition, extensive disintegration, deep and thorough discoloration, many extensively coated fractures.
Moderate	Slight decomposition of minerals, little disintegration, moderate discoloration, moderately coated fractures.
Little	No megascopic decomposition of minerals, slight to no effect on cementation, slight and intermittent, or localized discoloration, few stains on fracture surfaces.
Fresh	Unaffected by weathering agents, no disintegration or discoloration, fractures usually less numerous than joints.

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BEDROCK DESCRIPTIVE PROPERTIES
MCLELLAN RESIDENCE
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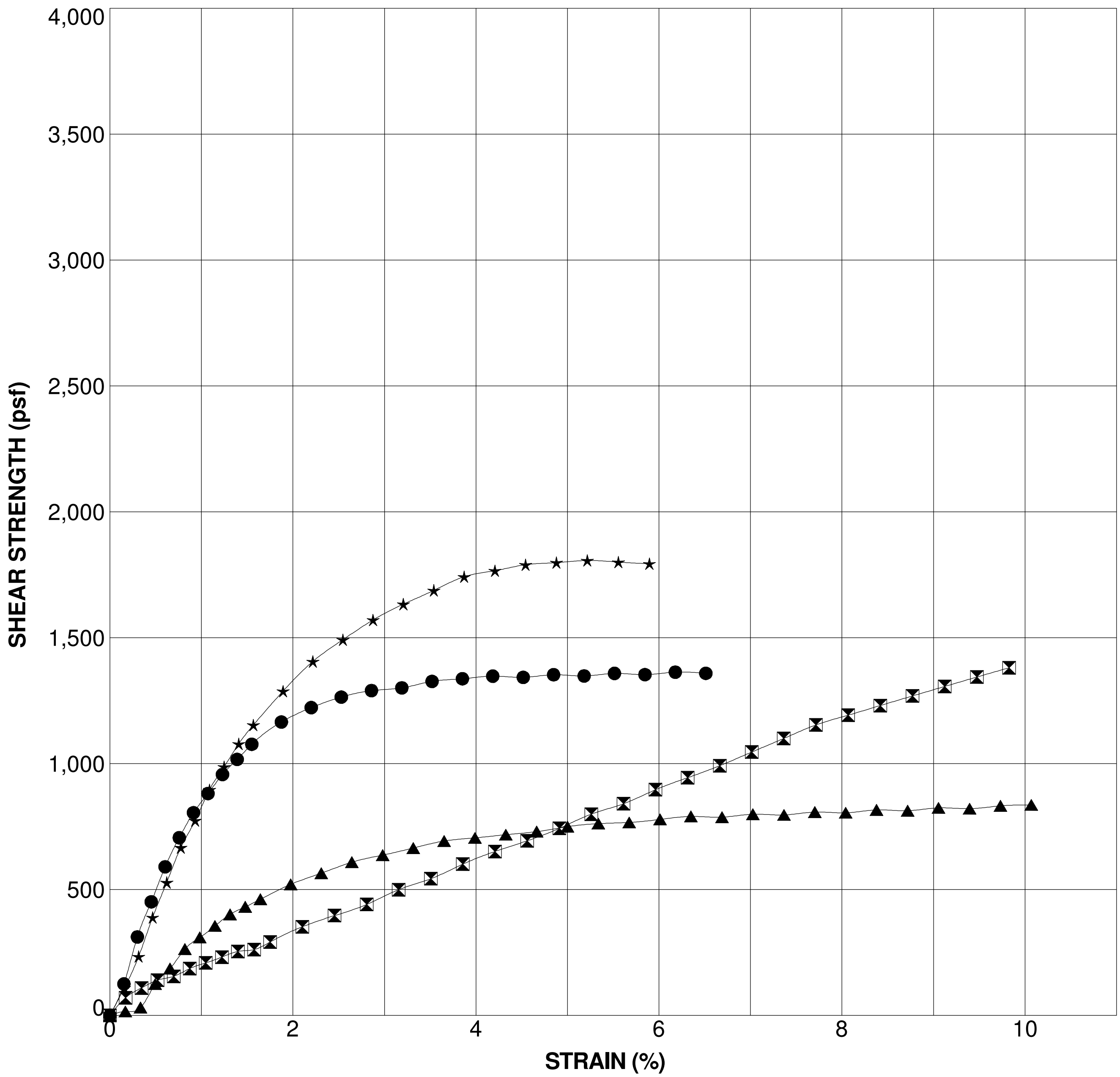
PLATE B-8

APPENDIX C

Laboratory Test Results



Sample Source	Classification	Confining Pressure (psf)	Ultimate Strength (psf)	Strain (%)	Dry Density (pcf)	Moisture Content (%)
● B-1 at 1.5 ft	DARK BROWN SILTY SAND (SM)	864	1363	6.2	98	14.9
⧗ B-1 at 5.5 ft	BROWN AND GRAY POORLY GRADED SAND (SP-SM) with silt	1008	1381	9.8	107	18.8
▲ B-2 at 2 ft	MOTTLED BROWN AND GRAY SILTY SAND (SM)	576	836	10.1	93	13.9
★ B-2 at 3.5 ft	BROWN SILTY SAND (SM)	720	1807	5.2	111	15.0

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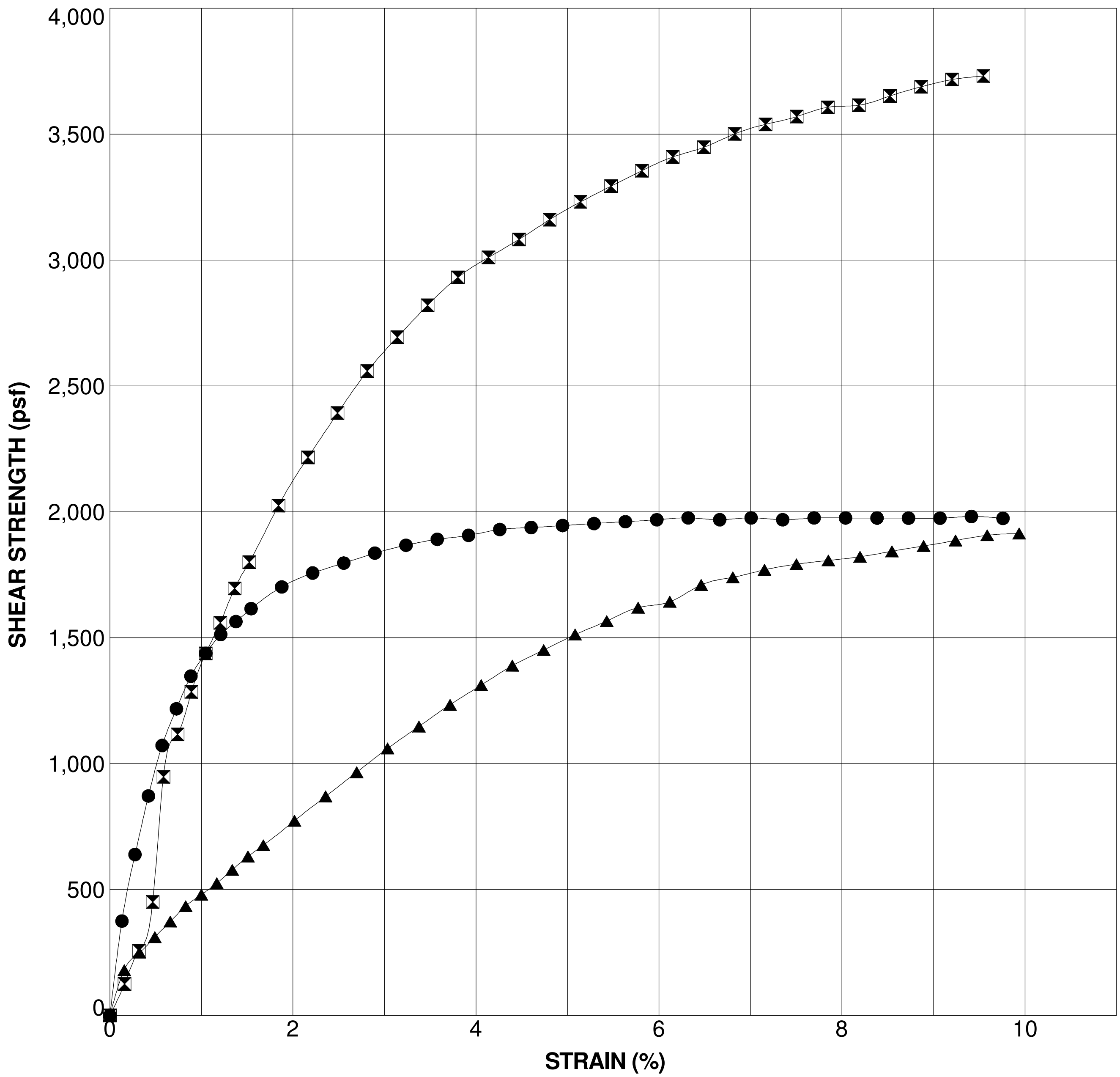
Date: 06/29/23

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

MCLELLAN RESIDENCE
34301 Pacific Reefs Road
Albion, California

PLATE C-1



Sample Source	Classification	Confining Pressure (psf)	Ultimate Strength (psf)	Strain (%)	Dry Density (pcf)	Moisture Content (%)
● B-3 at 4 ft	GRAY SAND (SP)	720	1981	9.4	106	12.0
⧗ B-3 at 11.5 ft	BROWN AND GRAY SILTY SAND (SM)	1296	3731	9.5	120	13.1
▲ B-4 at 5.5 ft	BROWN AND GRAY SILTY SAND (SM)	1008	1914	9.9	108	17.1

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Job No.: 11501.05
Appr.: EEO
Date: 06/29/23

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS

MCLELLAN RESIDENCE
34301 Pacific Reefs Road
Albion, California

PLATE C-2

APPENDIX D

Liquefaction Analysis

Project:	McLellan
Project #:	11501.05
Date:	6/29/2023
Boring:	B-1

Input Parameters:

Peak Ground Accel (g) =		1.053	
Earthquake Magnitude, M =		7.9	
Water Table Depth (m) =	2.1	7.00	(ft)
Average γ Above Water Table (kN/m^3) =	19.0	121.0	(lb/ft^3)
Average γ Below Water Table (kN/m^3) =	20.6	131.0	(lb/ft^3)
Borehole Diameter (mm) =	152.40	6	(in)
Requires Correction for Sample Liners (YES/NO):		no	
Rod Lengths Assumed Equal to the Depth Plus	1.5	m (for the above ground extension)	
Gravity Acceleration (m/sec^2)	9.81		
Height of Exposed Face (m)	4	13.5	(ft)
Boring Distance from Exposed Face (m)	37	120	(ft)

Ko = 0.5
Nc = 19.2

Liquefaction Potential

SPT Sample Number	Depth (m)	Depth (ft)	Layer Thickness (m)	Midpoint of Layer (m)	Measured N	Soil Type (USCS)	Flag "nlp"	Sat/Unsat	Fines Content (%)	Energy Ratio, ER (%)	C_E	C_B	C_R	C_S	N_{60}	σ_{vc} (kPa)	σ_{vc}' (kPa)	C_N	$(N_1)_{60}$	ΔN for Fines Content	$(N_1)_{60\text{-}cs}$	Stress Reduct, Coeff, r_d	CSR	MSF_{max}	MSF for Sand	K_σ for Sand	CRR for M=7.5 & σ_{vc}'=1atm	CRR	Factor of Safety
1	0.76	2.50	0.76	0.38	16	SM		0	30	80	1.33	1.15	0.75	1.00	18.4	14	14	1.70	31.28	5.4	36.64	1.00	0.686	2.2	0.85	1.10	1.603	N.A.	N.A.
2	1.37	4.50	0.61	1.07	13	SM		0	25	80	1.33	1.15	0.75	1.00	15.0	26	26	1.64	24.54	5.1	29.62	1.00	0.683	2.0	0.88	1.10	0.462	N.A.	N.A.
3	2.13	7.00	0.76	1.75	22	SP-SM		1	6	80	1.33	1.15	0.8	1.00	27.0	40	40	1.35	36.40	0.0	36.43	0.99	0.680	2.2	0.85	1.10	1.522	1.42	2.00
4	2.29	7.50	0.15	2.21	22	SP-SM		1	6	80	1.33	1.15	0.8	1.00	27.0	49	47	1.29	34.76	0.0	34.79	0.99	0.701	2.2	0.85	1.10	1.061	0.99	1.41
5	4.11	13.50	1.83	3.20	40	SP-SM		1	6	80	1.33	1.15	0.85	1.00	52.1	69	49	1.21	62.94	0.0	62.97	0.98	0.935	2.2	0.85	1.10	2.000	1.87	2.00
6	4.88	16.00	0.76	4.50	100	sandstone		1	30	80	1.33	1.15	0.95	1.00	145.7	94	67	1.11	162.22	5.4	167.58	0.97	0.934	2.2	0.85	1.10	2.000	1.87	2.00
7	5.64	18.50	0.76	5.26	100	sandstone		1	30	80	1.33	1.15	0.95	1.00	145.7	109	75	1.08	157.70	5.4	163.06	0.97	0.967	2.2	0.85	1.09	2.000	1.85	1.91

Liquefaction Induced Settlement and Lateral Spreading

Depth (m)	Depth (ft)	Limiting Shear Strain γ_{lim}	Parameter F_α	Maximum Shear Strain γ_{max}	ΔH_i (m)	ΔLDI_i (m)	ΔLDI_i (in)	Vertical Reconsol. Strain ε_v	ΔS_i (m)	ΔS_i (in)
0.76	2.50	0.017	-0.555	0.000	0.76	0.000	0.0	0.000	0.000	0.00
1.37	4.50	0.049	-0.063	0.000	0.61	0.000	0.0	0.000	0.000	0.00
2.13	7.00	0.017	-0.539	0.000	0.76	0.000	0.0	0.000	0.000	0.00
2.29	7.50	0.023	-0.421	0.000	0.15	0.000	0.0	0.000	0.000	0.00
4.11	13.50	0.000	-2.679	0.000	1.83	0.000	0.0	0.000	0.000	0.00
4.88	16.00	0.000	-12.821	0.000	0.76	0.000	0.0	0.000	0.000	0.00
5.64	18.50	0.000	-12.355	0.000	0.76	0.000	0.0	0.000	0.000	0.00
					LD =	0.00	0.0	S=	0.000	0.00
						(m)	(in)		(m)	(in)

Dry Sand Settlement

τ_{avg} (tsf)	Average Stress (p) (tsf)	Max Shear Modulus (Gmax) (tsf)	a	b	γ (%)	ε_{15} (%)	ε_{Nc} (%)	Dry Sand Settlement (in)
0.104	0.10	471.5	0.128	25352	0.68	0.330	0.368	0.22
0.186	0.18	589.2	0.131	17818	1.00	0.624	0.697	0.33
0.282	0.28	787.3	0.135	13669	0.00	0.000	0.000	0.00
0.344	0.30	802.5	0.136	13114	0.00	0.000	0.000	0.00
0.482	0.54	1312.3	0.145	9216.8	0.00	0.000	0.000	0.00
0.654	0.65	1979.7	0.149	8323.6	0.00	0.000	0.000	0.00
0.754	0.75	2109.5	0.153	7629.2	0.00	0.000	0.000	0.00
							S=	0.56
								(in)

Liquefaction Potential
Dry Settlement
(1) Flag "nlp" – based on laboratory testing of fine content, plasticity index, liquid limits and potential intact moisture content.
"nlp" - no liquefacton potential

Project:	McLellan
Project #:	11501.05
Date:	6/29/2023
Boring:	B-2

Input Parameters:

Peak Ground Accel (g) =		1.053	
Earthquake Magnitude, M =		7.9	
Water Table Depth (m) =	2.1	7.00	(ft)
Average γ Above Water Table (kN/m^3) =	19.0	121.0	(lb/ft^3)
Average γ Below Water Table (kN/m^3) =	20.6	131.0	(lb/ft^3)
Borehole Diameter (mm) =	152.40	6	(in)
Requires Correction for Sample Liners (YES/NO):		no	
Rod Lengths Assumed Equal to the Depth Plus	1.5	m (for the above ground extension)	
Gravity Acceleration (m/sec^2)	9.81		
Height of Exposed Face (m)	4	14	(ft)
Boring Distance from Exposed Face (m)	19	62	(ft)

Ko = 0.5
Nc = 19.2

Liquefaction Potential

SPT Sample Number	Depth (m)	Depth (ft)	Layer Thickness (m)	Midpoint of Layer (m)	Measured N	Soil Type (USCS)	Flag "nlp"	Sat/Unsat	Fines Content (%)	Energy Ratio, ER (%)	C_E	C_B	C_R	C_S	N_{60}	σ_{vc} (kPa)	σ_{vc}' (kPa)	C_N	$(N_1)_{60}$	ΔN for Fines Content	$(N_1)_{60-cs}$	Stress Reduct, Coeff, r_d	CSR	MSF_{max}	MSF for Sand	K_σ for Sand	CRR for M=7.5 & σ_{vc}'=1atm	CRR	Factor of Safety
1	0.76	2.50	0.76	0.38	19	SM		0	25	80	1.33	1.15	0.75	1.00	21.9	14	14	1.70	37.15	5.1	42.22	1.00	0.686	2.2	0.85	1.10	2.000	N.A.	N.A.
2	1.22	4.00	0.46	0.99	30	SM		0	25	80	1.33	1.15	0.75	1.00	34.5	23	23	1.47	50.82	5.1	55.89	1.00	0.684	2.2	0.85	1.10	2.000	N.A.	N.A.
3	2.13	7.00	0.91	1.68	24	SP-SM		1	5	80	1.33	1.15	0.8	1.00	29.4	37	37	1.35	39.79	0.0	39.80	0.99	0.680	2.2	0.85	1.10	2.000	1.87	2.00
4	2.90	9.50	0.76	2.51	24	SP-SM		1	5	80	1.33	1.15	0.85	1.00	31.3	53	46	1.27	39.62	0.0	39.63	0.99	0.787	2.2	0.85	1.10	2.000	1.87	2.00
5	4.27	14.00	1.37	3.58	44	SP-SM		1	2	80	1.33	1.15	0.85	1.00	57.3	75	54	1.18	67.65	0.0	67.65	0.98	0.930	2.2	0.85	1.10	2.000	1.87	2.00
6	4.72	15.50	0.46	4.50	1100	sandstone		1	30	80	1.33	1.15	0.95	1.00	1602.3	93	67	1.11	1784.05	5.4	1789.41	0.97	0.920	2.2	0.85	1.10	2.000	1.87	2.00

Liquefaction Induced Settlement and Lateral Spreading

Depth (m)	Depth (ft)	Limiting Shear Strain γ_{lim}	Parameter F_α	Maximum Shear Strain γ_{max}	ΔH_i (m)	ΔLDI_i (m)	ΔLDI_i (in)	Vertical Reconsol. Strain ε_v	ΔS_i (m)	ΔS_i (in)
0.76	2.50	0.005	-0.973	0.000	0.76	0.000	0.0	0.000	0.000	0.00
1.22	4.00	0.000	-2.075	0.000	0.46	0.000	0.0	0.000	0.000	0.00
2.13	7.00	0.009	-0.789	0.000	0.91	0.000	0.0	0.000	0.000	0.00
2.90	9.50	0.009	-0.776	0.000	0.76	0.000	0.0	0.000	0.000	0.00
4.27	14.00	0.000	-3.088	0.000	1.37	0.000	0.0	0.000	0.000	0.00
4.72	15.50	0.000	######	0.000	0.46	0.000	0.0	0.000	0.000	0.00
					LD =	0.00 (m)	0.0 (in)	S=	0.000 (m)	0.00 (in)

Dry Sand Settlement

τ_{avg} (tsf)	Average Stress (p) (tsf)	Max Shear Modulus (Gmax) (tsf)	a	b	γ (%)	ε_{15} (%)	ε_{Nc} (%)	Dry Sand Settlement (in)
0.104	0.10	494.2	0.128	25352	0.51	0.207	0.231	0.14
0.166	0.16	686.5	0.130	19123	0.30	0.089	0.099	0.04
0.262	0.28	810.9	0.135	13669	0.00	0.000	0.000	0.00
0.378	0.38	943.3	0.139	11380	0.00	0.000	0.000	0.00
0.523	0.56	1368.7	0.146	9017.9	0.00	0.000	0.000	0.00
0.645	0.63	4290.8	0.148	8483.6	0.00	0.000	0.000	0.00
							S=	0.17 (in)

Liquefaction Potential
Dry Settlement

(1) Flag "nlp" – based on laboratory testing of fine content, plasticity index, liquid limits and potential intact moisture content.
"nlp" - no liquefacton potential

Project:	McLellan
Project #:	11501.05
Date:	6/29/2023
Boring:	B-3

Input Parameters:

Peak Ground Accel (g) =		1.053		Ko =	0.5
Earthquake Magnitude, M =		7.9		Nc =	19.2
Water Table Depth (m) =	2.1	7.00	(ft)		
Average γ Above Water Table (kN/m³) =	19.0	121.0	(lb/ft³)		
Average γ Below Water Table (kN/m³) =	20.6	131.0	(lb/ft³)		
Borehole Diameter (mm) =	127.00	5	(in)		
Requires Correction for Sample Liners (YES/NO):		no			
Rod Lengths Assumed Equal to the Depth Plus	1.5	m (for the above ground extension)			
Gravity Acceleration (m/sec²)	9.81				
Height of Exposed Face (m)	4	12.5	(ft)		
Boring Distance from Exposed Face (m)	20	65	(ft)		

Liquefaction Potential

SPT Sample Number	Depth (m)	Depth (ft)	Layer Thickness (m)	Midpoint of Layer (m)	Measured N	Soil Type (USCS)	Flag "nlp"	Sat/Unsat	Fines Content (%)	Energy Ratio, ER (%)	C_E	C_B	C_R	C_S	N_{60}	σ_{vc} (kPa)	σ_{vc}' (kPa)	C_N	$(N_1)_{60}$	ΔN for Fines Content	$(N_1)_{60\text{-}cs}$	Stress Reduct, Coeff, r_d	CSR	MSF_{max}	MSF for Sand	K_σ for Sand	CRR for M=7.5 & σ_{vc}'=1atm	CRR	Factor of Safety
1	0.76	2.50	0.76	0.38	38	SM		0	30	80	1.33	1.05	0.75	1.00	39.9	14	14	1.67	66.51	5.4	71.87	1.00	0.686	2.2	0.85	1.10	2.000	N.A.	N.A.
2	1.22	4.00	0.46	0.99	39	SM		0	30	80	1.33	1.05	0.75	1.00	41.0	23	23	1.47	60.32	5.4	65.68	1.00	0.684	2.2	0.85	1.10	2.000	N.A.	N.A.
3	1.68	5.50	0.46	1.45	84	SP		0	2	80	1.33	1.05	0.8	1.00	94.1	32	32	1.35	127.44	0.0	127.44	1.00	0.682	2.2	0.85	1.10	2.000	N.A.	N.A.
4	2.13	7.00	0.46	1.91	44	SM		1	25	80	1.33	1.05	0.8	1.00	49.3	41	41	1.27	62.51	5.1	67.58	0.99	0.680	2.2	0.85	1.10	2.000	1.87	2.00
5	3.05	10.00	0.91	2.59	44	SM		1	25	80	1.33	1.05	0.85	1.00	52.4	55	46	1.23	64.51	5.1	69.58	0.99	0.809	2.2	0.85	1.10	2.000	1.87	2.00
6	3.66	12.00	0.61	3.35	58	SM		1	25	80	1.33	1.05	0.85	1.00	69.0	70	55	1.18	81.11	5.1	86.18	0.98	0.857	2.2	0.85	1.10	2.000	1.87	2.00
7	4.57	15.00	0.91	4.11	100	bedrock		1	30	80	1.33	1.05	0.95	1.00	133.0	85	61	1.14	151.92	5.4	157.29	0.98	0.930	2.2	0.85	1.10	2.000	1.87	2.00

Liquefaction Induced Settlement and Lateral Spreading

Depth (m)	Depth (ft)	Limiting Shear Strain γ_{lim}	Parameter F_α	Maximum Shear Strain γ_{max}	ΔH_i (m)	ΔLDI_i (m)	ΔLDI_i (in)	Vertical Reconsol. Strain ε_v	ΔS_i (m)	ΔS_i (in)
0.76	2.50	0.000	-3.462	0.000	0.76	0.000	0.0	0.000	0.000	0.00
1.22	4.00	0.000	-2.915	0.000	0.46	0.000	0.0	0.000	0.000	0.00
1.68	5.50	0.000	-8.746	0.000	0.46	0.000	0.0	0.000	0.000	0.00
2.13	7.00	0.000	-3.081	0.000	0.46	0.000	0.0	0.000	0.000	0.00
3.05	10.00	0.000	-3.258	0.000	0.91	0.000	0.0	0.000	0.000	0.00
3.66	12.00	0.000	-4.766	0.000	0.61	0.000	0.0	0.000	0.000	0.00
4.57	15.00	0.000	-11.762	0.000	0.91	0.000	0.0	0.000	0.000	0.00
					LD =	0.00 (m)	0.0 (in)	S=	0.000 (m)	0.00 (in)

Dry Sand Settlement

τ_{avg} (tsf)	Average Stress (p) (tsf)	Max Shear Modulus (Gmax) (tsf)	a	b	γ (%)	ε_{15} (%)	ε_{Nc} (%)	Dry Sand Settlement (in)
0.104	0.10	590.2	0.128	25352	0.19	0.041	0.046	0.03
0.166	0.16	724.4	0.130	19123	0.23	0.055	0.062	0.02
0.227	0.22	1059.5	0.133	15797	0.10	0.010	0.012	0.00
0.291	0.28	967.4	0.135	13669	0.00	0.000	0.000	0.00
0.386	0.40	1167.6	0.140	11035	0.00	0.000	0.000	0.00
0.489	0.48	1373.6	0.143	9891.7	0.00	0.000	0.000	0.00
0.592	0.61	1876.8	0.148	8652.2	0.00	0.000	0.000	0.00
							S=	0.05 (in)

Liquefaction Potential

Dry Settlement

(1) Flag "nlp" – based on laboratory testing of fine content, plasticity index, liquid limits and potential intact moisture content.

"nlp" - no liquefacton potential

Project:	McLellan
Project #:	11501.05
Date:	6/29/2023
Boring:	B-4

Input Parameters:

Peak Ground Accel (g) =		1.053	
Earthquake Magnitude, M =		7.9	
Water Table Depth (m) =	2.1	7.00	(ft)
Average γ Above Water Table (kN/m^3) =	19.0	121.0	(lb/ft^3)
Average γ Below Water Table (kN/m^3) =	20.6	131.0	(lb/ft^3)
Borehole Diameter (mm) =	127.00	5	(in)
Requires Correction for Sample Liners (YES/NO):		no	
Rod Lengths Assumed Equal to the Depth Plus	1.5	m (for the above ground extension)	
Gravity Acceleration (m/sec^2)	9.81		
Height of Exposed Face (m)	3	11	(ft)
Boring Distance from Exposed Face (m)	0	1	(ft)

Ko = 0.5
Nc = 19.2

Liquefaction Potential

SPT Sample Number	Depth (m)	Depth (ft)	Layer Thickness (m)	Midpoint of Layer (m)	Measured N	Soil Type (USCS)	Flag "nlp"	Sat/Unsat	Fines Content (%)	Energy Ratio, ER (%)	C_E	C_B	C_R	C_S	N_{60}	σ_{vc} (kPa)	σ_{vc}' (kPa)	C_N	$(N_1)_{60}$	ΔN for Fines Content	$(N_1)_{60-cs}$	Stress Reduct, Coeff, r_d	CSR	MSF_{max}	MSF for Sand	K_σ for Sand	CRR for M=7.5 & σ_{vc}'=1atm	CRR	Factor of Safety
1	0.76	2.50	0.76	0.38	23	SM		0	25	80	1.33	1.05	0.75	1.00	24.2	14	14	1.68	40.46	5.1	45.54	1.00	0.686	2.2	0.85	1.10	2.000	N.A.	N.A.
2	1.52	5.00	0.76	1.14	46	SM		0	25	80	1.33	1.05	0.8	1.00	51.5	29	29	1.39	71.56	5.1	76.63	1.00	0.683	2.2	0.85	1.10	2.000	N.A.	N.A.
3	1.83	6.00	0.30	1.68	46	SM		0	25	80	1.33	1.05	0.8	1.00	51.5	35	35	1.32	68.21	5.1	73.28	1.00	0.682	2.2	0.85	1.10	2.000	N.A.	N.A.
4	2.13	7.00	0.30	1.98	46	SM		1	25	80	1.33	1.05	0.8	1.00	51.5	41	41	1.27	65.40	5.1	70.47	0.99	0.680	2.2	0.85	1.10	2.000	1.87	2.00
5	3.35	11.00	1.22	2.74	64	SM		1	25	80	1.33	1.05	0.85	1.00	76.2	56	44	1.24	94.61	5.1	99.69	0.99	0.857	2.2	0.85	1.10	2.000	1.87	2.00
6	3.66	12.00	0.30	3.51	100	sandstone		1	25	80	1.33	1.05	0.85	1.00	119.0	71	56	1.17	138.97	5.1	144.04	0.98	0.853	2.2	0.85	1.10	2.000	1.87	2.00

Liquefaction Induced Settlement and Lateral Spreading

Depth (m)	Depth (ft)	Limiting Shear Strain γ_{lim}	Parameter F_α	Maximum Shear Strain γ_{max}	ΔH_i (m)	ΔLDI_i (m)	ΔLDI_i (in)	Vertical Reconsol. Strain ε_v	ΔS_i (m)	ΔS_i (in)
0.76	2.50	0.002	-1.231	0.000	0.76	0.000	0.0	0.000	0.000	0.00
1.52	5.00	0.000	-3.890	0.000	0.76	0.000	0.0	0.000	0.000	0.00
1.83	6.00	0.000	-3.588	0.000	0.30	0.000	0.0	0.000	0.000	0.00
2.13	7.00	0.000	-3.337	0.000	0.30	0.000	0.0	0.000	0.000	0.00
3.35	11.00	0.000	-6.038	0.000	1.22	0.000	0.0	0.000	0.000	0.00
3.66	12.00	0.000	-10.412	0.000	0.30	0.000	0.0	0.000	0.000	0.00
					LDI =	0.00 (m)	0.0 (in)	S=	0.000 (m)	0.00 (in)

Dry Sand Settlement

τ_{avg} (tsf)	Average Stress (p) (tsf)	Max Shear Modulus (Gmax) (tsf)	a	b	γ (%)	ε_{15} (%)	ε_{Nc} (%)	Dry Sand Settlement (in)
0.104	0.10	506.9	0.128	25352	0.44	0.163	0.182	0.11
0.207	0.20	852.6	0.132	16726	0.19	0.037	0.042	0.02
0.247	0.24	920.2	0.133	14993	0.21	0.043	0.048	0.01
0.290	0.28	981.0	0.135	13669	0.00	0.000	0.000	0.00
0.396	0.44	1380.5	0.141	10422	0.00	0.000	0.000	0.00
0.499	0.48	1630.1	0.143	9891.7	0.00	0.000	0.000	0.00
							S=	0.15 (in)

Liquefaction Potential
Dry Settlement
(1) Flag "nlp" – based on laboratory testing of fine content, plasticity index, liquid limits and potential intact moisture content.
"nlp" - no liquefacton potential

Project:	McLellan
Project #:	11501.05
Date:	6/29/2023
Boring:	B-5

Input Parameters:

Peak Ground Accel (g) =		1.053	
Earthquake Magnitude, M =		7.9	
Water Table Depth (m) =	2.1	7.00	(ft)
Average γ Above Water Table (kN/m^3) =	19.0	121.0	(lb/ft^3)
Average γ Below Water Table (kN/m^3) =	20.6	131.0	(lb/ft^3)
Borehole Diameter (mm) =	127.00	5	(in)
Requires Correction for Sample Liners (YES/NO):		no	
Rod Lengths Assumed Equal to the Depth Plus	1.5	m (for the above ground extension)	
Gravity Acceleration (m/sec^2)	9.81		
Height of Exposed Face (m)	3	9	(ft)
Boring Distance from Exposed Face (m)	6	20	(ft)

Ko = 0.5
Nc = 19.2

Liquefaction Potential

SPT Sample Number	Depth (m)	Depth (ft)	Layer Thickness (m)	Midpoint of Layer (m)	Measured N	Soil Type (USCS)	Flag "nlp"	Sat/Unsat	Fines Content (%)	Energy Ratio, ER (%)	C_E	C_B	C_R	C_S	N_{60}	σ_{vc} (kPa)	σ_{vc}' (kPa)	C_N	$(N_1)_{60}$	ΔN for Fines Content	$(N_1)_{60\text{-}cs}$	Stress Reduct, Coeff, r_d	CSR	MSF_{max}	MSF for Sand	K_σ for Sand	CRR for M=7.5 & σ_{vc}'=1atm	CRR	Factor of Safety
1	0.46	1.50	0.46	0.23	15	SM		0	25	80	1.33	1.05	0.75	1.00	15.8	9	9	1.70	26.78	5.1	31.85	1.00	0.687	2.1	0.86	1.10	0.629	N.A.	N.A.
2	1.22	4.00	0.76	0.84	24	SM		0	25	80	1.33	1.05	0.75	1.00	25.2	23	23	1.51	38.04	5.1	43.11	1.00	0.684	2.2	0.85	1.10	2.000	N.A.	N.A.
3	2.13	7.00	0.91	1.68	38	SM		1	25	80	1.33	1.05	0.8	1.00	42.6	40	40	1.28	54.37	5.1	59.44	0.99	0.680	2.2	0.85	1.10	2.000	1.87	2.00
4	2.74	9.00	0.61	2.44	38	SM		1	25	80	1.33	1.05	0.85	1.00	45.2	55	49	1.21	54.75	5.1	59.83	0.99	0.760	2.2	0.85	1.10	2.000	1.87	2.00
5	3.20	10.50	0.46	2.97	52	sandstone		1	25	80	1.33	1.05	0.85	1.00	61.9	65	55	1.17	72.67	5.1	77.74	0.99	0.804	2.2	0.85	1.10	2.000	1.87	2.00

Liquefaction Induced Settlement and Lateral Spreading

Depth (m)	Depth (ft)	Limiting Shear Strain γ_{lim}	Parameter F_α	Maximum Shear Strain γ_{max}	ΔH_i (m)	ΔLDI_i (m)	ΔLDI_i (in)	Vertical Reconsol. Strain ε_v	ΔS_i (m)	ΔS_i (in)
0.46	1.50	0.036	-0.214	0.000	0.46	0.000	0.0	0.000	0.000	0.00
1.22	4.00	0.004	-1.042	0.000	0.76	0.000	0.0	0.000	0.000	0.00
2.13	7.00	0.000	-2.375	0.000	0.91	0.000	0.0	0.000	0.000	0.00
2.74	9.00	0.000	-2.409	0.000	0.61	0.000	0.0	0.000	0.000	0.00
3.20	10.50	0.000	-3.991	0.000	0.46	0.000	0.0	0.000	0.000	0.00
					LDI =	0.00	0.0	S=	0.000	0.00
						(m)	(in)		(m)	(in)

Dry Sand Settlement

τ_{avg} (tsf)	Average Stress (p) (tsf)	Max Shear Modulus (Gmax) (tsf)	a	b	γ (%)	ε_{15} (%)	ε_{Nc} (%)	Dry Sand Settlement (in)
0.062	0.06	348.5	0.126	34445	0.97	0.554	0.619	0.22
0.166	0.16	629.6	0.130	19123	0.49	0.195	0.217	0.13
0.283	0.28	926.9	0.135	13669	0.00	0.000	0.000	0.00
0.388	0.36	1053.3	0.138	11755	0.00	0.000	0.000	0.00
0.460	0.42	1241.5	0.140	10717	0.00	0.000	0.000	0.00
							S=	0.35
								(in)

Liquefaction Potential
Dry Settlement
(1) Flag "nlp" – based on laboratory testing of fine content, plasticity index, liquid limits and potential intact moisture content.
"nlp" - no liquefacton potential

DISTRIBUTION

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