CALIFORNIA COASTAL COMMISSION
NORTH COAST DISTRICT OFFICE
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F8c

MEMORANDUM

Date: November 17, 2010

To: Commissioners and Interested Parties

From: Peter Douglas, Executive Director
Robert Merrill, District Manager – North Coast District
Melissa Kraemer, Coastal Program Analyst – North Coast District

Subject: **Addendum to Commission Meeting for Friday, November 19, 2010**
North Coast District Item F 8c, CDP No. 1-10-010 (Maier)

Staff is proposing to make minor changes to the November 4, 2010 staff recommendation on Coastal Development Permit Application No. 1-10-010. The project description includes the proposed development of a new 416-square-foot, maximum 15.5-foot-high attached one-car garage and associated compacted crushed gravel driveway. Special Condition No. 1 of the staff recommendation, which would require submittal of revised plans prior to permit issuance for the Executive Director's review and approval that demonstrate the following: (a) any new development proposed seaward of the 160-foot geologic setback line from the bluff edge shall be deleted, including the proposed compacted crushed gravel driveway and proposed stamped concrete walk, and (b) the proposed one-car garage shall be redesigned so that access to its primary entrance is landward of the 160-foot geologic setback line from the bluff edge. The applicants' consulting engineer has informed staff that the redesign of the one-car garage and driveway required by Special Condition No. 1 would necessitate significant changes to other aspects of the proposed project, including changes to the design and layout of the proposed separate new two-car garage and landscaped entry court, which the applicants are unwilling to make at this time. The applicants have indicated they would rather delete the development of the one-car garage entirely from the project. Thus, staff is revising Special Condition No. 1 and related findings to allow the condition to be satisfied by deleting the garage.

Staff continues to recommend that the Commission approve the project with the special conditions included in the staff recommendation of November 4, 2010, as modified by the revisions described below.

I. REVISIONS TO THE STAFF RECOMMENDATION

The revisions to the staff report dated November 4, 2010, including the modification of special condition language and related findings, are shown below. Text to be deleted is shown in ~~strikethrough~~; text to be added appears in **bold double-underline**.

- *Add language to Special Condition No. 1 on page 5 as follows:*

1. Revised Plans & Elevations

A. **PRIOR TO ISSUANCE OF THE COASTAL DEVELOPMENT PERMIT**, the applicant shall submit revised plans and elevations for the proposed project that demonstrate all of the following:

1. Any new development proposed seaward of the 160-foot geologic setback line from the bluff edge shall be deleted, including the proposed compacted crushed gravel driveway and proposed stamped concrete walk;

2. The proposed one-car garage shall **either** be **deleted or** redesigned so that access to its primary entrance is landward of the 160-foot geologic setback line from the bluff edge; and

3. The foundations for the proposed new garages shall be designed to facilitate moving the structures in the future if necessary.

B. The permittee shall undertake development in accordance with the approved final plans. Any proposed changes to the approved plans shall be reported to the Executive Director. No changes to the approved plans shall occur without a Coastal Commission approved amendment to this coastal development permit unless the Executive Director determines that no amendment is legally required.

- *Modify the text of the "Geologic Hazards" Finding No. IV-C on pages 12-13 as follows:*

Although the proposed new garage additions both are located landward of the geologic setback line identified in the Busch report and approved by the Commission's geologist in 2003, the applicants are proposing some new development seaward of the recommended geologic setback line including (1) portions of the new compacted crushed gravel driveway associated with the proposed new one-car garage, and (2) a new stamped concrete walk extending from the proposed new one-car garage entrance to the existing lawn area west of the existing residence. The Commission finds that such approval of new development seaward of the recommended geologic setback would not be sufficient to protect such development from bluff retreat hazards over its expected economic life consistent with the requirements of Section 30253. Furthermore, the current design plan for the one-car garage, as proposed, shows the garage door facing and immediately adjacent to/abutted against the recommended geologic setback line. If the compacted crushed gravel driveway proposed to serve the garage were to become threatened by bluff retreat hazards in the future (due to its proposed location seaward of the geologic setback line), the one-car garage, as proposed, would be non-functional. Therefore, the Commission

attaches **Special Condition No. 1**. This condition requires submittal of revised plans prior to permit issuance for the Executive Director's review and approval that demonstrate the following: (a) any new development proposed seaward of the 160-foot geologic setback line from the bluff edge shall be deleted, including the proposed compacted crushed gravel driveway and proposed stamped concrete walk, and (b) the proposed one-car garage shall **either** be **deleted or** redesigned so that access to its primary entrance is landward of the 160-foot geologic setback line from the bluff edge. Reorienting the garage to face landward of the bluff or up coast and making associated driveway changes would be feasible, as the driveway entrance to the site is located landward of the home and the areas between the garage and the street and northern property line contain no known environmentally sensitive habitats or other significant constraints to development. Special Condition No. 1 also requires that the foundations for the proposed new garages shall be designed to facilitate moving the structures in the future if necessary. Coastal Development Permit No. 1-03-024 similarly required that the foundations of the relocated home be designed to facilitate moving the structures in the future if necessary.

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Date Filed:	August 1, 2010
49th Day:	September 28, 2010
180th Day:	February 6, 2011
Staff:	Melissa B. Kraemer
Staff Report:	November 4, 2010
Hearing Date:	November 19, 2010
Commission Action:	

STAFF REPORT: REGULAR CALENDAR

APPLICATION NO.:	**1-10-010**
APPLICANT:	Richard & Cindy Maier
PROJECT LOCATION:	294 Roundhouse Creek Road, in the Big Lagoon area, Humboldt County (APN 517-251-039)
PROJECT DESCRIPTION:	Development of (1) a new 763-square-foot, maximum 14.5-foot-high attached two-car garage with a divided rear storage area and associated new paved driveway and paved front walk layout areas; (2) a new 416-square-foot, maximum 15.5-foot-high attached one-car garage and associated compacted crushed gravel driveway, (3) a new landscaped entry court between the two proposed garage structures; and (4) a new stamped concrete walk extension to the proposed one-car garage.
GENERAL PLAN DESIGNATION:	Residential Estates (RE)
ZONING DESIGNATION:	Residential Single Family with no further subdivision allowed and a design review combining zone (RS-X/D)

LOCAL APPROVALS RECEIVED:	Humboldt County Special Permit (for Design Review) No. SP-09-37);
OTHER APPROVALS REQUIRED:	None
SUBSTANTIVE FILE DOCUMENTS:	(1) Humboldt County Local Coastal Program; (2) CDP File Nos. NCR-74-CC-344 & 1-03-028

SUMMARY OF STAFF RECOMMENDATION:

Staff recommends approval of the coastal development permit application for the proposed project on the basis that, as conditioned, the project is consistent with the Chapter 3 policies of Coastal Act.

The subject site is currently developed with an existing single-family residence (which has no garage), driveway, septic system, 250-gallon propane tank, property fencing, and landscaping. The site is located a bluff top parcel in the Big Lagoon subdivision in an area of active erosion and where extraordinary episodes of bluff retreat have occurred in the past (Exhibit Nos. 1-4). In the winter of 1997-1998, nearby lots within the subdivision experienced an episode of extraordinary bluff retreat where more than 60 feet of bluff retreated during the singular stormy winter. The existing residence on the property used to be situated closer to the bluff edge (as permitted by the North Coast Regional Commission in 1974 under CDP No. NCR-74-CC-344) and was moved to its current location 160 feet back from the bluff edge in 2003 under Emergency Permit No. 1-03-027-G. In December of 2003, the Coastal Commission approved CDP No. 1-03-024, granting permanent authorization for the house relocation authorized on a temporary basis under the emergency permit. The location of the relocated residence, which is a minimum of 160 feet from the bluff edge, was determined to be sufficient to assure structural stability and integrity and to be safe from bluff erosion and retreat for the assumed economic life of the development by a geotechnical evaluation completed in 2003 by a consulting geologist commissioned by applicant Frank Rohner (Busch Geotechnical Consultants, Exhibit No. 8). The Commission's geologist, during the review of CDP Application No. 1-03-024, reviewed the geotechnical evaluation and quantitative slope stability analysis and concurred with its findings.

The proposed project involves the development of (1) a new 763-square-foot, maximum 14.5-foot-high attached two-car garage with a divided rear storage area and associated new paved driveway and paved front walk layout areas; (2) a new 416-square-foot, maximum 15.5-foot-high attached one-car garage and associated compacted crushed gravel driveway, (3) a new landscaped entry court between the two proposed garage structures; and (4) a new stamped concrete walk extension to the proposed one-car garage (see project plans, Exhibit Nos. 5-6). The proposed development would involve approximately 45 cubic yards of grading and fill.

Although the proposed new garage additions both are located landward of the geologic setback line identified in the Busch report and approved by the Commission's geologist in 2003, the applicants are proposing some new development seaward of the recommended geologic setback line including (1) portions of the new compacted crushed gravel driveway associated with the proposed new one-car garage, and (2) a new stamped concrete walk extending from the proposed new one-car garage entrance to the existing lawn area west of the existing residence. Staff believes that such approval of new development seaward of the recommended geologic setback would not be sufficient to protect such development from bluff retreat hazards over its expected economic life consistent with the requirements of Section 30253. Furthermore, the current design plan for the one-car garage, as proposed, shows the garage door facing and immediately adjacent to/abutted against the recommended geologic setback line. If the compacted crushed gravel driveway proposed to serve the garage were to become threatened by bluff retreat hazards in the future (due to its proposed location seaward of the geologic setback line), the one-car garage, as proposed, would be non-functional. Therefore, staff recommends attachment of Special Condition No. 1. This condition would require submittal of revised plans prior to permit issuance for the Executive Director's review and approval that demonstrate the following: (a) any new development proposed seaward of the 160-foot geologic setback line from the bluff edge shall be deleted, including the proposed compacted crushed gravel driveway and proposed stamped concrete walk, and (b) the proposed one-car garage shall be redesigned so that access to its primary entrance is landward of the 160-foot geologic setback line from the bluff edge. Reorienting the garage to face landward of the bluff or up coast and making associated driveway changes would be feasible, as the driveway entrance to the site is located landward of the home and the areas between the garage and the street and northern property line contain no known environmentally sensitive habitats or other significant constraints to development. Special Condition No. 1 also would require that the foundations for the proposed new garages be designed to facilitate moving the structures in the future if necessary. Coastal Development Permit No. 1-03-024 similarly required that the foundations of the relocated home be designed to facilitate moving the structures in the future if necessary.

Staff also recommends inclusion of the following special conditions to ensure consistency with Section 30253 and to ensure that the development, as conditioned, (1) will not contribute significantly to the creation of any geologic hazards, (2) will not have adverse impacts on the stability of the coastal bluff or on erosion, and (3) will not require the construction of shoreline protective works:

- Special Condition No. 2 would require that the final design and construction plans conform to the geologic recommendations given in the November 11, 2009 LACO Associates report on site preparation, cut and fill slopes, fill materials, compaction standards, seismic design parameters, foundation design, drainage, and other recommendations (Exhibit No. 7);
- Special Condition No. 3 would prohibit the construction of shoreline protective devices on the parcel, require that the landowner provide a geotechnical investigation and remove the house and its foundation if bluff retreat reaches the point where the structure is threatened, and require that the landowners accept sole responsibility for

the removal of any structural debris resulting from landslides, slope failures, or erosion of the site.

- Special Condition No. 4 would require the landowner to assume the risks of extraordinary erosion and geologic hazards of the property and waive any claim of liability on the part of the Commission.
- Special Condition No. 5 would require the applicants to record a deed restriction to impose the special conditions of the permit as covenants, conditions and restrictions on the use and enjoyment of the property.
- Special Condition No. 6 would require that all future development on the subject parcel that might otherwise be exempt from coastal permit requirements requires an amendment or coastal development permit.

Staff recommends that the Commission find the project, as conditioned, is consistent with all applicable Chapter 3 policies of the Coastal Act. The motion to adopt the staff recommendation of approval with special conditions is below on Page 4.

STAFF NOTES:

1. Standard of Review

The proposed project is located on the west side of Roundhouse Creek Road, in the Big Lagoon Park Subdivision south of Big Lagoon in Humboldt County. Humboldt County has a certified LCP. However, the project is located in an area of deferred certification (ADC). Therefore, the standard of review that the Commission must apply to the project is the Chapter 3 policies of the Coastal Act.

I. MOTION, STAFF RECOMMENDATION AND RESOLUTION:

The staff recommends that the Commission adopt the following resolution:

Motion:

I move that the Commission approve Coastal Development Permit No. 1-10-010 pursuant to the staff recommendation.

Staff Recommendation of Approval:

Staff recommends a **YES** vote. Passage of this motion will result in approval of the permit as conditioned and adoption of the following resolution and findings. The motion passes only by affirmative vote of a majority of the Commissioners present.

Resolution to Approve the Permit:

The Commission hereby approves a coastal development permit for the proposed development and adopts the findings set forth below on grounds that the development as conditioned will be in conformity with the policies of Chapter 3 of the Coastal Act. Approval of the permit complies with the California Environmental Quality Act because either 1) feasible mitigation measures and/or alternatives have been incorporated to substantially lessen any significant adverse effects of the development on the environment, or 2) there are no further feasible mitigation measures or alternatives that would substantially lessen any significant adverse impacts of the development on the environment.

II. STANDARD CONDITIONS: See Appendix A

III. SPECIAL CONDITIONS:

1. Revised Plans & Elevations

A. **PRIOR TO ISSUANCE OF THE COASTAL DEVELOPMENT PERMIT**, the applicant shall submit revised plans and elevations for the proposed project that demonstrate all of the following:

1. Any new development proposed seaward of the 160-foot geologic setback line from the bluff edge shall be deleted, including the proposed compacted crushed gravel driveway and proposed stamped concrete walk;

2. The proposed one-car garage shall be redesigned so that access to its primary entrance is landward of the 160-foot geologic setback line from the bluff edge; and

3. The foundations for the proposed new garages shall be designed to facilitate moving the structures in the future if necessary.

B. The permittee shall undertake development in accordance with the approved final plans. Any proposed changes to the approved plans shall be reported to the Executive Director. No changes to the approved plans shall occur without a Coastal Commission approved amendment to this coastal development permit unless the Executive Director determines that no amendment is legally required.

2. Conformance of Final Design and Construction Plans to the Engineering Geologic/Foundation and Soils Report

A. All final design and construction plans, including site, foundation, and drainage plans, shall be consistent with the recommendations contained in the geologic report titled, "Engineering Geologic/Foundation and Soils Report, Proposed Detached Garage Additions, 294 Roundhouse Creek Road, Trinidad, California…" dated November 11, 2009, prepared by LACO Associates Consulting Engineers. **PRIOR TO ISSUANCE OF THE COASTAL**

DEVELOPMENT PERMIT, the applicant shall submit, for the Executive Director's review and approval, evidence that a licensed professional (Certified Engineering Geologist or Geotechnical Engineer) has reviewed and approved all final design, construction, site, foundation, and drainage plans and has certified that each of those plans is consistent with all of the recommendations specified in the above-referenced geologic report approved by the California Coastal Commission for the project site.

B. The permittee shall undertake development in accordance with the approved final plans. Any proposed changes to the approved final plans shall be reported to the Executive Director. No changes to the approved final plans shall occur without a Commission amendment to this coastal development permit unless the Executive Director determines that no amendment is legally required.

3. <u>No Future Bluff or Shoreline Protective Device</u>

A. By acceptance of this permit, the applicants agree, on behalf of themselves and all successors and assigns, that no bluff or shoreline protective device(s) shall ever be constructed to protect the development approved pursuant to Coastal Development Permit No. 1-10-010, including, but not limited to, the garages, driveways, or appurtenant residential development, in the event that the authorized development is threatened with damage or destruction from waves, erosion, storm conditions, bluff retreat, landslides, ground subsidence or other natural hazards in the future. By acceptance of this permit, the applicants hereby waive, on behalf of themselves and all successors and assigns, any rights to construct such devices that may exist under Public Resources Code Section 30235.

B. By acceptance of this Permit, the applicants further agree, on behalf of themselves and all successors and assigns, that the landowner(s) shall remove the development authorized by this permit, including, but not limited to, the garages, driveways, or appurtenant residential development, if any government agency has ordered that the structures are not to be occupied due to any of the hazards identified above. In the event that portions of the development fall to the beach before they are removed, the landowner shall remove all recoverable debris associated with the development from the beach and ocean and lawfully dispose of the material in an approved disposal site. Such removal shall require a coastal development permit.

C. In the event the edge of the bluff recedes to within 10 feet of the authorized development but no government agency has ordered that the structures not be occupied, a geotechnical investigation shall be prepared by a licensed geologist or civil engineer with coastal experience retained by the applicant, that addresses whether any portions of the structures are threatened by wave, erosion, storm conditions, or other natural hazards. The report shall identify all those immediate or potential future measures that could stabilize the structures without shore or bluff protection, including but not limited to removal or relocation of the

structures. The report shall be submitted to the Executive Director and the appropriate local government official. If the geotechnical report concludes that the structures are unsafe for occupancy, the permittee shall, within 90 days of submitting the report, apply for a coastal development permit amendment to remedy the hazard which shall include removal of the threatened portion of the structure.

4. Assumption of Risk, Waiver of Liability and Indemnity

By acceptance of this permit, the applicants acknowledge and agree: (i) that the site may be subject to hazards from landslide, bluff retreat, erosion, subsidence, and earth movement; (ii) to assume the risks to the applicants and the property that is the subject of this permit of injury and damage from such hazards in connection with this permitted development; (iii) to unconditionally waive any claim of damage or liability against the Commission, its officers, agents, and employees for injury or damage from such hazards; and (iv) to indemnify and hold harmless the Commission, its officers, agents, and employees with respect to the Commission's approval of the project against any and all liability, claims, demands, damages, costs (including costs and fees incurred in defense of such claims), expenses, and amounts paid in settlement arising from any injury or damage due to such hazards.

5. Deed Restriction

PRIOR TO ISSUANCE OF THE COASTAL DEVELOPMENT PERMIT, the applicant shall submit to the Executive Director for review and approval documentation demonstrating that the applicant has executed and recorded against the parcel(s) governed by this permit a deed restriction, in a form and content acceptable to the Executive Director: (1) indicating that, pursuant to this permit, the California Coastal Commission has authorized development on the subject property, subject to terms and conditions that restrict the use and enjoyment of that property; and (2) imposing the Special Conditions of this permit as covenants, conditions and restrictions on the use and enjoyment of the Property. The deed restriction shall include a legal description of the entire parcel or parcels governed by this permit. The deed restriction shall also indicate that, in the event of an extinguishment or termination of the deed restriction for any reason, the terms and conditions of this permit shall continue to restrict the use and enjoyment of the subject property so long as either this permit or the development it authorizes, or any part, modification, or amendment thereof, remains in existence on or with respect to the subject property.

6. Future Development Restriction

This permit is only for the development described in Coastal Development Permit (CDP) No. 1-10-010. Pursuant to Title 14 California Code of Regulations section 13250(b)(6), the exemptions otherwise provided in Public Resources Code section 30610(a) shall not apply to the development governed by the CDP No. 1-10-010. Accordingly, any future improvements to this structure authorized by this permit shall require an amendment to CDP No. 1-10-010 from the Commission or shall require an additional coastal

development permit from the Commission or from the applicable certified local government. In addition thereto, an amendment to CDP No. 1-10-010 from the Commission or an additional coastal development permit from the Commission or from the applicable certified local government shall be required for any repair or maintenance identified as requiring a permit in Public Resources Code Section 30610(d) and Title 14, California Code of Regulations Sections 13252(a)-(b).

7. <u>Drainage, Erosion, & Runoff Control Plans</u>

A. **PRIOR TO ISSUANCE OF THE COASTAL DEVELOPMENT PERMIT**, the applicant shall submit a Drainage, Erosion, & Runoff Control Plan for review and approval of the Executive Director. The plan shall incorporate design elements and/or Best Management Practices (BMPs) which will serve to minimize the volume and velocity of stormwater runoff leaving the developed site, and to capture sediment and other pollutants contained in stormwater runoff from the development, by facilitating on-site infiltration and trapping of sediment generated from construction. The final drainage and runoff control plans shall at a minimum include the following provisions:

1. Runoff from the roofs, driveways and other impervious surfaces shall be collected and directed into pervious areas on the site (landscaped areas) for infiltration to the maximum extent practicable in a non-erosive manner, prior to being conveyed off-site. Where gutters and downspouts are used, velocity reducers shall be incorporated, to prevent scour and erosion at the outlet;

2. Runoff from impervious surfaces shall be designed to sheet-flow through biofilters or other filtration oriented BMPs;

3. Vegetation at the site shall be maintained to the maximum extent possible, and any disturbed areas shall be replanted or seeded with native vegetation immediately following project completion;

4. Provisions for maintaining the drainage system, including structural BMPs, in a functional condition throughout the life of the approved development. Such maintenance shall include, but shall not be limited to, the following: (a) BMPs shall be inspected, cleaned and repaired when necessary prior to the onset of the storm season, no later than September 30th each year, and (b) should any of the project's surface or subsurface drainage/filtration structures or other BMPs fail or result in increased erosion, the applicant/landowner or successor-in-interest shall be responsible for any necessary repairs to the drainage/filtration system or BMPs and restoration of the eroded area. Should repairs or restoration become necessary, prior to the commencement of such repair or restoration work, the applicant shall submit a repair and restoration plan to the Executive Director to determine if an amendment or new coastal development permit is required to authorize such work.

B. The permittee shall undertake development in accordance with the approved final plans. Any proposed changes to the approved plans shall be reported to the Executive Director. No changes to the approved plans shall occur without a Coastal Commission approved amendment to this coastal development permit unless the Executive Director determines that no amendment is legally required.

8. Landscaping Restrictions

A. No plant species listed as problematic and/or invasive by the California Native Plant Society, the California Invasive Plant Council, or as may be identified from time to time by the State of California, shall be employed or allowed to naturalize or persist on the site. No plant species listed as a "noxious weed" by the governments of the State of California or the United States shall be utilized within the property that is the subject of CDP No. 1-10-010.

B. Rodenticides containing any anticoagulant compounds, including but not limited to, Bromadiolone, Brodifacoum, or Diphacinone, shall not be utilized within the property that is the subject of CDP No. 1-10-010.

9. Exterior Lighting Standards

All exterior lights, including any lights attached to the outside of the buildings, shall be the minimum necessary for the safe ingress, egress, and use of the structures, and shall be low-wattage, non-reflective, shielded, and have a directional cast downward such that no light will be directed to shine beyond the boundaries of the subject parcel.

IV. FINDINGS & DECLARATIONS

The Commission hereby finds and declares as follows:

A. Background & Site Description

In 1974 the North Coast Regional Commission granted CDP No. NCR-74-CC-344 to Frank Rohner for the development of a 1,620-square-foot single-family residence, gravel parking area, septic system, and landscaping on a bluff top parcel in the Big Lagoon subdivision (APN 517-251-014) (Exhibit Nos. 1-3). The approved building footprint was situated approximately 50 feet from the bluff edge. In the winter of 1997-1998, nearby lots within the subdivision experienced an episode of extraordinary bluff retreat where more than 60 feet of bluff retreated during the singular stormy winter. Due to the high potential for bluff failure on the Rohner lot, in the spring of 2003 the Executive Director approved Emergency Permit No. 1-03-027-G to relocate the existing residence onto a new foundation located approximately 120 feet to the east (onto APN 517-251-015). The emergency permit also authorized the merger of APNs 517-251-14 & -15 into a single approximately 0.80-acre lot (the subject lot, now known as APN 517-251-039), which was necessary to meet local requirements on yard setbacks and siting residences and septic systems on the same parcel. In December of 2003, the Coastal Commission

approved CDP No. 1-03-024, granting permanent authorization for the house relocation and merger authorized on a temporary basis under the emergency permit. The location of the relocated residence, which is a minimum of 160 feet from the bluff edge, was determined to be sufficient to assure structural stability and integrity and to be safe from bluff erosion and retreat for the assumed economic life of the development by a geotechnical evaluation completed in 2003 by a consulting geologist commissioned by the applicant (Busch Geotechnical Consultants, Exhibit No. 8). The Commission's geologist, during the review of CDP Application No. 1-03-024, reviewed the geotechnical evaluation and quantitative slope stability analysis and concurred with its findings.

CDP No. 1-03-024 contains seven special conditions that require: (1) construction responsibilities and debris removal; (2) preparation and submittal of an erosion and runoff control plan to minimize the volume and velocity of stormwater runoff leaving the development site; (3) conformance of design and construction plans with the recommendations in the October 6, 2003 Busch geotechnical report reviewed and approved by the Commission's geologist; (4) execution and recordation of a deed restriction against the subject parcel imposing the permit conditions as covenants, conditions, and restrictions on the use and enjoyment of the property; (5) agreement that no bluff or shoreline protective device shall ever be constructed to protect the development approved pursuant to CDP No. 1-03-028; (6) acknowledgement and agreement a) that the site may be subject to geologic hazards, b) assumption of the risks of injury and damage from such hazards in connection with the permitted development, and c) unconditional waiver of any claim of damage or liability against the Commission and indemnification of the Commission for injury or damage from such hazards; and (7) that any future improvements to development authorized by CDP No. 1-03-024 will require a coastal development permit or permit amendment and will not be exempt pursuant to Public Resources Code Section 30610(a).

The subject site is currently developed with an existing single-family residence (which has no garage), driveway, septic system, 250-gallon propane tank, property fencing, and landscaping.

The subject property is not within any County designated scenic or view area, although some limited blue water views are afforded through the property. The subject property contains no known environmentally sensitive habitat areas. Except for the bluff itself, the property slopes gently to the west with an average slope of less than 20 percent. The bluff is approximately 126 feet high in this location and is very steep (Exhibit No. 4).

Although Humboldt County has a certified local coastal program, the project site is located within the Big Lagoon area of deferred certification. The area was not certified in part because of issues concerning protecting future development from the extraordinary bluff retreat that occurs along this section of the Humboldt County coastline.

B. Project Description

The proposed project involves the development of (1) a new 763-square-foot, maximum 14.5-foot-high attached two-car garage with a divided rear storage area and associated new paved driveway and paved front walk layout areas; (2) a new 416-square-foot, maximum 15.5-foot-high attached one-car garage and associated compacted crushed gravel driveway, (3) a new landscaped entry court between the two proposed garage structures; and (4) a new stamped concrete walk extension to the proposed one-car garage (see project plans, Exhibit Nos. 5-6). The proposed development would involve approximately 45 cubic yards of grading and fill.

C. Geologic Hazards

Section 30253 of the Coastal Act states in applicable part:

> *New development shall:*
>
> *(1) Minimize risks to life and property in areas of high geologic, flood, and fire hazard.*
>
> *(2) Assure stability and structural integrity, and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any way require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs…*

The subject property is located on a bluff-top lot situated approximately 126 feet above the ocean. The Big Lagoon Subdivision was built on an uplifted marine terrace that has been subject to extraordinary rates of bluff retreat in the past. According to the geotechnical analysis prepared for the house relocation authorized under CDP No. 1-03-024 by Busch Geotechnical Consultants (Exhibit No. 8), the project site is located on a high bluff where the Franciscan Complex bedrock does not outcrop at the base of the bluff, and the beach below is unprotected by offshore rocks or a nearby headland. As a result, whenever winter storm waves strip the sand from the beach, the base of the bluff, with its erodible marine terrace, begin to erode.

In previous actions on coastal development permits, the Commission has interpreted Section 30253 of the Coastal Act to require that coastal development be sited a sufficient distance landward of coastal bluffs that it will neither be endangered by erosion nor lead to the construction of protective coastal armoring during the assumed economic life of the development. The Commission has generally assumed the economic life of a new house to be 75 to 100 years. A setback adequate to protect development over the economic life of a development must account both for the expected bluff retreat during that time period and the existing slope stability. Long-term bluff retreat is measured by examining historic data including vertical aerial photographs and any surveys conducted that identified the bluff edge. Slope stability is a measure of the resistance of a slope to landsliding, and is assessed by a quantitative slope stability analysis. In such an analysis, the forces resisting a potential landslide are first determined. These are essentially the strength of the rocks or soils making up the bluff. Next, the forces driving a potential landslide are determined. These forces are the weight of the rocks as projected along a potential slide surface. The resisting forces are divided by the driving forces to determine the "factor of safety." The process involves determining a setback from the bluff edge

where a factor of safety of 1.5 is achieved. The distance from the bluff edge necessary to achieve a factor of safety of 1.5 must be added to the long term bluff retreat rate setback discussed above. The quantitative slope stability analysis needs to be prepared by licensed geotechnical professional familiar with the process.

Busch Geotechnical Consultants (Busch) performed a geotechnical investigation of the site documented in a report dated October 6, 2003. In assessing the long-term bluff retreat rate at the site, the Busch investigation utilized 14 aerial photographs spanning 61 years. The report documents anecdotally short-term erosion events in the nearby area resulting in up to 60 feet of bluff retreat in a single winter season (1997-1998). The report indicates a long-term average erosion rate for the 61 year period is 0.74 feet per year, but recommends that the calculated rate be rounded up to 1 foot per year to account for higher erosion rates determined by other studies.

The Busch investigation included a quantitative slope stability analysis, which showed that the current bluff is marginally stable, with a static factor of safety of 1.024. The factor of safety increases with distance from the bluff edge. Busch determined that a factor of safety of 1.5, the industry standard for new development, is achieved 76 feet from the bluff edge.

Based on the results of the analyses of long term bluff retreat and slope stability, the Busch report recommended a minimum setback distance from the present bluff edge of 160 feet to protect the relocated house authorized under CDP No. 1-03-024 over its assumed 75-year lifespan. The Busch report also recommended that the relocated home use a foundation that would facilitate moving the house in the future, if necessary. The Commission's geologist, during the review of CDP Application No. 1-03-024, reviewed the geotechnical evaluation and quantitative slope stability analysis and concurred with its findings. CDP No. 1-03-024 included Special Condition No. 3 to require that final design and construction plans for the relocated residence be consistent with the recommendations included in the Busch report.

In addition to the Busch report, the applicants commissioned a geologic report specific to the proposed project. LACO Associates, as documented in its November 11, 2009 report (Exhibit No. 7), investigated and characterized the subsurface soil conditions, assessed potential geologic hazards at the site, and provided recommended foundation design criteria to be utilized for design and construction of the proposed development. Specifically excluded from the LACO scope of work was an additional slope stability investigation examining long-term bluff retreat rate in conjunction with an analysis of factor of safety against landsliding, since this analysis was documented in the aforementioned Busch report. Regarding the geologic setback recommended by the Busch report, the LACO report states "…we have no additional recommendations provided the new garage does not encroach within the 160-foot setback."

Although the proposed new garage additions both are located landward of the geologic setback line identified in the Busch report and approved by the Commission's geologist

in 2003, the applicants are proposing some new development seaward of the recommended geologic setback line including (1) portions of the new compacted crushed gravel driveway associated with the proposed new one-car garage, and (2) a new stamped concrete walk extending from the proposed new one-car garage entrance to the existing lawn area west of the existing residence. The Commission finds that such approval of new development seaward of the recommended geologic setback would not be sufficient to protect such development from bluff retreat hazards over its expected economic life consistent with the requirements of Section 30253. Furthermore, the current design plan for the one-car garage, as proposed, shows the garage door facing and immediately adjacent to/abutted against the recommended geologic setback line. If the compacted crushed gravel driveway proposed to serve the garage were to become threatened by bluff retreat hazards in the future (due to its proposed location seaward of the geologic setback line), the one-car garage, as proposed, would be non-functional. Therefore, the Commission attaches **Special Condition No. 1**. This condition requires submittal of revised plans prior to permit issuance for the Executive Director's review and approval that demonstrate the following: (a) any new development proposed seaward of the 160-foot geologic setback line from the bluff edge shall be deleted, including the proposed compacted crushed gravel driveway and proposed stamped concrete walk, and (b) the proposed one-car garage shall be redesigned so that access to its primary entrance is landward of the 160-foot geologic setback line from the bluff edge. Reorienting the garage to face landward of the bluff or up coast and making associated driveway changes would be feasible, as the driveway entrance to the site is located landward of the home and the areas between the garage and the street and northern property line contain no known environmentally sensitive habitats or other significant constraints to development. Special Condition No. 1 also requires that the foundations for the proposed new garages shall be designed to facilitate moving the structures in the future if necessary. Coastal Development Permit No. 1-03-024 similarly required that the foundations of the relocated home be designed to facilitate moving the structures in the future if necessary.

The Commission also attaches **Special Condition No. 2**, which requires that the final design and construction plans conform to the geologic recommendations given in the November 11, 2009 LACO Associates report on site preparation, cut and fill slopes, fill materials, compaction standards, seismic design parameters, foundation design, drainage, and other recommendations (Exhibit No. 7).

In addition, the Commission attaches **Special Condition No. 3**, which prohibits the construction of shoreline protective devices on the parcel, requires that the landowner provide a geotechnical investigation and remove the house and its foundation if bluff retreat reaches the point where the structure is threatened, and requires that the landowners accept sole responsibility for the removal of any structural debris resulting from landslides, slope failures, or erosion of the site. These requirements are consistent with Section 30253 of the Coastal Act, which states that new development shall minimize risk to life and property in areas of high geologic, flood, and fire hazard, assure structural integrity and stability, and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding areas, nor in any way require the

construction of protective devices that would substantially alter natural landforms along bluffs and cliffs. The Commission finds that the proposed development could not be approved as being consistent with Section 30253 of the Coastal Act if projected bluff retreat would affect the proposed development and necessitate construction of a seawall to protect it.

The applicants are proposing to construct development that would be located on a high uplifted marine terrace bluff-top that is actively eroding. Thus, the proposed development would be located in an area of high geologic hazard. However, new development can only be found consistent with Section 30253 if the risks to life and property from the geologic hazards are minimized and if a protective device will not be needed in the future. The application file contains information from a registered engineering geologist that has been reviewed and approved by the Commission's geologist which states that if the new development is set back 160 feet from the bluff edge, it will be safe from erosion and will not require any devices to protect the proposed development during its useful economic life.

Although a comprehensive geotechnical evaluation is a necessary and useful tool that the Commission relies on to determine if proposed development is permissible at all on any given bluff top site, the Commission finds that a geotechnical evaluation alone is not a guarantee that a development will be safe from bluff retreat. It has been the experience of the Commission that in some instances, even when a thorough professional geotechnical analysis of a site has concluded that a proposed development will be safe from bluff retreat hazards, unexpected bluff retreat episodes that threaten development during the life of the structure sometimes still do occur. Such unexpected bluff retreat happened in the immediate vicinity of the subject property and prompted the relocation of the subject residence (under CDP No. 1-03-024) onto the subject site from its original location approximately 85 feet to the west. Other examples of this situation include:

- The Kavich Home at 176 Roundhouse Creek Road in the Big Lagoon Area north of Trinidad (Humboldt County). In 1989, the Commission approved the construction of a new house on a vacant bluff top parcel (Permit 1-87-230). Based on the geotechnical report prepared for the project it was estimated that bluff retreat would jeopardize the approved structure in about 40 to 50 years. In 1999 the owners applied for a coastal development permit to move the approved house from the bluff top parcel to a landward parcel because the house was threatened by 40 to 60 feet of unexpected bluff retreat that occurred during a 1998 El Nino storm event. The Executive Director issued a waiver of coastal development permit (1-99-066-W) to authorize moving the house in September of 1999.

- The Denver/Canter home at 164/172 Neptune Avenue in Encinitas (San Diego County). In 1984, the Commission approved construction of a new house on a vacant bluff top lot (Permit 6-84-461) based on a positive geotechnical report. In 1993, the owners applied for a seawall to protect the home (Permit Application 6-93-135). The Commission denied the request. In 1996 (Permit Application 6-96-138), and again in

1997 (Permit Application 6-97-90) the owners again applied for a seawall to protect the home. The Commission denied the requests. In 1998, the owners again requested a seawall (Permit Application 6-98-39) and submitted a geotechnical report that documented the extent of the threat to the home. The Commission approved the request on November 5, 1998.

- The Arnold project at 3820 Vista Blanca in San Clemente (Orange County). Coastal development permit (Permit # 5-88-177) for a bluff top project required protection from bluff top erosion, despite geotechnical information submitted with the permit application that suggested no such protection would be required if the project conformed to 25-foot bluff top setback. An emergency coastal development permit (Permit #5-93-254-G) was later issued to authorize bluff top protective works.

The Commission notes that the examples above are not intended to be absolute indicators of bluff erosion on the subject parcel, as coastal geology can vary significantly from location to location. However, these examples do illustrate that site-specific geotechnical evaluations cannot always accurately account for the spatial and temporal variability associated with coastal processes and therefore cannot always absolutely predict bluff erosion rates. Collectively, these examples have helped the Commission form its opinion on the vagaries of geotechnical evaluations with regard to predicting bluff erosion rates.

Although the project has been evaluated and designed in a manner to minimize the risk of geologic hazards, and although the Commission is requiring with Special Condition No. 2 that the applicant adhere to all recommended specifications to minimize potential geologic hazards, some risk of geologic hazard still remains. This risk is reflected in the aforementioned Busch geotechnical investigation report, which states the following:

> "Although we have used standard engineering geologic practices and professional standards of care to provide erosion-rate estimates, predictions, and a risk assessment, nothing in this report should be construed to state or imply a guarantee of safety of the home for any specific duration of time. Bluff retreat occurs in a largely unpredictable fashion, and it will continue to occur in the Big Lagoon area into the foreseeable future. Even if we have overstated the risk at the proposed site, and the future realized rate of bluff failure is less than the minimum rate we predict, it is important to understand that LOW risk is not the same as NO risk; rapid rate bluff failure could occur before the calculated minimum economic lifespan is realized (herein stated as 75 years).
>
> In conclusion, although the evaluation presented here in is based on a consideration of the geologic, geodetic, tectonic, and near shore marine processes active at Big Lagoon, greater or lesser retreat rates than those documented in the past and predicted in the future may be realized in the next 75 years."

This language in the report itself is indicative of the underlying uncertainties of this and any geotechnical evaluation and supports the notion that no guarantees can be made regarding the safety of the proposed development with respect to bluff retreat.

Geologic hazards are episodic, and bluffs that may seem stable now may not be so in the future. Therefore, the Commission finds that the subject lot is an inherently hazardous piece of property, that the bluffs are clearly eroding, and that the proposed new development will be subject to geologic hazard and could potentially someday require a bluff or shoreline protective device, inconsistent with Section 30253 of the Coastal Act. The Commission finds that the proposed development could not be approved as being consistent with Section 30253 of the Coastal Act if projected bluff retreat would affect the proposed development and necessitate construction of a seawall to protect it.

Based upon the referenced geologic report and the evaluation of the project site by the Commission's staff geologist, the Commission finds that the risks of geologic hazard are minimized if the development is set back approximately 160 feet or more from the bluff edge. However, given that the risk cannot be eliminated and the geologic report cannot assure that shoreline protection will never be needed to protect the residence, the Commission finds that the proposed development is consistent with the Coastal Act only if it is conditioned to provide that shoreline protection will not be constructed. Thus, the Commission further finds that due to the inherently hazardous nature of this lot, the fact that no geology report can conclude with any degree of certainty that a geologic hazard does not exist, the fact that the approved development and its maintenance may cause future problems that were not anticipated, and because new development shall not engender the need for shoreline protective devices, it is necessary to attach Special Condition No. 3 to ensure that no future shoreline protective device will be constructed to protect the proposed new development.

Special Condition No. 3 prohibits the construction of shoreline protective devices on the parcel to protect the proposed garages, driveways, appurtenant residential development and/or other development approved by CDP No. 1-10-010 and requires that the landowner provide a geotechnical investigation and remove the proposed improvements associated with the development approved by CDP No. 1-10-010 if bluff retreat reaches the point where this development is threatened, and requires that the landowners accept sole responsibility for the removal of any structural debris resulting from landslides, slope failures, or erosion of the site. These requirements are necessary for compliance with Section 30253 of the Coastal Act which states that new development shall minimize risk to life and property in areas of high geologic, flood, and fire hazard, assure structural integrity and stability, and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding areas, nor in any way require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs. The Commission finds that the proposed development could not be approved as being consistent with Section 30253 if projected bluff retreat would affect the proposed development and necessitate construction of a seawall to protect it.

Special Condition No. 4 requires the landowner to assume the risks of extraordinary erosion and geologic hazards of the property and waive any claim of liability on the part of the Commission. Given that the applicants have chosen to implement the project despite these risks, the applicants must assume the risks. In this way, the applicants are notified that the Commission is not liable for damage as a result of approving the permit for development. The condition also requires the applicants to indemnify the Commission in the event that third parties bring an action against the Commission as a result of the failure of the development to withstand hazards.

In addition, **Special Condition No. 5** requires the applicants to record a deed restriction to impose the special conditions of the permit as covenants, conditions and restrictions on the use and enjoyment of the property. This special condition is required, in part, to ensure that the development is consistent with the Coastal Act and to provide notice of potential hazards of the property and help eliminate false expectations on the part of potential buyers of the property, lending institutions, and insurance agencies that the property is safe for an indefinite period of time and for further development indefinitely into the future, or that a protective device could be constructed to protect the approved development and will ensure that future owners of the property will be informed of the Commission's immunity from liability, and the indemnity afforded the Commission.

As noted above, some risks of an unforeseen natural disaster, such as an unexpected landslide, massive slope failure, erosion, etc. could result in destruction or partial destruction of the house or other development approved by the Commission. In addition, the development itself and its maintenance may cause future problems that were not anticipated. When such an event takes place, public funds are often sought for the clean-up of structural debris that winds up on the beach or on an adjacent property. As a precaution, in case such an unexpected event occurs on the subject property, Special Condition No. 3 also requires the landowner to accept sole responsibility for the removal of any structural debris resulting from landslides, slope failures, or erosion on the site, and agree to remove the residential development should the bluff retreat reach the point where a government agency has ordered that these facilities not be used.

As conditioned, the proposed development will not contribute significantly to the creation of any geologic hazards and will not have adverse impacts on slope stability or cause erosion. However, the Commission notes that Section 30610(a) of the Coastal Act exempts certain additions to existing single-family residential structures from coastal development permit requirements. Pursuant to this exemption, once a house has been constructed, certain additions and accessory buildings that the applicant might propose in the future are normally exempt from the need for a permit or permit amendment. Depending on its nature, extent, and location, such an addition or accessory structure could contribute to geologic hazards at the site. For example, installing a landscape irrigation system on the property in a manner that leads to saturation of the bluff could increase the potential for landslides or catastrophic bluff failure. Another example would be installing a sizable accessory structure for additional parking, storage, or other uses

normally associated with a single family home in a manner that does not provide for the recommended setback from the bluff edge.

However, Section 30610(a) requires the Commission to specify by regulation those classes of development which involve a risk of adverse environmental effects and require that a permit be obtained for such improvements. Pursuant to Section 30610(a) of the Coastal Act, the Commission adopted Section 13250 of Title 14 of the California Code of regulations. Section 13250(b)(6) specifically authorizes the Commission to require a permit for additions to existing single-family residences that could involve a risk of adverse environmental effect by indicating in the development permit issued for the original structure that any future improvements would require a development permit. As noted above, certain additions or improvements to the approved structure could involve a risk of creating geologic hazards at the site. Therefore, pursuant to Section 13250 (b)(6) of Title 14 of the California Code of Regulations, the Commission attaches **Special Condition No. 6**, which requires that all future development on the subject parcel that might otherwise be exempt from coastal permit requirements requires an amendment or coastal development permit. This condition will allow future development to be reviewed by the Commission to ensure that future improvements will not be sited or designed in a manner that would result in a geologic hazard. As discussed above, Special Condition No. 5 also requires that the applicant record and execute a deed restriction approved by the Executive Director against the property that imposes the special conditions of this permit as covenants, conditions and restrictions on the use and enjoyment of the property. Special Condition No. 5 will also help assure that future owners are aware of these CDP requirements applicable to all future development.

The Commission thus finds that the proposed development, as conditioned, is consistent Section 30253 of the Coastal Act, since the development as conditioned (1) will not contribute significantly to the creation of any geologic hazards, (2) will not have adverse impacts on the stability of the coastal bluff or on erosion, and (3) will not require the construction of shoreline protective works. Only as conditioned is the proposed development consistent with the Coastal Act.

D. Protection of Water Quality & Environmentally Sensitive Habitat Areas (ESHA)

Coastal Act Section 30230 states as follows:

> *Marine resources shall be maintained, enhanced, and where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes.*

Coastal Act Section 30231 states as follows:

> *The biological productivity and the quality of coastal waters, streams, wetlands, estuaries, and lakes appropriate to maintain optimum populations of marine organisms and for the protection of human health shall be maintained and, where feasible, restored through, among other means, minimizing adverse effects of waste water discharges and entrainment, controlling runoff, preventing depletion of ground water supplies and substantial interference with surface water flow, encouraging waste water reclamation, maintaining natural vegetation buffer areas that protect riparian habitats, and minimizing alteration of natural streams.*

Coastal Act Section 30107.5 defines "environmentally sensitive habitat area" as:

> *…any area in which plant or animal life or their habitats are either rare or especially valuable because of their special nature or role in an ecosystem and which could be easily disturbed or degraded by human activities and developments.*

Coastal Act Section 30240 states that:

> *(a) Environmentally sensitive habitat areas shall be protected against any significant disruption of habitat values, and only uses dependent on such resources shall be allowed within such areas.*
>
> *(b) Development in areas adjacent to environmentally sensitive habitat areas and parks and recreation areas shall be sited and designed to prevent impacts which would significantly degrade those areas, and shall be compatible with the continuance of those habitat and recreation areas.*

Stormwater runoff from new residential development can adversely affect the biological productivity of coastal waters by degrading water quality. Sections 30230 and 30231 of the Coastal Act require the protection of the biological productivity and quality of coastal waters. Section 30240 of the Coastal Act provides for the protection of areas that are identified as environmentally sensitive, and only resource-dependent uses, such as habitat restoration, are allowed within an ESHA. Additionally, all development within or adjacent to an ESHA must be sited and designed to prevent significant disruption of ESHA.

As discussed above, the subject parcel is located on a coastal terrace atop a steep coastal bluff above the ocean. As proposed, the project will result in changes in soil infiltration rates, drainage patterns, and the rate and amount of surface runoff. Although grading is proposed to be minimal, excavation of the site for the new garage additions will expose loosened soil to stormwater runoff. Runoff originating from the development site that is allowed to drain over the bluff edge could contain entrained sediment and other pollutants in the runoff that would contribute to degradation of the quality of marine waters. In addition to the proposed new structural additions, the proposed project also will create new paved driveway and walkway areas, which will further decrease the amount of pervious surface area on the property and increase the volume of stormwater runoff leaving the site. The applicants have proposed the construction of a new approximately 130-foot-long drainage swale along the northern property boundary to drain driveway runoff to the western end of the property, within the geologic setback area, within less than 50 feet of the existing septic leach field area. No information is

provided, however, as to the anticipated volume of runoff expected to be routed to the area and how it may affect geologic stability or septic system functionality.

The proposed development will result in an increase in impervious surface, which in turn will decrease the infiltrative function and capacity of existing permeable land on site. The reduction in permeable space thus leads to an increase in the volume and velocity of stormwater runoff that can be expected to leave the site. Further, pollutants commonly found in runoff associated with residential use include petroleum hydrocarbons such as oil and grease from vehicles; heavy metals; synthetic organic chemicals including paint and household cleaners; soap and dirt from washing vehicles; dirt and vegetation from yard maintenance; litter; fertilizers, herbicides, and pesticides; and bacteria and pathogens from animal waste. The discharge of these pollutants to coastal waters can cause cumulative impacts such as: eutrophication and anoxic conditions resulting in fish kills and diseases and the alteration of aquatic habitat, including adverse changes to species composition and size; excess nutrients causing algae blooms and sedimentation increasing turbidity which both reduce the penetration of sunlight needed by aquatic vegetation which provide food and cover for aquatic species; disruptions to the reproductive cycle of aquatic species; and acute and sublethal toxicity in marine organisms leading to adverse changes in reproduction and feeding behavior. These impacts reduce the biological productivity and the quality of coastal waters, streams, wetlands, estuaries, and lakes and reduce optimum populations of marine organisms and have adverse impacts on human health.

Therefore, in order to find the proposed development consistent with the water and marine resource policies of the Coastal Act, the Commission attaches **Special Condition No. 7.** This condition requires submittal of a final drainage, erosion, and runoff control plan prior to permit issuance for the review and approval of the Executive Director. The plan is required to incorporate design elements and/or Best Management Practices (BMPs) to minimize the volume and velocity of stormwater runoff leaving the developed site and to capture sediment and other pollutants contained in stormwater runoff from the development, by facilitating on-site infiltration and trapping of sediment generated from construction.

The applicants have submitted a landscaping plan for the subject site (Exhibit No. 6), which proposes the use of a variety of native species and non-invasive horticultural varieties on the property. To help in the establishment of landscaping vegetation, rodenticides are sometimes used to prevent rats, moles, voles, gophers, and other similar small animals from eating the newly planted saplings. Certain rodenticides, particularly those utilizing blood anticoagulant compounds such as brodifacoum, bromadiolone and diphacinone, have been found to poses significant primary and secondary risks to non-target wildlife present in urban and urban/ wildland areas. As the target species are preyed upon by raptors or other environmentally sensitive predators and scavengers, these compounds can bio-accumulate in the animals that have consumed the rodents to concentrations toxic to the ingesting non-target species. Therefore, to minimize this potential significant adverse cumulative impact to environmentally sensitive wildlife

species, the Commission attaches **Special Condition No. 8** prohibiting the use of specified rodenticides on the property governed by CDP No. 1-10-010. The condition also prohibits the use of invasive or otherwise problematic plant species on the property.

Therefore, the Commission finds that the proposed project, as conditioned to incorporate and maintain a drainage and polluted runoff control plan and to prohibit the use of certain rodenticides and invasive plant species on the property, is consistent with Sections 30230, 30231, and 30240 of the Coastal Act.

E. Visual Resources

Section 30251 of the Coastal Act states that the scenic and visual qualities of coastal areas shall be considered and protected as a resource of public importance and requires, in applicable part, that permitted development be sited and designed to protect views to and along the ocean and scenic coastal areas, to minimize the alteration of natural land forms, to restore and enhance, where feasible, the quality of visually degraded areas, and to be visually compatible with the character of surrounding areas.

The subject parcel is located on a bluff-top lot in a residential subdivision overlooking the Pacific Ocean. The site is not located within a designated "highly scenic area." Although limited blue water views are afforded through the property, the proposed development will be sited in a manner that will not adversely affect views to or along the coast.

During the processing of the County Special Permit for the proposed project for "design review" purposes, the project was reviewed by the Big Lagoon Design Review Committee. The Committee found that the proposed development is compatible with the neighborhood in terms of height, bulk, architectural style, and building materials common to the area. In a May 9, 2010 memo on the project from the Big Lagoon Design Review Committee to the County, the committee recommended certain limitations on exterior lighting associated with the proposed new development, which the County included as a condition of approval of the special permit. Similarly, the Commission attaches **Special Condition No. 9** to require that any exterior lighting associated with the proposed development be the minimum necessary for the safe ingress, egress, and use of the structures and be low-wattage, non-reflective, shielded, and have a directional cast downward such that no light will be directed to shine beyond the boundaries of the subject parcel.

Finally, as the site of the proposed development is relatively flat to gently sloping, only minimal grading is proposed for the proposed development. Thus, the amount of landform alteration will be minimized, consistent with Section 30251.

In conclusion, the Commission finds that the proposed development, as conditioned, is consistent with Section 30251 of the Coastal Act, as the project has been sited and designed to minimize visual impacts, will be visually compatible with the character of surrounding area, and will not result in significant landform alteration.

F. Public Access

Coastal Act Sections 30210, 30211, and 30212 require the provision of maximum public access opportunities, with limited exceptions. Section 30210 states that maximum access and recreational opportunities shall be provided consistent with public safety needs and the need to protect public rights, rights of private property owners, and natural resource areas from overuse. Section 30211 states that development shall not interfere with the public's right of access to the sea where acquired through use or legislative authorization, including, but not limited to, the use of dry sand and rocky coastal beaches to the first line of terrestrial vegetation. Section 30212 states that public access from the nearest public roadway to the shoreline and along the coast shall be provided in new development projects except where it is inconsistent with public safety, military security needs, or the protection of fragile coastal resources, adequate access exists nearby, or agriculture would be adversely affected. In its application of these policies, the Commission is limited by the need to show that any denial of a permit application based on these sections, or any decision to grant a permit subject to special conditions requiring public access, is necessary to offset a project's adverse impact on existing or potential public access.

There is no evidence of trails on the subject site and no indication from the public that the site has been used for public access purposes in the past. Furthermore, the proposed development will not increase the demand for public access to the shoreline and will otherwise have no significant impact on existing or potential public access. Therefore, the Commission finds that the proposed project, which does not include provisions of public access, is consistent with the public access policies of the Coastal Act.

G. California Environmental Quality Act (CEQA)

Humboldt County acted as the lead agency for the project in its processing of Special Permit No. SP-09-37 for design review purposes. The County found the proposed project to be exempt from environmental review pursuant to Section 15303 of the CEQA Guidelines.

Section 13096 of the Commission's administrative regulations requires Commission approval of coastal development permit applications to be supported by a finding showing the application, as modified by any conditions of approval, to be consistent with any applicable requirement of the California Environmental Quality Act (CEQA). Section 21080.5(d)(2)(A) of CEQA prohibits a proposed development from being approved if there are feasible alternatives or feasible mitigation measures available, which would substantially lessen any significant adverse effect the proposed development may have on the environment.

The Commission incorporates its findings on conformity with the Chapter 3 policies of the Coastal Act at this point as set forth in full. These findings address and respond to all public comments regarding potential significant adverse environmental effects of the project that were received prior to preparation of the staff report. As discussed herein in the findings addressing the consistency of the proposed project with the Chapter 3 policies of the Coastal

Act, the proposed project has been conditioned to be found consistent with the Coastal Act. Mitigation measures, which will minimize all adverse environmental impacts, have been required. As conditioned, there are no feasible alternatives or feasible mitigation measures available, beyond those required, which would substantially lessen any significant adverse impact that the activity may have on the environment. Therefore, the Commission finds that the proposed project can be found to be consistent with the requirements of the Coastal Act to conform to CEQA.

V. EXHIBITS

1. Regional location map
2. Vicinity map
3. Assessor's parcel map
4. Aerial photo
5. Proposed site plan & elevations
6. Proposed landscaping plan
7. Geology report for proposed garage additions (excerpt)
8. Geotechnical report on long-term erosion and bluff retreat rates for the property (excerpt)

ATTACHMENT

Standard Conditions:

1. Notice of Receipt and Acknowledgment. The permit is not valid and development shall not commence until a copy of the permit, signed by the permittee or authorized agent, acknowledging receipt of the permit and acceptance of the terms and conditions, is returned to the Commission office.

2. Expiration. If development has not commenced, the permit will expire two years from the date on which the Commission voted on the application. Development shall be pursued in a diligent manner and completed in a reasonable period of time. Application for extension of the permit must be made prior to the expiration date.

3. Interpretation. Any questions of intent or interpretation of any condition will be resolved by the Executive Director of the Commission.

4. Assignment. The permit may be assigned to any qualified person, provided assignee files with the Commission an affidavit accepting all terms and conditions of the permit.

5. Terms and Conditions Run with the Land. These terms and conditions shall be perpetual, and it is the intention of the Commission and the permittee to bind all future owners and possessors of the subject property to the terms and conditions.

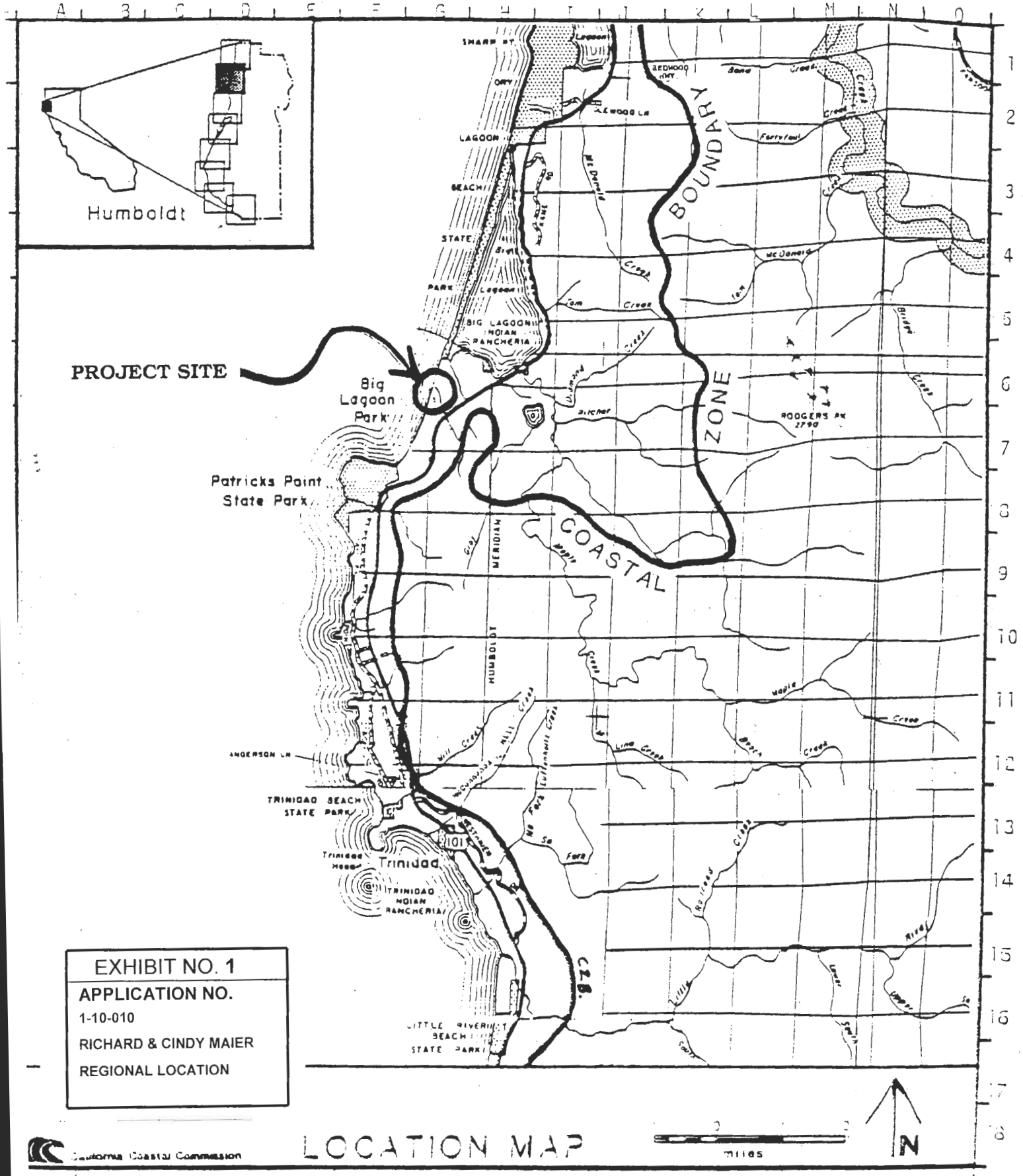

EXHIBIT NO. 1

APPLICATION NO.

1-10-010

RICHARD & CINDY MAIER

REGIONAL LOCATION

California Coastal Commission

County of Humboldt

LACO ASSOCIATES
CONSULTING ENGINEERS
21 W 4TH ST. EUREKA, CA 95501 (707)443-5054

PROJECT	MAIER'S SITE PLAN	BY JB	FIGURE 1
CLIENT	RICHARD AND CINDY MAIER	DATE 1/5/10	
LOCATION	294 ROUNDHOUSE CREEK ROAD, BIG LAGOON	CHECK RLD	JOB NO. 7197.00
	LOCATION MAP	SCALE 1"=2000'	

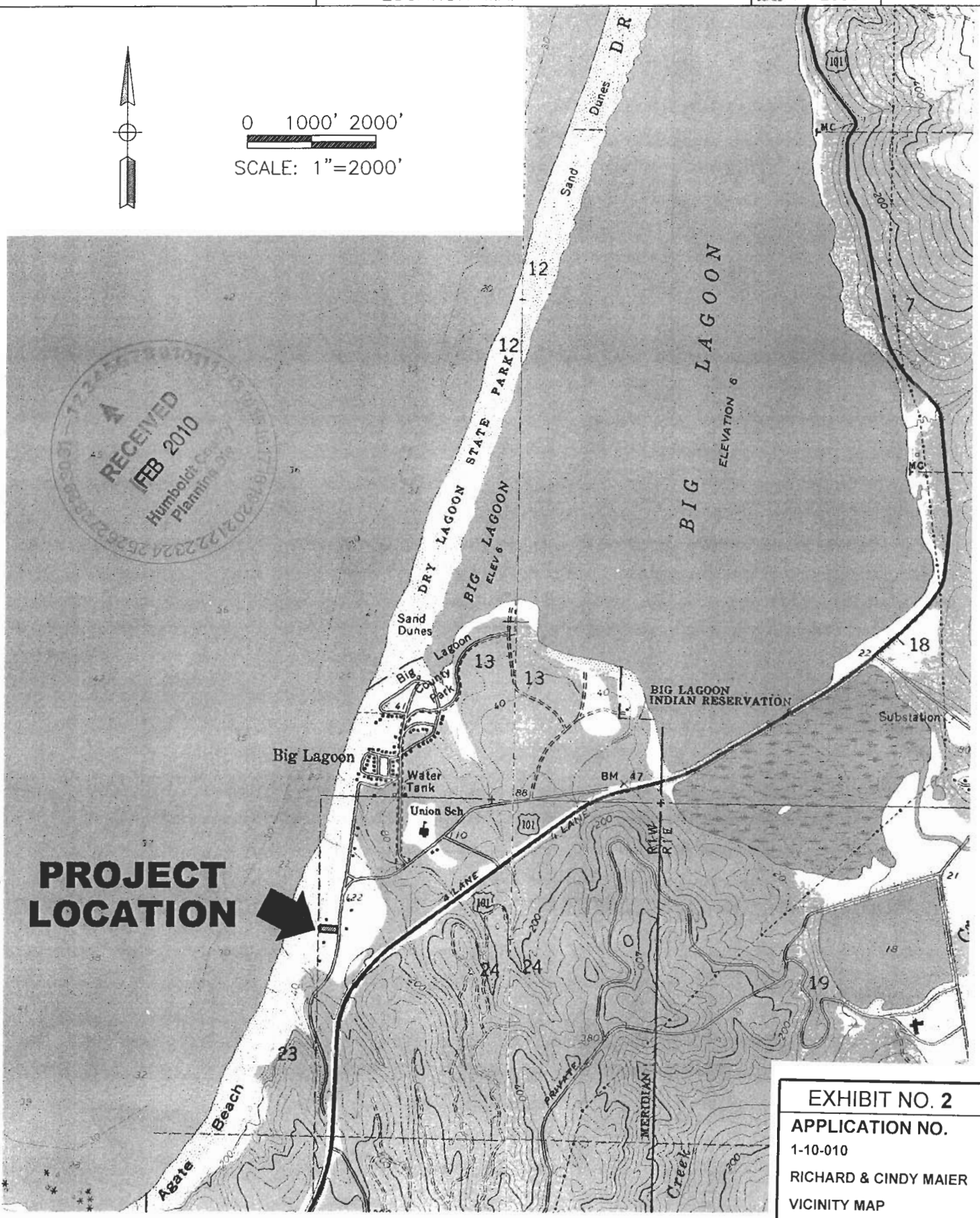

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EXHIBIT NO. 2
APPLICATION NO.
1-10-010
RICHARD & CINDY MAIER
VICINITY MAP

SECS 23 & 24, 9N 1W

(BIG LAGOON PARK SUBDVN., TRACT 22, BLK. A)

517 - 25

1" = 100'

8/31/62

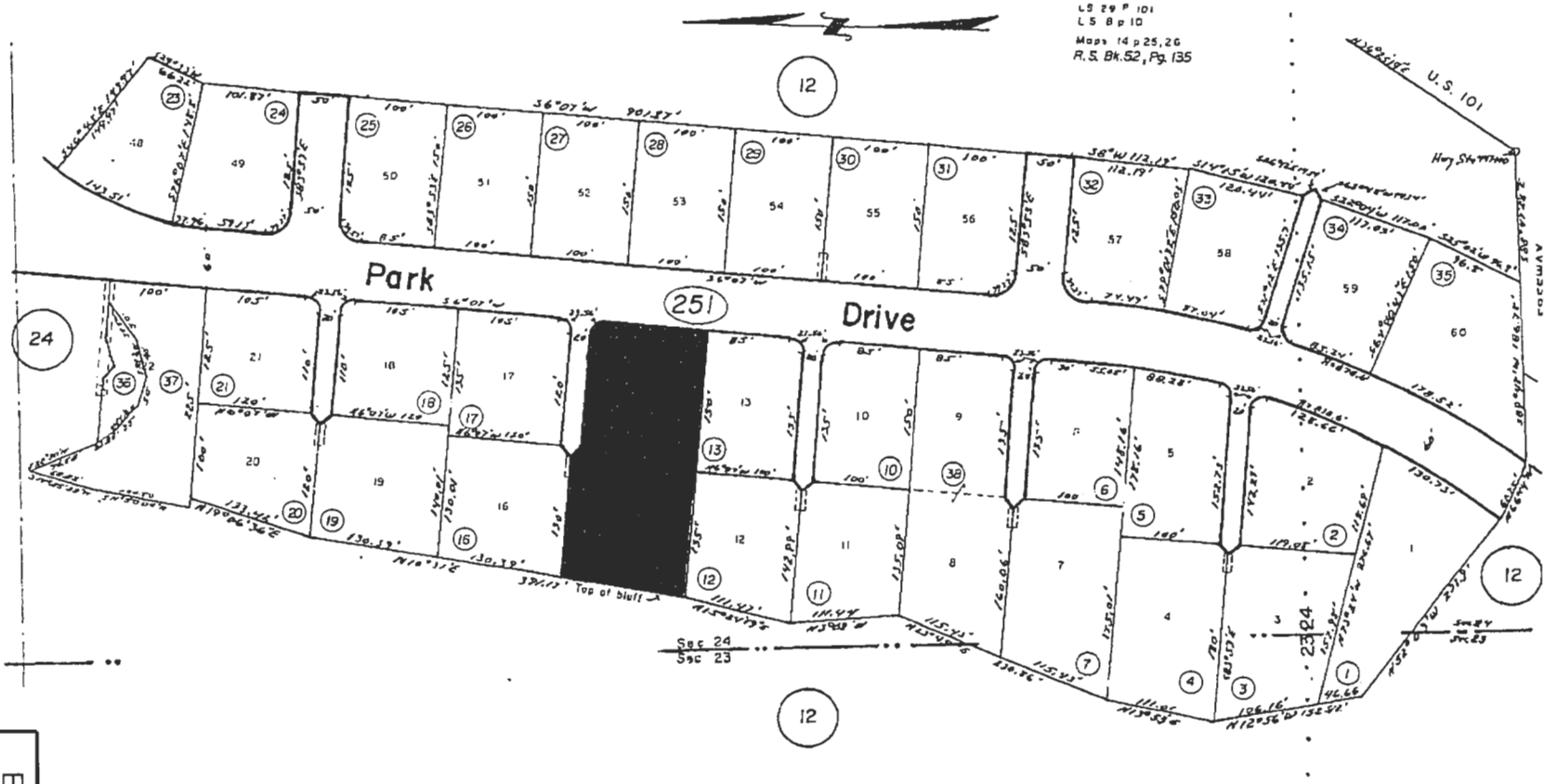


EXHIBIT NO. 3

APPLICATION NO.

1-10-010

RICHARD & CINDY MAIER

ASSESSOR'S PARCEL MAP

EXHIBIT NO. 4

APPLICATION NO.
1-10-010

RICHARD & CINDY MAIER
AERIAL PHOTO

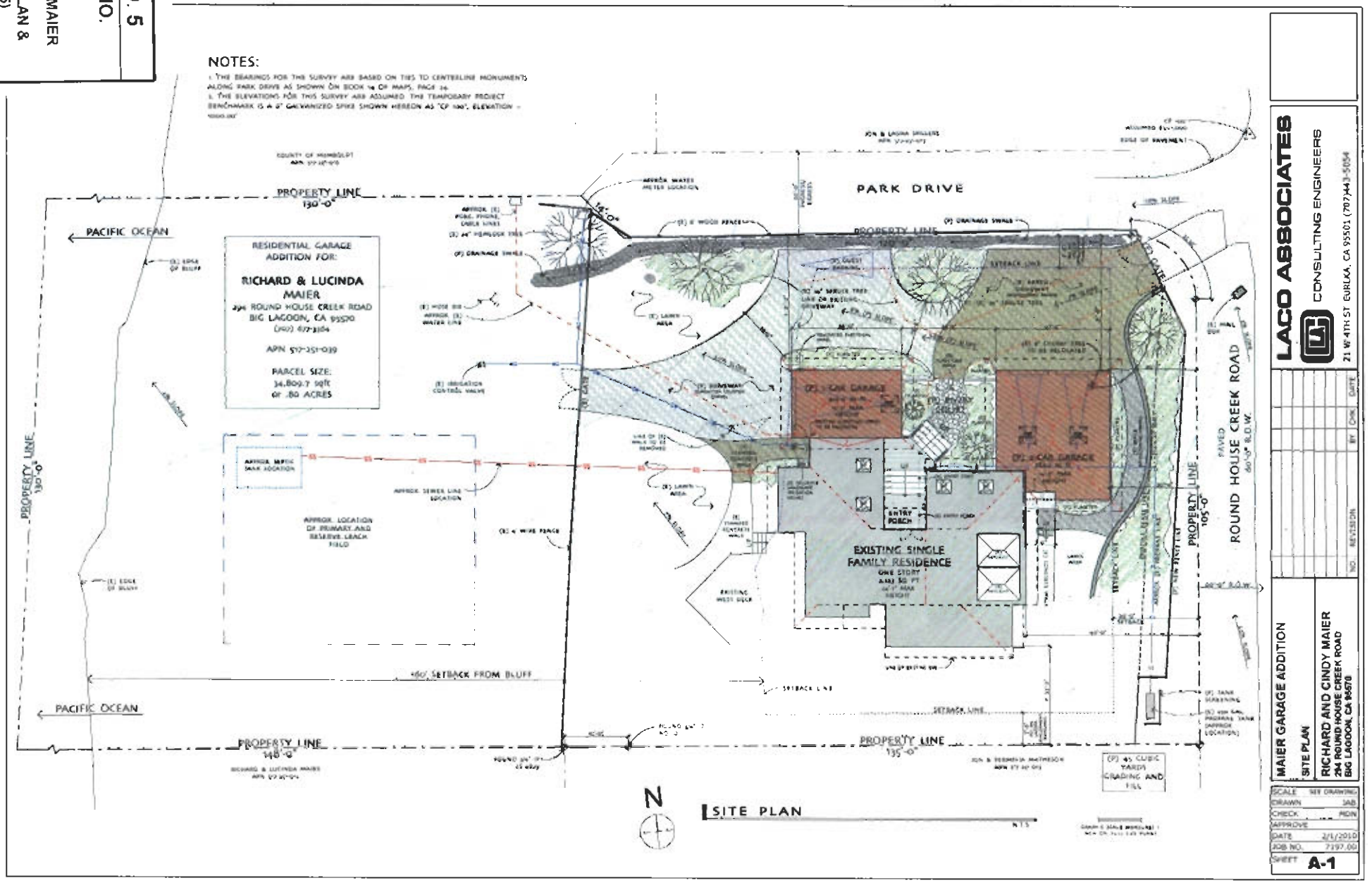
EXHIBIT NO. 5

APPLICATION NO.

1-10-010

RICHARD & CINDY MAIER

PROPOSED SITE PLAN & ELEVATIONS (1 of 5)



NORTH ELEVATION

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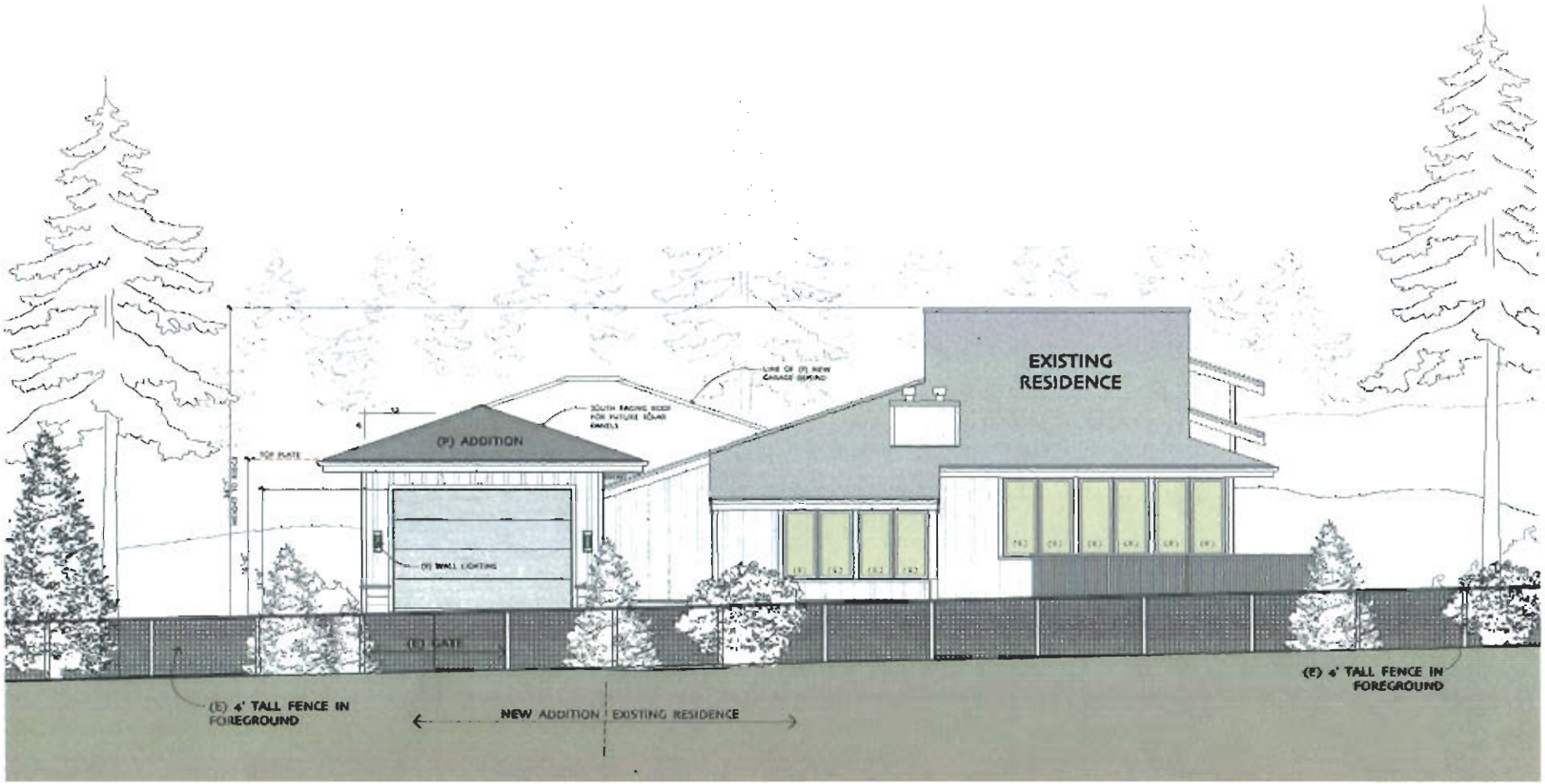

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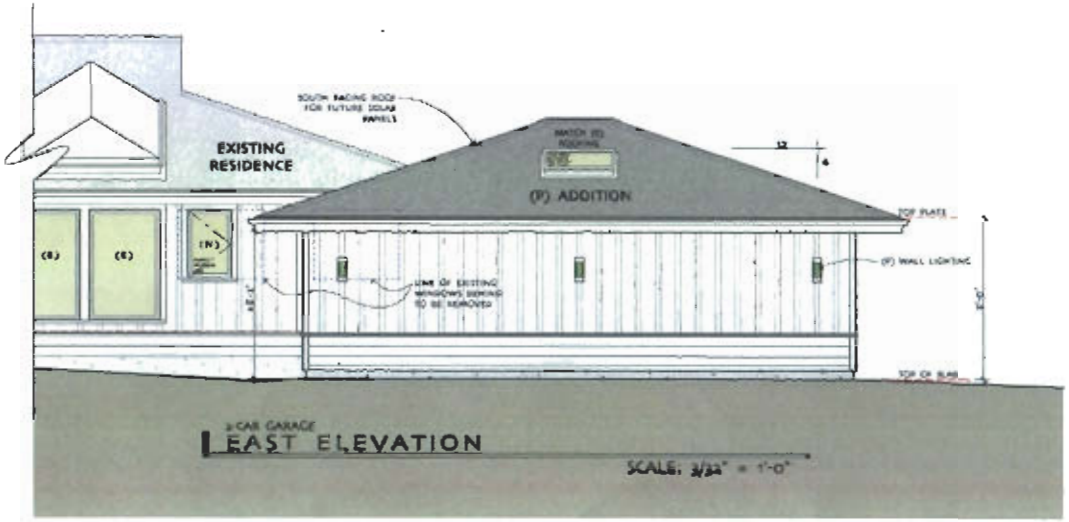
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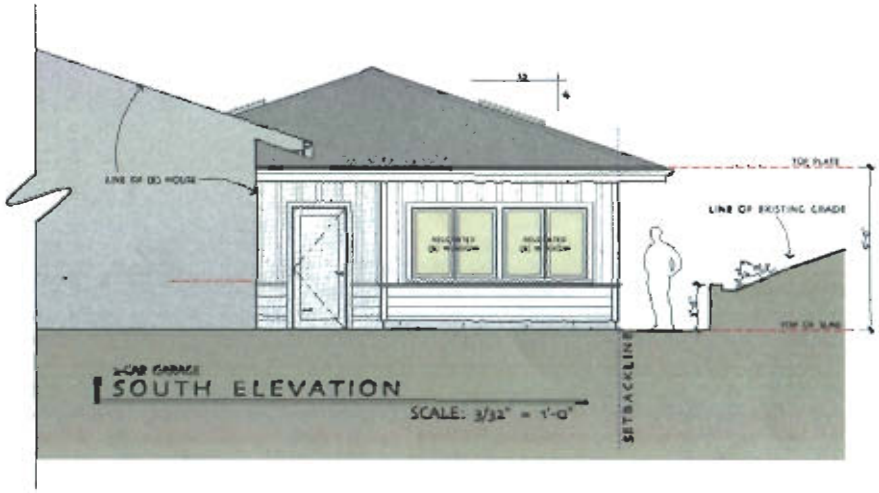
(E)
(E)
(N)
(P) WALL LIGHTING
TOP PLATE
TOP OF SLAB
2-CAR GARAGE
EAST ELEVATION
SCALE: 3/32" = 1'-0"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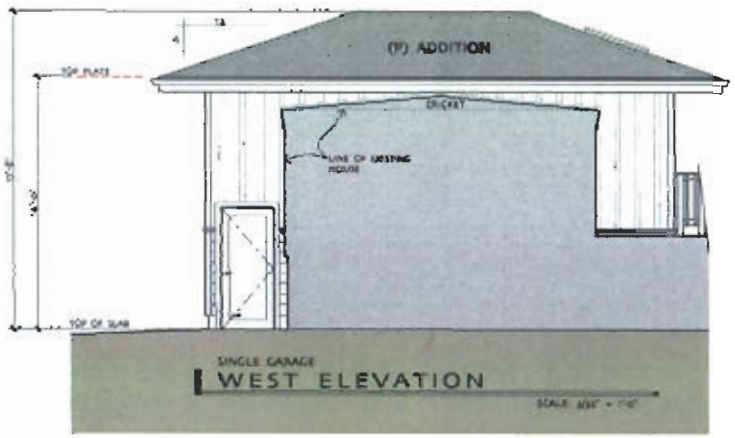
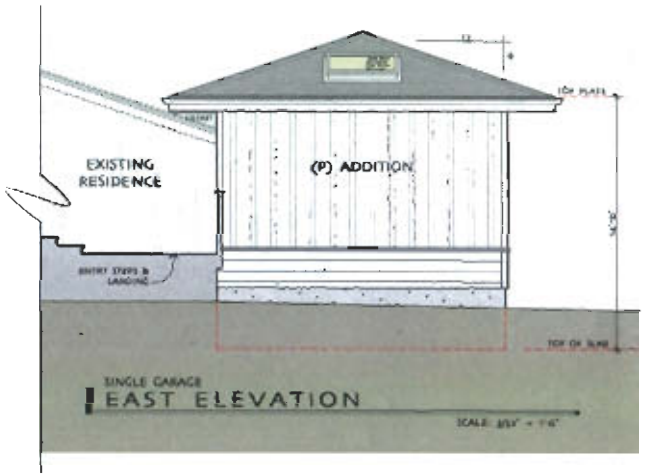
TOP PLATE
LINE OF EXISTING GRADE
TOP OF SLAB
SETBACKLINE
2-CAR GARAGE
SOUTH ELEVATION
SCALE: 3/32" = 1'-0"

E 3 5


(P) ADDITION
TOP PLATE
TOP OF SLAB
SINGLE GARAGE
WEST ELEVATION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RESIDENCE
(P) ADDITION
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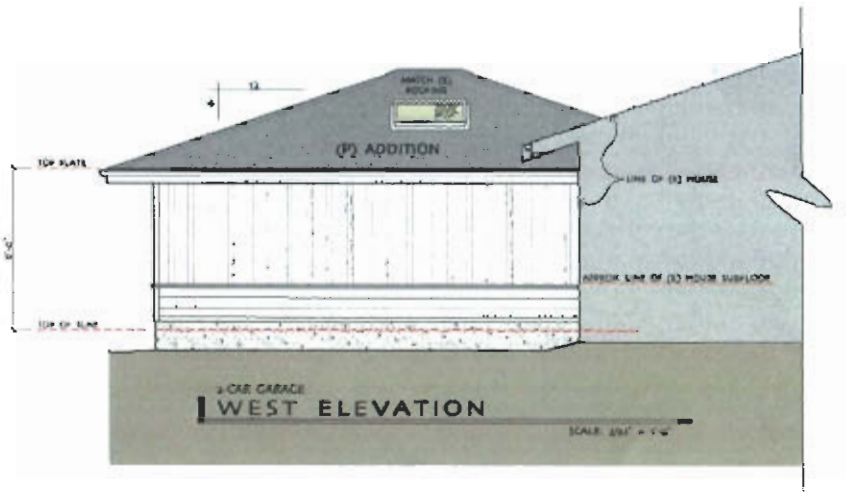
EAST ELEVATION


(P) ADDITION
TOP PLATE
TOP OF SLAB
2-CAR GARAGE
WEST ELEVATION

5 of 5

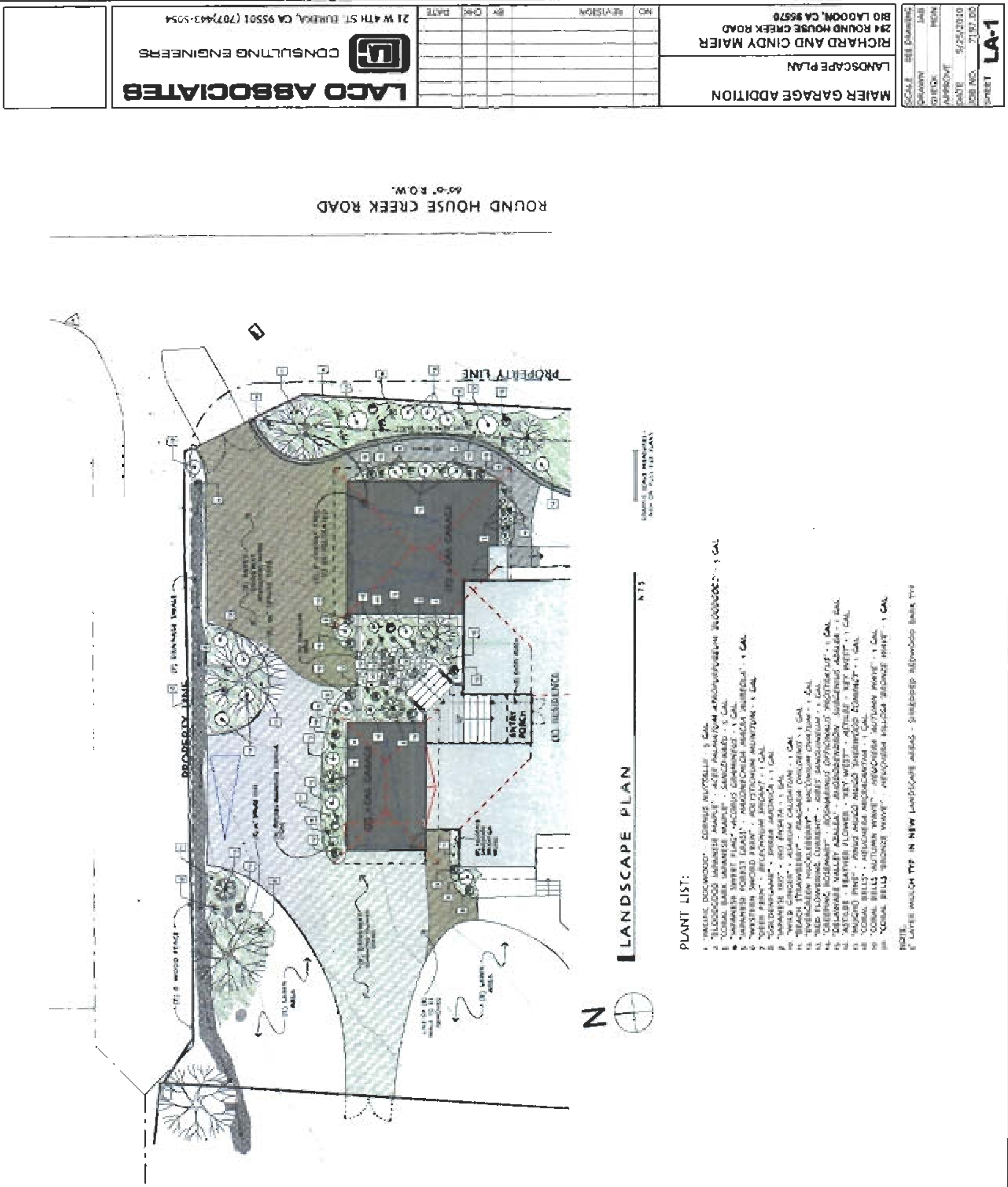


EXHIBIT NO. 6

APPLICATION NO.

1-10-010

RICHARD & CINDY MAIER

PROPOSED LANDSCAPING PLAN

ENGINEERING GEOLOGIC/FOUNDATION AND SOILS REPORT

Proposed Detached Garage Additions
294 Roundhouse Creek Road
Trinidad, California

Assessor's Parcel Number 517-251-039

Prepared for:
Dick and Cindy Maier
294 Round House Road
Big Lagoon, California 95555

EXHIBIT NO. 7
APPLICATION NO.
1-10-010
RICHARD & CINDY MAIER
GEOLOGIC REPORT FOR PROPOSED GARAGE ADDITIONS (EXCERPT) (1 of 15)

Prepared by:
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November 11, 2009
LACO Project No. 7197.00

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ENGINEERING GEOLOGIC/FOUNDATION AND SOILS REPORT

Proposed Detached Garage Additions
294 Roundhouse Creek Road, Trinidad, California
Assessor's Parcel Number 517-251-039
LACO Project Number 7197.00

1.0 INTRODUCTION

1.1 Site and Project Description

This report presents the results of a preliminary foundation and soils investigation conducted at 294 Roundhouse Creek Road in the Big Lagoon area of Trinidad, California (Figure 1). Pertinent project site location information is listed in Table 1 below. The project site is currently developed with an existing residence. Ingress and egress is from an existing driveway accessed from southeast property corner of the parcel.

TABLE 1 - PROJECT LOCATION INFORMATION

Latitude and Longitude	41.1532°N and -124.1363°W
Legal Description	NW ¼ of Section 24 Township 9N Range 1W HB&M.
Parcel Size	0.54 acres
USGS Quadrangle	Trinidad 7.5-minute topographic quadrangle.

LACO Associates (LACO) understands that the property owners propose to further develop the site with separate single-story detached garage additions. The new garages will have footprints of 24 feet by 20 feet, and 12 feet by 30 feet to accommodate two vehicles and an RV, respectively (Figure 2).

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

1.2 Scope of Work

LACO was retained to investigate and characterize the subsurface soil conditions, assess potential geologic hazards to the site, provide recommended foundation design criteria to be utilized for design and construction of the new development, and to prepare this report in accordance with Section 1802, Chapter 18 - *Foundation and Soils Investigations*, of the 2007 California Building Code (CBC), to meet the permit requirements of the County of Humboldt Division of Planning and Building. The following information, recommendations, and design criteria are presented in this report:

- Description of site terrain and local geology.
- Description of subsurface soil and groundwater conditions interpreted based on our field exploration.

- Assessment of potential earthquake-related geologic and geotechnical hazards including surface fault rupture, liquefaction, differential settlement, and site instability.
- Seismic design parameters per the applicable portions of the 2007 CBC, including soil profile type, fault classifications, and near-source factors.
- Discussion of appropriate foundation design options.
- Recommendations regarding foundation elements, including:
    - Allowable bearing pressures or capacities (dead, live, and seismic loads)
    - Estimates of settlement (total and differential)
    - Minimum foundation embedment
- Recommendations for support of slabs-on-grade.
- Recommendations for earthwork; site and subgrade preparation fill material fill placement and compaction requirements, and criteria for temporary excavation support.
- Recommendations for observation of foundation installation.
- Recommendations for construction materials testing and inspection.

Specifically excluded from our scope of work was an environmental assessment for the presence or absence of any hazardous, toxic, or corrosive materials. Although we have explored subsurface conditions as part of this investigation, we have not conducted any analytical laboratory testing of samples obtained for the presence of hazardous material.

1.3 Limitations

This report has been prepared for the exclusive use of Richard and Cindy Maier, their contractors and sub consultants, and appropriate public authorities for specific application to development of the site. LACO has endeavored to comply with the generally accepted geotechnical engineering standard of care common to the local area. LACO makes no other warranty, express or implied.

The analyses and recommendations contained in this report are based on data obtained from subsurface explorations. The methods used indicate subsurface conditions only at specific locations where samples were obtained, only at the time they were obtained, and only to the depths penetrated. Samples can not always be relied on to accurately reflect stratigraphic variations that commonly exist between sampling locations, nor do they necessarily represent conditions at any other time. Results of any analysis of samples obtained during this project will be retained on file in our office. Unless directed otherwise by our client, collected samples will be discarded after 30 days following the issuance of this report.

The recommendations included in this report are based, in part, on assumptions about subsurface conditions that may only be tested during earthwork. Accordingly, the validity of these recommendations is contingent upon LACO being retained to provide a complete professional service. LACO cannot assume responsibility or liability for the adequacy of the recommendations when they are applied in the field unless LACO is retained to observe

construction. We will discuss the extent of such observations required to provide assurance of the validity of our recommendations upon request.

Do not apply any of this report's conclusions or recommendations if the nature, design, or location of the facility is changed. If changes are contemplated, LACO should be consulted to review their impact on the applicability of the recommendations in this report. Also note that LACO is not responsible for any claims, damages, or liability associated with any other party's interpretation of the subsurface data or reuse of this report for other projects or at other locations without our express written authorization.

2.0 FIELD EXPLORATION

To assess the *in-situ* soil conditions within the proposed development areas, LACO performed an investigation of the shallow subsurface on October 9, 2009. LACO's investigation utilized hand augered test borings to visually assess the soil profile. The cuttings from the test borings were logged in the field in general accordance with ASTM D 2488 Visual-Manual Procedure. The exploration locations were sited to provide a reasonable cross-sectional view of the subsoils underlying the building footprints. Exploration locations are depicted on the Figure 2 Site Plan. Soil profile logs are included as Appendix A.

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Topography and Site Conditions

The project site is located atop a broad, uplifted marine terrace surface bordering a steep coastal bluff at an elevation of 160 feet above mean sea-level (Trinidad 7.5-minute quadrangle, 1927 North American Datum). The terrace surface slopes gently to the north at approximately 5 degrees and projects beneath Big Lagoon. The terrace surface supports a well-established upland forest comprised primarily of mature spruce and pine trees.

In plan view, the seaward edge of the marine terrace that comprises the coastal bluff is generally linear to broadly concave. Along its entire length the bluff maintains a nominal 45 degree to greater than 60 degree sloping face. The uppermost portion of the bluff face is typically near vertical to slightly overhanging. Currently, the existing residence and proposed garage footprints are setback a horizontal distance in excess of 160 feet from the slope break defining the edge of the bluff.

3.2 Geologic Setting

Field investigation indicates the project area to be underlain by uplifted and north tilted late Pleistocene marine terrace deposits. Previous geotechnical drilling investigations conducted by LACO in the Big Lagoon and Patrick's Point State Park areas indicate the Pleistocene marine terrace deposits to consist of alternating sequences of medium dense to very dense, poorly graded gravels with sands and clays, and poorly graded sands with gravel and silt. Overlying the marine terrace deposits is relatively thin (less than 8 feet thick) veneer of eolian deposits

composed of dune sand and a silt cap likely to have been deposited following uplift and emergence of the marine terrace sediments.

The beach profile from Agate Beach to Big Lagoon is characterized by a steep beach face and relatively shallow sloping berm that comprises the backshore environment. The steeply sloping beach face is a reflection of the coarse particle size being transported and deposited within the swash zone and along the beach face. A longshore bar does not appear to be present as a result of the coarse particle size. The lack of a longshore bar allows wave energy to be delivered directly to the beach face unimpeded. The entire beach system can be morphologically classified as a "reflective" beach due to its steep, linear beach faces, and well-developed beach cusps and berm. As is typical of reflective beaches, the entire beach system from Agate Beach to Big Lagoon experiences surging breakers and high run-up, resulting in episodic sea cliff erosion and bluff top retreat.

3.3 Seismicity

This project site is located within a seismically active region in which large earthquakes are expected to occur during the economic life span (50 years) of the development. North of the Mendocino triple junction, the regional tectonic framework is controlled by the Cascadia subduction zone (CSZ) wherein oceanic crust of the Juan de Fuca/Gorda plate is being actively subducted beneath the leading edge of the North American plate. The CSZ in its entirety extends from the Mendocino triple junction to British Columbia. Plate convergence along the Gorda segment of the CSZ is occurring at a rate of approximately 30 to 40 millimeters per year (mm/yr) (Heaton & Kanamori, 1984). Rupture along the entire CSZ boundary may produce an earthquake with a maximum moment magnitude (M_w) of 9.0 or greater (Satake, 2003).

Upper plate crustal deformation associated with the subduction of the Gorda plate is expressed as a 90-kilometer (km) wide fold and thrust belt that comprises the accretionary complex along the North American plate margin (Carver, 1987). Faults associated with the offshore and onshore portions of the CSZ fold and thrust belt include the Trinidad fault located within Mad River fault zone.

The project site is located on the northeast-dipping backlimb of the tectonically active Trinidad anticline as evidenced by the tilted nature of the underlying terrace deposits. The Trinidad fault is a northwest-striking, northeast-dipping; low-angle thrust fault located less than 7 miles south-southwest of the project site (Figure 3), and is recognized to be the fault responsible for the active growth of the Trinidad anticline. The offshore trace of the Trinidad fault may be as close as 4 miles to the project site. The upper bound earthquake considered likely to occur on the Trinidad fault has an estimated maximum moment magnitude (M_w) of 7.3 (ICBO-CDMG, 1998).

Based on the record of historical earthquakes (approximately 150 years), faults within the plate boundary zone and internally deforming Gorda Plate have produced numerous small-magnitude and several moderate to large (i.e. magnitude greater than 6) earthquakes affecting the local area. Several active regional seismic sources in addition to those mentioned above are proximal to the project site and have the potential to produce strong ground motions. These seismic sources include:

- The northern segment of the San Andreas transform fault that represents the boundary between the stable North American plate and the northwest-migrating Pacific plate.
- The Mendocino fault, an offshore, high-angle, east-west-trending, right-lateral strike-slip fault that forms the boundary between the Gorda and Pacific plates.
- Faults within the internally-deforming Gorda plate consisting of high-angle, northeast-trending, left-lateral, strike-slip faults.

3.4 Subsurface Conditions

The generalized stratigraphy underlying the project site within the upper 8-feet of the soil profile consists of landscape fill, underlain by Pleistocene aged marine terrace deposits consisting predominantly of silt, silty sand, and poorly graded sand. The following soil types were encountered in borings HB-1 and HB-2:

- Between 0 and 1 foot: Landscape fill consisting of imported topsoil, the upper 3-feet.
- Between 1 to 3 feet: Organic-rich, dark brown, soft, low dry strength silt (ML) that comprises the remaining in-place native topsoil.
- Between 3 to 5 feet: Medium dense, weakly cemented with medium dry strength, yellowish brown, silty sand (SM) to clayey sand (SC).
- Between 5 to 8 feet: Medium dense, weakly to moderately cemented with medium to high dry strength, yellowish brown, poorly graded sand with silt (SP).

A summary of the generalized soil types and their relative consistency underlying the project site is presented in the table below.

TABLE 2 – SOIL PROFILE SUMMARY

Depth (feet bgs)	Primary Soil Type(s)	Consistency[1]
0-1	Landscape Fill	soft/---
1-3	ML (native topsoil)	soft/---
3-5	SM/SC	---/medium dense
5-8	SP	---/medium dense

Note: (1) consistency of cohesive materials/consistency of non-cohesive materials

Detailed descriptions of the subsurface stratigraphy encountered during drilling are provided in the Geotechnical Hand Auger Boring Logs (Appendix A).

3.5 Groundwater Conditions

At the time of our field investigation in the location of our borings, no groundwater was encountered to a depth of 8-feet below ground surface (bgs). In addition, no soil mottling, indicative of seasonal high groundwater elevations, was observed to this depth. Groundwater levels may fluctuate with seasonal climatic variations and changes in land use. However, groundwater is not expected to be encountered during earthwork on the project site. Provided our recommendations are adhered to, high groundwater conditions are not anticipated to have an adverse affect on foundation construction or performance.

4.0 GEOLOGIC HAZARDS

Potential geologic hazards assessed for the site include seismic ground shaking, surface fault rupture, liquefaction and related phenomena, settlement, slope instability, flooding and high groundwater, and swelling or shrinking soils. The assessments for these potential hazards are presented below.

4.1 Seismic Ground Shaking

As noted in Section 3.3, the project site is situated within a seismically active area proximal to multiple seismic sources capable of generating moderate to strong ground motions. Given the proximity of multiple active seismic sources (the Trinidad fault and Mad River fault zone to the south, and the Cascadia subduction zone offshore), as well as other active faults within and offshore of northern California, there is high probability that the project site will experience strong ground shaking during the economic life span of the proposed development.

The spectral response accelerations prescribed by the 2007 CBC as related to seismic analysis and design of the proposed structure are presented in Section 6.5.

4.2 Surface Fault Rupture

The on-land portion of the Trinidad fault is reportedly located less than 7 miles southwest of the project site (Figure 3), and is the closest recognized active fault (CDMG, 1983 and 2000). The subject parcel, however, is not located within an Alquist-Priolo earthquake fault zone. Therefore, based on the information available, the potential for surface fault rupture to occur at the project site is considered negligible.

4.3 Liquefaction

Liquefaction is a soil behavior phenomenon in which soil strength is rapidly decreased due to high excess pore-water pressure generated by strong earthquake ground motions. Geologically young and relatively unconsolidated granular soils and artificial fills located below the groundwater surface are susceptible to liquefaction (Youd and Perkins, 1978). Relatively clean, loose, uniformly graded sand and non-plastic silts are typically most susceptible to liquefaction.

Bluff exposures indicate the depth to groundwater to be in excess of 50 feet bgs. Based on the age and density of the subsoils exposed in the bluff face, and projected to underlie the site, the hazard due to potential soil liquefaction is considered low. Additionally, as presented on Map S-3 of Special Publication 115 (CDMG, 1995), the project site is not located in an area with a liquefaction potential

4.4 Settlement

The foundation bearing subsoils beginning at 3-feet below existing grade consist of medium dense, consolidated granular soils and are relatively uniform across the site. Provided the subgrade is adequately prepared, and load bearing structural elements are founded on these uniform materials beginning at 3-feet below existing grade, the risk of differential and total settlement is low and is not anticipated to adversely affect the structures.

4.5 Site Instability/Landsliding

Lateral spreading consisting of the lateral displacement of surficial soil, is usually associated with liquefaction of underlying soils where slope free faces are present. The nearest slope free face is located approximately 160 feet to the west of the proposed garage building footprint, consisting of the coastal bluff. Because the potential liquefaction hazard at the site is considered to be low, we anticipate the potential for lateral spreading to occur and to affect the structures also to be low.

Events of the recent past indicate the coastal bluffs bordering the project site to be susceptible to episodic, large-scale slope instability in which tens of feet of bluff top retreat can occur instantaneously. Slope failure along the entire coastal bluff typically occurs in the form of toppling block failures with near vertical failure planes that result from undermining of the toe of the sea cliff during high storm surf events. Bluff retreat is characterized by sudden and catastrophic slope failure that involves the entire bluff as opposed to gradual "grain to grain" erosion and retreat. Bluff retreat has been observed to be temporal in nature due to external factors associated with El Niño-Southern Oscillation events such as those which occurred during the winter of 1997/1998.

Evidence of historic slope failure and coastal bluff retreat is observable along the entire coastal bluff from Agate Beach to Big Lagoon. This section of coastal bluff has a higher potential for slope failure, in general, than many areas of Humboldt County due to (among other factors) the over-steepened sea cliff and easily erodible marine terrace deposits, high annual precipitation, and direct exposure to northwest winter swells coupled with a steep wave slope. An additional contributing factor is the lack of an offshore bar which would otherwise dissipate wave energy prior to reaching the shoreline.

Previous slope stability investigations conducted by Busch Geotechnical Consultants (Busch, 2003) for this project site recommended a minimum bluff top setback of 160 feet. At that time the residence was removed from its original building site and relocated to the east, and placed on a new permanent foundation at the recommended setback distance. The setback recommended by Busch took into consideration an average erosion rate (bluff face retreat rate) of 1.0 feet per year for the 75-year design life of the structure, in conjunction with a factor of safety against landsliding. The 160-foot setback was approved by the California Coastal Commission at that time. Therefore, we have no additional recommendations provided the new garage does not encroach within the 160-foot setback.

4.6 Soil Swelling or Shrinkage Potential

The subsurface soils at structural load bearing depths consist primarily of granular soils composed of silty sand to poorly graded sand with silt. Therefore, the potential for soil swelling or shrinkage typically associated with fine-grained, residual soils is considered low.

5.0 CONCLUSIONS AND DISCUSSION

Based on the results of our investigation, it is our opinion that the project site is suitable for its proposed use. The new structures will neither contribute to nor be subject to potential geologic hazards.

The proposed structures can be supported on a shallow foundation system that consists of a reinforced concrete floor slab with thickened edges or with a continuous concrete perimeter foundation in combination with a slab-on-grade. Any foundation type utilized should be supported on the undisturbed, medium dense granular soils beginning at not less than 3-feet below existing grade.

6.0 RECOMMENDATIONS

6.1 Site Preparation

All earthwork, including, but not limited to, site clearing, grubbing, and stripping should be conducted in such a manner so as to limit rutting and mixing of disturbed surficial soils with the underlying bearing soils.

All construction areas should be cleared of construction debris, sod, undocumented fill, and native topsoil, and any other debris encountered at or below the existing ground surface.

Any holes created by the grubbing process in areas that will receive fill, will support a foundation, or are at or near final grade should be backfilled with engineered fill as described in Sections 6.3 and 6.4.

6.2 Cut and Fill Slopes

There is currently no development plan requiring significant unrestrained cut or fill slopes. In the event that unrestrained cut and/or fill slopes with heights in excess of 3-feet are required, they should be constructed in accordance with the Humboldt County Grading Ordinance, and Chapter 33 and Appendix J of the 2007 CBC.

6.3 Fill Materials

Aggregate Base

Imported aggregate base material may be used for pavement subgrade, placed beneath footings or floor slabs, or used as trench backfill. This material should meet the requirements in the Caltrans Standard Specifications, Class 2 Aggregate Base (3/4-inch maximum particle size).

Select Fill

Select fill should consist of imported granular material that may be used as non-expansive fill beneath floor slabs and for the upper portion of the pavement subgrade, if any. Select fill should be a soil/rock mixture free of organic material and other deleterious material. The select fill material should contain low plasticity clay, well-graded sand, and/or gravel. The material should contain no rocks larger than 3 inches in greatest dimension, nor more than 15 percent larger than 2 inches. Additionally, the material should meet the following specifications:

Plasticity index:	<12
Liquid Limit:	<30
Percent passing No. 200 sieve:	50 maximum, 5 minimum

Structural fill on sloping ground with a gradient in excess of 4H:1V should be placed on a suitably prepared "benched" subgrade surface and should be compacted mechanically to minimize potential settlement.

6.4 Compaction Standard

Structural fill and backfill material shall be compacted in accordance with the specifications listed in the table below. The material should be placed in horizontal lifts that do not exceed 8 inches in uncompacted thickness. A qualified field technician should be present to observe fill placement and 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.

TABLE 3 – STRUCTURAL FILL PLACEMENT SPECIFICATIONS

Fill Placement Location	Compaction Recommendation (ASTM D1557-Standard Proctor)	Moisture Content (Percent Optimum)
Granular cushion beneath Floor Slab	90%	**-1 to +3 percent**
Structural fill supporting Footings	90%	**-1 to +3 percent**
Structural fill placed within 5-feet beyond the perimeter of the building pad	90%	**-1 to +3 percent**
Roadway fill placed within 2-feet of the base of the Pavement	95%	**-1 to +3 percent**
Utility trenches within building and pavement areas	95%	**-1 to +3 percent**
Utility trenches beneath landscape areas	90%	**-1 to +3 percent**

6.5 Seismic Design Parameters

Based on the site conditions and an assumption of the soils within 100-feet of the ground surface, we classify the site as Site Class D consisting of a "stiff soil profile" (Section 1613.5.2, 2007 CBC). The following parameters are based on this classification and were determined using ASCE Standard 7-05, Minimum design loads for buildings and other structures (USGS, 2009).

TABLE 4 - SPECTRAL RESPONSE ACCELERATIONS

Site Location - Latitude: 41.1532° and Longitude: -124.1363°		
Occupancy Category - II		
Seismic Design Category - E		
Spectral Response Accelerations (Based on F_a=1.0, F_v=1.5):		
Site Class D		
S_{MS},	0.2	**2.559**
S_{M1}	1.0	**1.730**
S_{DS}	0.2	**1.706**
S_{D1}	1.0	**1.153**

6.6 Foundation Design

6.6.1 Discussion

A specific foundation plan has not been provided to LACO. The following foundation recommendations assume two single-story, detached garages will be constructed on this site. In our opinion, the proposed structures can be supported on a shallow foundation system that consists of a reinforced concrete floor slab with thickened edges or with a continuous concrete perimeter foundation with slab-on-grade.

All structural load bearing footings should bear on undisturbed competent native granular soils beginning at not less than 3 feet below existing grade. Alternatively, footings may bear on compacted select structural fill placed on the aforementioned competent native soils. The reinforced concrete slab should be supported on a structural fill.

The structural fill supporting the reinforced floor slab should consist of at least 8-inches of compacted fill consisting of Class 2 Aggregate Base (per Caltrans) or select fill. The fill material should be compacted in lifts not exceeding 8 inches in uncompacted thickness. To minimize the potential for moisture transmission through the floor slab, the slab should be underlain by a vapor retarder consisting of an impermeable membrane at least 6 mils thick. The membrane should be covered by a minimum 2-inch thick layer of moistened (not saturated) sand to both protect the membrane and to promote proper concrete curing. A 1-inch thick layer of sand should be placed beneath the membrane to provide a uniform surface on which it is to be placed. The difference, if any, between the 8-inches of structural fill under the floor slab and the depth to undisturbed competent native soil should be made up with additional engineered fill.

6.6.2 Floor Slab Subgrade Preparation

To create a suitable subgrade for a floor slab, all of the existing landscape fill shall be removed and replaced with structural fill. Prior to placing the structural fill beneath the concrete floor slab, compact the exposed surface of the exposed subgrade to a minimum of 90 percent of the maximum dry density as determined by ASTM D1557. The moisture content should also be controlled to 0 to +3 percent of optimum. The compacted soil subgrade should not be allowed to dry excessively, nor be excessively wet before the structural fill is placed.

If soft-soil areas are encountered, which can not be adequately compacted in place, these soils should be removed and replaced with compacted engineered fill material placed in accordance with the "Structural Fill" section of this report, or concrete slurry. Prepared subgrade should be protected from drying or excessive moisture.

6.6.3 Allowable Soil Bearing Pressures

All load-bearing foundation elements founded on the undisturbed competent native granular soils described in this report should be designed with an allowable foundation bearing pressure of 2,000 psf, for dead load and long-term live load. An increase of one-third is permitted (in Section 1605.3.2, 2007 CBC) when using alternate load combinations that include wind or earthquake loads.

At minimum, all footings should be designed and sized in accordance with the 2007 CBC. Where necessary, lateral soil pressures and sliding resistance shall be based on the more conservative of an engineering analysis performed to the standard of care or values presented in the 2007 CBC.

6.7 Drainage

The finished floor elevation must be high enough to provide positive drainage with a minimum gradient of three percent for a distance of 10-feet away from the foundations. Also, the grading and landscaping should be designed to minimize the potential for water to migrate beneath any structure. Runoff from hardscaped areas, roofs, patios, and other impermeable surfaces should be contained, controlled and collected, and tight-lined to a suitable discharge point. Energy dissipaters should be placed at outlet points to minimize the potential for soil erosion to occur.

6.8 Additional Services

The conclusions and recommendations provided in this report are based on the assumption that soil conditions encountered during grading and/or foundation construction will be essentially as exposed during our evaluation, and that the general nature of the grading and use of the property will be as described above. At the election of the project site owner/builder, LACO can be retained for the following services:

- Monitor site grading and inspect exposed subgrade prior to placement of structural fills
- Inspect foundation excavations prior to placement of any forms or reinforcing steel
- Monitor the placement of structural fill
- Test all structural fill to verify the required relative compaction is achieved

7.0 REFERENCES

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8.0 LIST OF FIGURES AND APPENDICES

Figure 1: Location Map
Figure 2: Site Plan
Figure 3: Earthquake Fault Hazard Zones Map

Appendix A: Soil Profile Logs

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October 6, 2003

BUSCH GEOTECHNICAL CONSULTANTS

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Recommended Setback for the Rohner Bluff-top Home Based on an Erosion-Rate Analysis and Factor-of-Safety Considerations, 294 Roundhouse Creek Road, Big Lagoon Park Subdivision, Humboldt County, California [APNs 517-251-14 and 517-251-15]

EXECUTIVE SUMMARY

This report provides a setback for the Rohner home based on a methodology approved by the California Coastal Commission (CCC). The report characterizes the geologic site conditions, provides a preliminary factor of safety analysis of the bluff, and provides information about long term and short term erosion rates at the site. The report also discusses the probable economic lifespan of the home after relocation. **The report recommends a setback of 160 feet based on an average long-term erosion rate of 1.0 ft/yr applied for 75 years, a 76-ft setback attributable to Factor-of-Safety calculations, and an additional 9 ft for prudence.**

Ultimately, this report was necessary because the Rohner home currently is ~44 ft east of the top of a 126-ft-high bluff composed of erodible late Pleistocene sediments. A recent (winter 1997-98) episode of bluff retreat removed up to ~40 ft of bluff from the southwestern edge of the property (and the adjacent lot to the south), putting the home at an increased level of risk of damage by the next episode of rapid-rate retreat. Of his own volition, the owner decided to relocate the home to the east. This report facilitates that move by providing required geotechnical information.

INTRODUCTION

Contract Information, Site Location, and Purpose of the Report

We are delivering this document under the terms of BGC contract #03-053 dated 8/21/03. The report provides geologic information about erosion rates, bluff-failure modes, and levels of risk associated with the relocation of the home.

Mr. Rohner owns three lots located in the Big Lagoon Park Subdivision in northern Humboldt County. This area is about 6.5 miles north of Trinidad. All three lots are in the southern part of the subdivision, west of Roundhouse Creek Road (see Figure 1). Two are bluff-top lots. The home sits on one.

The properties are Lots 12, 14, and 15 of the subdivision, respectively Humboldt County APNs 517-215-12, 517-251-14, and 517-251-15 (see Figure 2). Lots 12 and 15 are the bluff-top lots and Lot 14 is the lot onto which the home would be moved. The focus of this report is Lots 14 and 15; we do not address Lot 12 at all, other than to mention a stratigraphic feature on it. The Rohner home, a single-story wood-frame single-family residence on a concrete-block perimeter foundation, sits on Lot 15. Mr. Rohner proposes to merge Lots 14 and 15 and move the home east onto former Lot 14 . **At its closest, the relocated home will be 160 ft from the location of the top-of-bluff at the time we completed this report.**

The ultimate purpose of this report is to provide a setback for the home based on a methodology approved by the California Coastal Commission (CCC). To do this we characterize the geologic site conditions, provide a preliminary factor-of-safety analysis of the bluff, and provide information about long term and short term erosion rates at the site. We also discuss the probable economic lifespan of the home after relocation. **Although two previous geologic reports have been prepared for the site (SHN, 2003a, b), this report is self-contained. It presents all of the geologic information necessary for the CCC to make a determination.**

Figure 1. Nested Site Location Map. The topographic map is a portion of the USGS Trinidad 7.5' quadrangle map. Various scales.

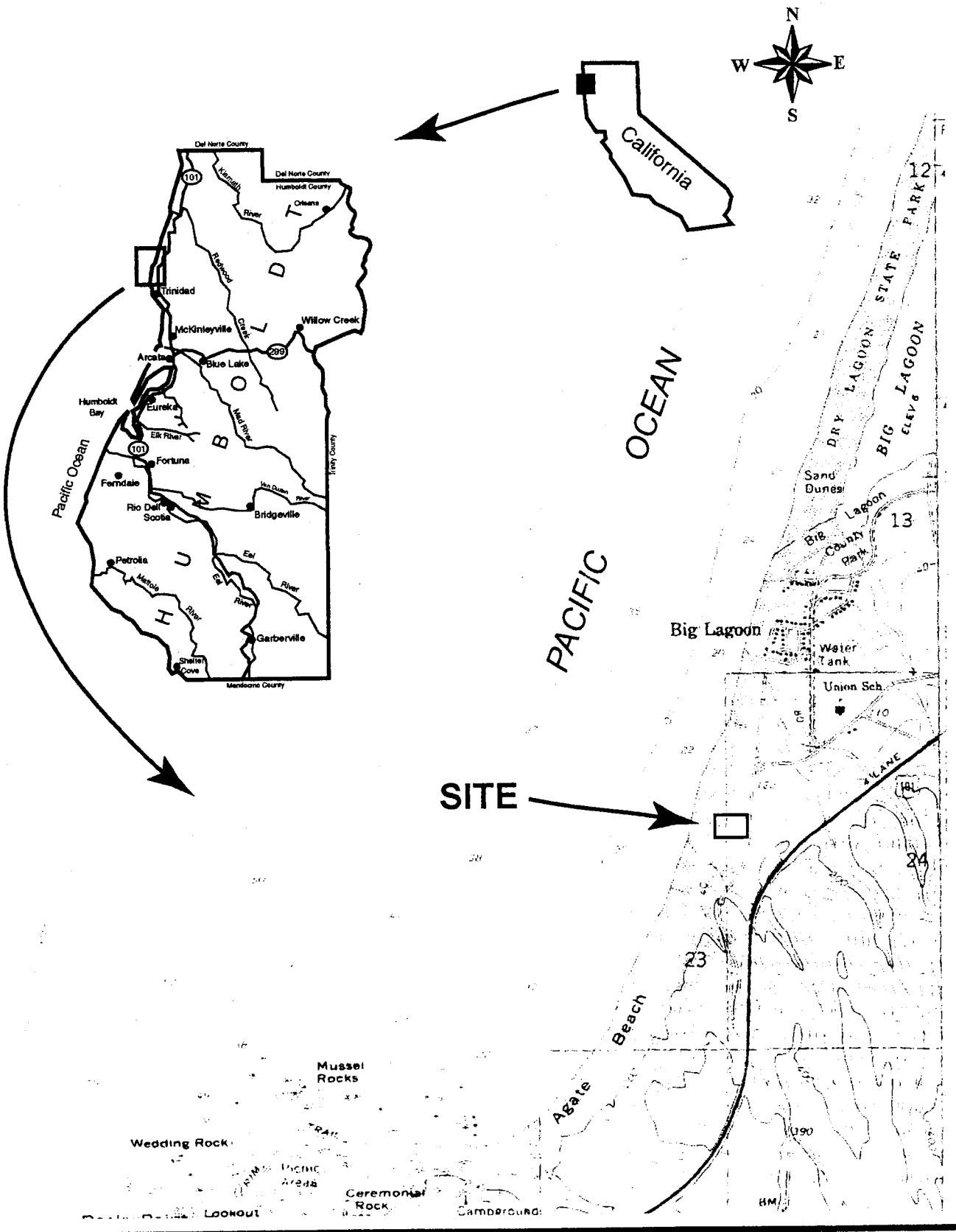
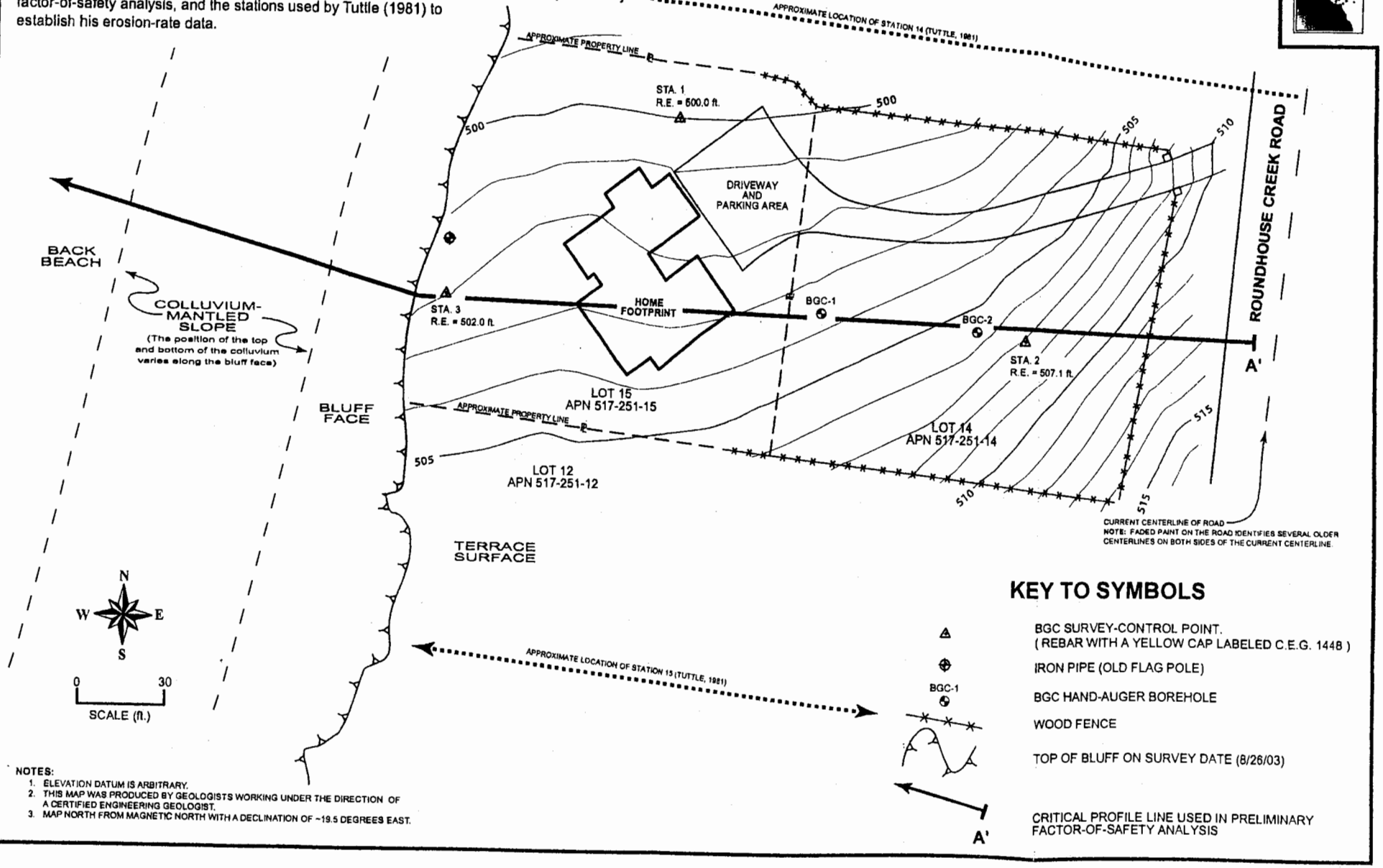


Figure 2. Survey-controlled topographic map showing the present location of the Rohner home, the edge of the bluff on 8/26/03, the critical profile used in our preliminary factor-of-safety analysis, and the stations used by Tuttle (1981) to establish his erosion-rate data.



NOTES:
1. ELEVATION DATUM IS ARBITRARY.
2. THIS MAP WAS PRODUCED BY GEOLOGISTS WORKING UNDER THE DIRECTION OF A CERTIFIED ENGINEERING GEOLOGIST.
3. MAP NORTH FROM MAGNETIC NORTH WITH A DECLINATION OF ~19.5 DEGREES EAST.

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Scope of Work and Methods

Generally speaking, and to simplify somewhat, our scope-of-work called for us to calculate historic short-term erosion rates and a long-term erosion rate of the Rohner homesite property; to predict a future erosion rate; to complete a quantitative slope stability analysis based on measured and assumed site-specific conditions; to provide an overall risk assessment; and to recommend a minimum setback for the Rohner home based on our work. Specific tasks in our scope-of-work included:

- Reviewing pertinent professional literature, consultant's reports, maps, and stereographic pairs of air photos;
- Making a survey-controlled topographic base map of the lot on which the Rohner home currently sits and of the contiguous lot onto which it will be moved;
- Making a survey-controlled critical profile of the bluff face on the lot;
- Characterizing the stratigraphy of the site by describing the bluff face and selecting appropriate soil parameters for the various identified lithostratigraphic units;
- Characterizing the geology of the site;
- Completing a preliminary mathematical ("Factor-of-Safety") analysis of the bluff and identifying the location of the $FOS_s = 1.5$ line on the critical profile and the project base map;
- Using a hand-auger to explore, describe, and sample shallow soils in the proposed relocation area in case a foundation-soils report was needed by either the California Coastal Commission or Humboldt County;
- Testing selected representative shallow soil samples for that soils report;
- Providing erosion rate information and a recommended setback based on the long-term erosion rate and the preliminary FOS calculations;
- Providing a risk assessment for the proposed home relocation area;
- Interacting with the client, his representatives, and key staff of involved regulatory agencies (notably, Mark Johnsson of the California Coastal Commission); and
- Providing this report.

On August 20th, 2003, our principal, Bob Busch, C.E.G., made a reconnaissance-level inspection of the site with Staff Engineering Geologist Bryan Dussell. Bob and Bryan returned to the site on August 26th with BGC Staff Geologist Beau Whitney to make a detailed inspection of the lot and bluff-face (as possible); profile the bluff face using a total station; hand-auger exploration holes in the proposed home relocation area; take field notes and documentary digital photographs; and collect representative soil samples of the shallow soils for use in a possible foundation-soils report.

We use standard practices and professional standards of care for all of our geotechnical studies, and we follow American Society of Testing and Materials (ASTM) procedures for all sampling and lab testing. We also follow the recommendations provided by Southern California Earthquake Center (SCEC) for implementation of DMG Special Publication 117 (SCEC, 2002). For this job, to determine site-specific erosion rates and to recommend a setback, we followed the methods described in Johnsson (in press). This report contains field and lab data, the results of a preliminary factor-of-safety (FOS) analysis, a summary of observations and conclusions, and a hazard and risk assessment.

We surveyed the site and profile using a Sokkia Set 3A Total Station and SDR 33 Data Recorder. In the office we finished CADD work on the map and profile.

To measure the position of the bluff top on the aerial photographs we used a Xerox machine capable of incremental (percent-by-percent) enlargements to enlarge each photograph about 400%. On the ground we measured the length of a specific feature that is present on all photographs (a field in a park), then we used that measurement to determine the exact scale of the enlargement. The field is less than 100 ft lower in elevation that the Rohner site, so the scales of the two areas are within 1% of each other (Avery, 1968). We worked in stereo with the original photographs to locate the exact position of the top edge of the bluff, then we measured the distance from the centerline of Roundhouse Creek Road to the edge-of-bluff on the enlargement. Using this methodology, we can measure the centerline-to-bluff distance to an accuracy of + / - about 11 feet. Although we can measure a distance to within 1/60th of an inch (equivalent to +/- ~5 to 6 ft at the enlarged scale of most of the photos), an additional error of up to ~5 ft is introduced by the historic variability of the position of the road centerline stripe. At present there are at least five centerline stripes on the road at the entrance to the Rohner driveway. The difference between the two outside lines is about five feet. Additional discussion follows.

ENGINEERING GEOLOGY OF THE SITE

Site Geology

The Big Lagoon Subdivision was built on an uplifted marine terrace, the 83,000-year-old Savage Creek terrace (Carver and Burke, 1992). The western, seaward edge of the terrace ends at the Pacific Ocean. Over time, the ocean has eroded into the terrace and created a bluff-backed shoreline. Along its entire length the bluff maintains a nominal >60° face with a near-vertical to slightly overhanging top. In map view the edge of the bluff is surprisingly linear, trending about N15°E. It does not contain deep cusps or "bites" caused by recent large bluff failures, and our review of aerial photographs dating back to 1942 indicates that it never has. We estimate that the deepest failure since 1942 bit back no more than ~40 ft into the top-of-bluff. The next two deepest failures removed no more than ~20 ft.

The site is located at the northern edge of the Mad River fault zone (MRfz) of Carver et al. (1982). The MRfz is the onland portion of the Cascadia fault and fold belt (ibid.). Compressional tectonics in the belt formed the Big Lagoon fault (at the north side of Big Lagoon about 4.2 mi north of the Rohner lots) and the Trinidad fault (which passes out to sea about 6 miles south of the site), and they tilted the terrace to the north (Carver, 1987). As a result of this dip, the bluff height varies from ~175 ft at Patrick's Point State Park about 5100 ft south of the site, to zero at the south edge of Big Lagoon where the terrace surface dives beneath the water. At the Rohner site, the top of the bluff is ~126 ft above the back-beach.

Along the western edge of the subdivision, erodible marine terrace sediments back up the beach. Franciscan Complex bedrock, which is exposed in the headlands of Patrick's Park State Park and on the north side of the Big Lagoon fault, does <u>not</u> outcrop at the base of the bluff in the subdivision. Here the beach is unprotected by offshore rocks or a nearby headland, so whenever winter storm waves strip the sand from the beach, the base of the bluffs—whether talus or in-situ soil units—begins to erode. At times the result is rapid-rate erosion of the bluff (e.g., Tuttle, 1981).

Based on their characteristics, the sediments at the site—technically, poorly consolidated rocks, can be placed into four main units (our soil units 2 through 5 of Figures 3 and 4). These units are capped by a dark brown eolian topsoil ~2 ft thick (not shown on Figure 4). For our FOS analysis we grouped the beach sand and colluvium mantling the base of the bluff into soil unit 1.

The uppermost soil unit (soil unit 2) is a loose, yellow-brown to olive-brown silty fine sand (USCS, SM) of probable eolian origin. This unit is ~20 ft thick at the face of the bluff and ~12 ft thick at borehole BGC-1 some 140 ft back of the bluff edge. Along most of the bluff face, this unit maintains a near vertical face.

Soil unit 3 is a coarse grained deposit (USCS, SW-GW). This unit is composed of alternating beds of pebble conglomerate, pebbly sandstone, and sandstone. Beds vary in thickness from a few inches to a few feet. The pebbles are well-graded subangular to well-rounded (mostly well-rounded) clasts derived from Franciscan Complex sites and reworked older marine terraces. The beds vary in thickness laterally and are a crudely fining upward sequence. Sub-horizontal bands of iron and manganese cementation of variable thickness are common throughout this unit.

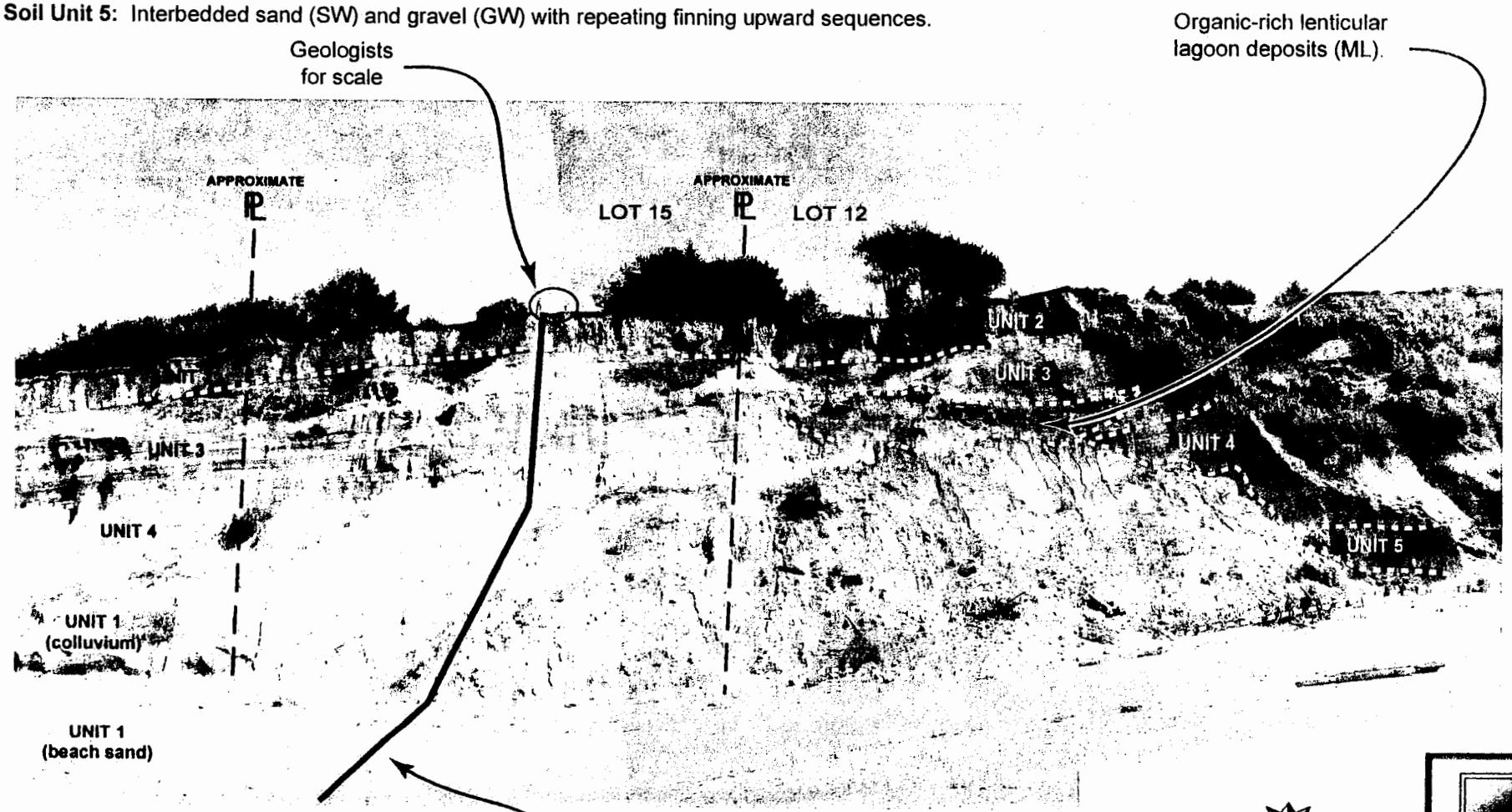
Soil unit 4 is a medium dense, poorly graded, fine- to medium-sand ~45 ft thick (USCS, SP). The sand is slightly coarser than the sand in soil unit 3. The grains are subangular to subrounded. Low-angle cross-bedding is visible throughout the unit.

Soil unit 5 is covered with talus across most of the site. We described the unit from a small exposure immediately south of the site (see Figure 3). There, the unit is composed of alternating poorly graded sands with interlayer pebble conglomerate beds. This unit is composed of numerous fining-upward sequences.

Immediately south of the property line within the upper part of soil unit 3 is a localized organic-rich deposit. Here, the conglomerate and sandstone beds of soil unit 3 change laterally into a dark brown to black clayey silt. The silt deposit is strongly lenticular and contains woody debris including seemingly in-place root masses. This deposit represents an isolated shallow-water, low-energy estuarine or lagoonal facies. This silt was wet at the time of our investigation. This fine-grained layer impedes the downward percolation of groundwater, so springs, seeps, groundwater staining, and small soil pipes (open voids) are common in the bluff face just above these layers. Perhaps coincidentally—and perhaps not—this area is the approximate axis of the largest recent failure on the entire bluff face.

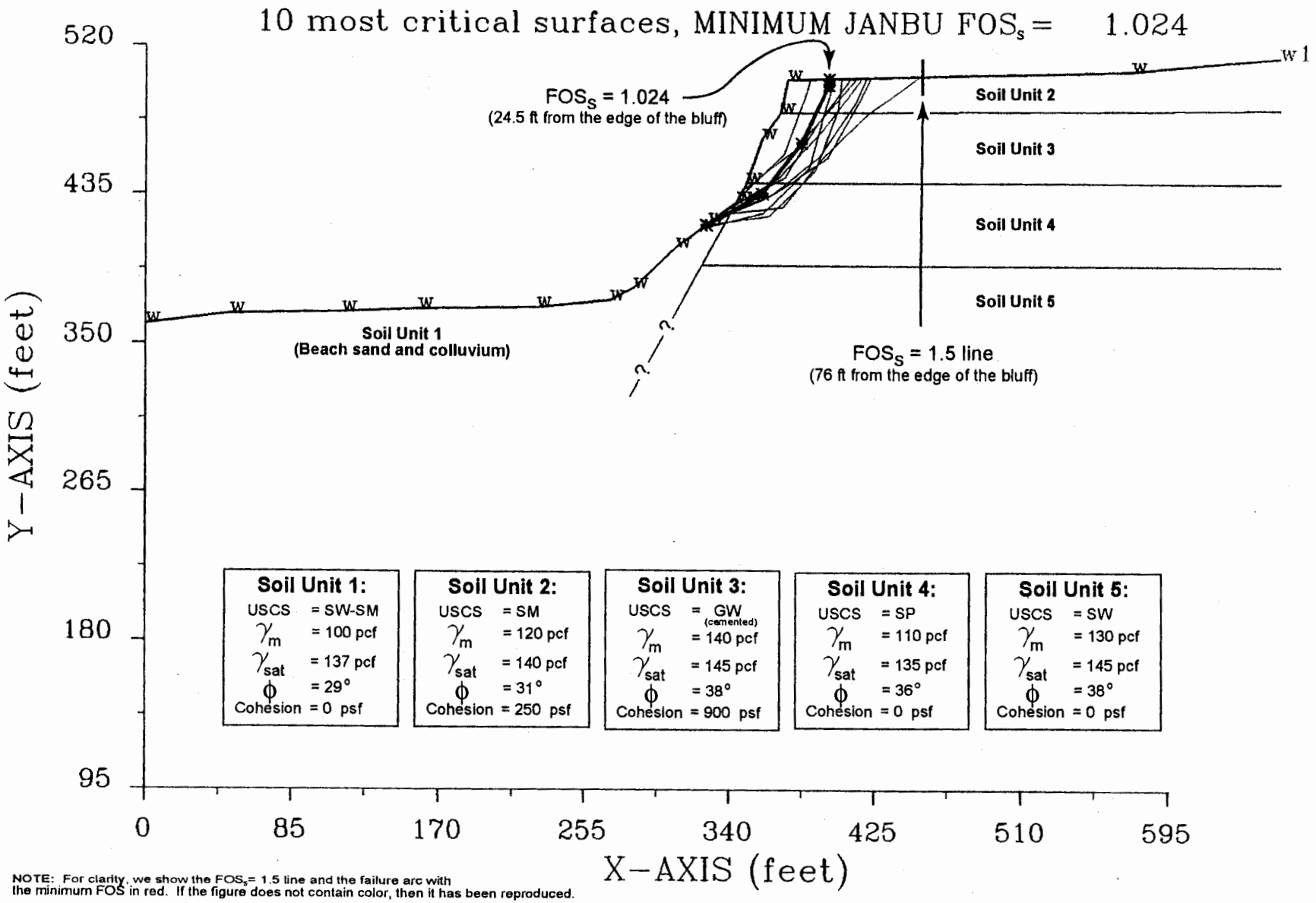
Figure 3. Photograph of the bluff face on the Rohner property on 8/26/03 showing the five soil units used in the preliminary factor of safety analysis, and the profile line. Note the two geologist at the top of the bluff for scale.

Soil Unit 1: Bluff colluvium and beach.
Soil Unit 2: Eolian sand (SM) with a topsoil cap (ML).
Soil Unit 3: Interbedded sand (SW) and gravel (GW) with iron and magnesium cementation.
Soil Unit 4: Cross-bedded sand (SP).
Soil Unit 5: Interbedded sand (SW) and gravel (GW) with repeating finning upward sequences.



NOTE: This figure contains color for clarity. If the figure does not contain color, then it has been reproduced.

Figure 4. Critical profile of the bluff. See Figures 2 and 3 for the profile location on the Rohner property. All soil parameters assumed. See text for discussion.



NOTE: For clarity, we show the FOS$_s$= 1.5 line and the failure arc with the minimum FOS in red. If the figure does not contain color, then it has been reproduced.

Aalto (1989) describes these soil units as part of the "upper Agate Beach deposit". Excluding the capping unit (soil unit 2), he interprets all of these deposits as records of storm events in a high-energy shallow-water environment. Near the Park stairway to Agate Beach, the upper Agate Beach unit is ~30 m thick. To the north the unit thickens to ~300 m (ibid.).

Seismic Hazard

Coastal northern California is located within an active tectonic regime. The most likely source of an earthquake that could affect this site is the southern part of the offshore Gorda plate. The predicted peak ground acceleration of the design basis earthquake (DBE) for the area is 0.64 g (USGS, 2003).

The Big Lagoon area is located within the Mad River fault zone, sandwiched between two active regionally significant thrust faults, the Big Lagoon fault about 4.2 miles north of the site and the Trinidad fault about 5.5 miles away to the south. Both faults dip to the northeast. The slip plane of the Trinidad fault passes beneath the Rohner site at depth. The recurrence interval of individual faults within the Mad River fault zone is two thousand years or less (Petersen et al., 1996). The date of the last rupture of either of these faults is unknown.

Work by geoscientists has demonstrated that great (M_w 8.0 to 9.0) earthquakes have occurred in the coastal Pacific Northwest in the recent past, and that the potential for similar earthquakes to occur is HIGH within the next 200 years. These earthquakes occur along the dipping interface between the oceanic Juan de Fuca plate and the continental North America plate. Plate tectonic processes are causing the Juan de Fuca plate to subduct (dive down) beneath the North America plate, so it underlies North America, beginning at the base of the continental slope, which is offshore. This tectonic interface, which is called the Cascadia subduction zone or Csz, last ruptured early in the evening on January 26, 1700 (Satake et al., 1996). The most recent work suggests that recurrence interval of great Csz earthquakes is 480-535 yrs (Kelsey and others, 2002). Previously it was thought to be ~300 to 500+ years (Clarke and Carver, 1992). A Csz event would cause a regional catastrophe in the Pacific Northwest. Prior to the publication of Kelsey and others, 2002, the probability of a Csz event was thought to be 10% to 20% within the next 50 years (Geomatrix, 1995). Seismogenic failures of the bluff strand would occur during a Cascadia event.

Bluff Failure Processes, Global Warming, and Geodesy

In the Big Lagoon area, bluff failures are caused primarily by marine undercutting of the base of the erodible marine terrace sediments. As the base of the bluff erodes to an over-steepened slope angle (~70° to near-vertical), the sediments fail as planar slides, debris slides, and "flake" failures of coherent blocks of sediment. Over time these failures cause the top-of-bluff to "backwaste" or "erode back."

In the Pacific Northwest in general, and in the Big Lagoon area in particular, undercutting by winter waves historically has caused dramatic, rapid, episodic shoreline retreat, especially during and following strong El Nino years. An El Nino is a climatic perturbation that effects the entire Pacific Ocean basin and the surrounding land masses. A strongly negative value of the June-November Southern Oscillation Index [SOI] is used to classify a year as a strong El Nino year (per the logic of Redmond and Koch, 1991). Typically, strong storms occur during an "El Nino winter." Based on the SOI, an El Nino winter occurred in 1940-41, 1941-42, 1946-47, 1951-52, 1965-66, 1972-73, 1977-78, 1982-83, 1987-88, 1993-94, 1994-1995, and 1997-98 (WRCC, 2003). Ranked by their SOI, the El Ninos of 1982-83 (-2.42), 1940 (-1.80), 1941 (-1.73), 1997 (-1.67), 1965 (-1.58), and 1977 (-1.52) were the strongest (ibid.). Of these, the Pacific Northwest was most affected by the 1982-83 event, which Quinn et al. (1987) classify as a very strong El Nino. Very strong El Ninos have an average recurrence interval of ~50 years, but a range of 13 to 150 years (ibid.). The previous very strong El Nino occurred in 1925-26 (ibid.).

In the Pacific Northwest, coastal erosion typically is greater (more rapid, more significant) during strong El Ninos because the winter water height is higher than average, large storms tend to be more frequent, and storm swells tend to be larger. In addition, wave trains may arrive from a different direction than usual. During an El Nino winter, after a few weeks of exceptionally adverse wave and current conditions, most of the sands and fine gravels on an affected beach have been moved offshore into deeper-than-usual water. When the protective beach is gone, marine undercutting of the base of the bluff begins, followed by rapid-rate bluff back-wasting. Furthermore, erosion remains more rapid afterwards, at least at sites where erodible bluffs have lost their beach, until the beach profile approaches its "normal" configuration. Unfortunately, the transport of the sand farther offshore prevents the sand from returning to the beach the following summer. As a result of the interaction of these complex factors, at least

three of the five past strong El Ninos (1940-41, 1941-42, and 1997-98) have triggered an episode of rapid-rate bluff erosion in the Big Lagoon area (conclusion based on aerial photo research and review of reports including Tuttle, 1981; Falls, 1998; BGC, 1998; SHN, 1998; SHN, 2003a, b). Surprisingly, the 1982-83 "Very Strong El Nino" winter did not trigger a significant episode of erosion at the Rohner site.

When El Nino winter waves and the associated longshore currents redistribute beach sands, a multi-year episode of sea cliff erosion begins and does not abate until a beach is present again. This phenomenon was wide-spread in the Pacific Northwest following the 1982-83 El Nino (Komar, 1986; Tuttle, 1987; Peterson et al., 1990).

In addition, groundwater emerging from the bluff face can cause subsurface erosion and bluff instability. This process causes certain areas of the bluff top to experience larger-than-typical failures. Localized saturation, higher porewater pressures, and associated groundwater affects collectively may have been the cause of the recent failure at the south edge of the property (above the silt bed within soil unit 3).

Until recently, eustatic sea level rise has been cited as 1.8 +/- 0.2 mm/yr (Douglas, 1991). However, this rate may be accelerating. The "best midrange estimate" of the Intergovernmental Panel on Climate Change (IPCC, 2001) is that eustatic sea level will rise 50 cm over the next century, or 5.0 mm/yr. In Oregon, where the beaches have been studied in greater detail than in northern Humboldt County, many beaches have a 50:1 (H:V) slope (Peterson et al., 1991). Theoretically, and with other things held equal, a 2 mm rise of sea level each year could lead to a long-term retreat rate of an erodible bluff of ~10 cm/yr (3.9" or 0.33 ft/yr); a 5 mm rise could trigger a retreat of ~25 cm (9.9" or 0.8 ft/yr).

Despite the high potential for retreat, many Oregon bluffs show little or no retreat over a 50-year time span, probably because roughly equivalent tectonic uplift is occurring (Peterson et al., 1992). A similar situation exists for some Humboldt County and Del Norte County beaches. That is, tectonic uplift roughly offsets global sea level rise by raising the land at about the same rate as sea level is rising. The current estimate is that the Big Lagoon area is rising about 4 mm/yr (Mitchell et al., 1994).

Although it is an ominous situation that sea level is rising, and that the rate of rise is increasing, episodic bluff erosion presents a greater hazard to the Rohner property than does inundation.

Summary of Air Photo Observations

(All measurement distances are +/- ~11 ft; see following discussion)

A large reentrant (for this coastal strand) was present just south of the Rohner property from prior to 1942 through 1948. When it formed, the failure "bit" at least 50 ft out of the bluff top. (The failure might have occurred as one large failure, but more probably it happened as a series of small failures.) In the 1942, photos waves are lapping up against the base of the bluff. (Recall that successive strong El Ninos struck the Pacific Northwest and affected the Big Lagoon area during the winters of 1940-41 and 1941-42. The winter storms would have removed most—if not all—of the beach and triggered rapid-rate erosion.) By 1948, a narrow beach is present at the base of the bluff. (In the Big Lagoon area, even large storm waves cannot reach the base-of-bluff when a beach is present. The beach must be almost completed eroded away before marine undercutting of the base of the bluff can begin.)

In the 1954 and 1958 photos a wide beach is present at the base of the bluff, so the bluff is protected from wave erosion. Thick vegetation blankets the bluff face.

By 1962, the trees and brush on the terrace surface had been cleared and the infrastructure for this part of the subdivision had been started. The top of the bluff just north of the Rohner site is bare and has a jagged appearance from recent small bluff failures. None of the failures appears to have removed more than 10 or 20 ft from the edge of the bluff.

By 1966, the access driveways for the lots in this part of the subdivision had been established. Bare soil is exposed across the entire bluff face, perhaps due to the 1965-66 El Nino winter. Despite the bluff failures, the edge-of-bluff is linear. Only one failure has removed a significant "bite" from the top of the bluff. This failure is located west of the intersection of Roundhouse Creek Road and Park Drive, but it does not appear to be a "typical" bluff failure. It is tear-drop shaped (the bulb end is in the bluff face), extends at least 100 ft into the bluff, and has a northwest-southeast trend (it is not perpendicular to the bluff face). A large alluvial fan is present on the beach at the outlet of the "tear drop." We suspect that this feature is the result of surface erosion of the bluff top and face caused by the heavy winter rains of December, 1964. We surmise that run-off captured by newly constructed Roundhouse Creek Road and part of the recently cleared terrace surface spilled over the edge of the bluff here and gullied it severely.

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By 1970, homes had been constructed on the east side of Roundhouse Creek Road. Most of the bluff face was bare and a road had been built through the center of the tear-drop-shaped feature present in 1966. Near the center of the Rohner property, a failure ~80 ft long had bit back into the bluff edge ~20 ft.

The 1974 and 1981 photos record a period of relative stability of the bluff top and face. On both photos, vegetation covers most of the bluff face. Home construction has continued in the subdivision on both sides of Roundhouse Creek Road.

In 1982, the upper part of the bluff face once again is mostly devoid of vegetation and has a jagged appearance. As in the 1962 and 1966 photos, the bluff face is linear and does not contain any significant reentrants.

Home construction continued in the subdivision through 1988. Several homes, including the Rohner home, are visible on the west side of Roundhouse Creek Road. A small cuspate notch is barely visible west of the home. The cusp appears to have removed less than ~20' of the bluff edge.

The favorable scale of the 1996 photos permits a more accurate interpretation of detail. The cusp west of the Rohner home is still visible as a ~20 ft deep "bite." The south edge of the cusp merges into a narrow "peninsula" in the bluff top. The peninsula failed during the most recent (1997-98) bluff failure.

To recap and summarize, the edge of the bluff south of Big Lagoon has remained essentially linear, trending ~N15°E, through the ~60 years of photos we reviewed. The largest bluff failure we observed "bit" into the bluff edge no more than ~40 ft (+/- ~11 ft), and failures <20 ft in depth (+/- ~11 ft) appear to be the characteristic failure size. (The larger-than-typical feature visible in the 1966 photos is a gully system related to surface runoff following road construction).

Erosion Rates

In 1981, Don Tuttle of the Humboldt County Department of Public Works (now retired) compiled coastal bluff erosion data for much of the Humboldt County coastline (Tuttle, 1981). His data was based on historic photographs, aerial photographs, maps, survey notes, highway plans, historical letters and journals, archaeological reports, and interviews with long-time residents.

In the Big Lagoon area, Tuttle established numerous stations to measure bluff retreat on air photos taken between 1941 and 1974. He cross-checked his measurements using various other sources of data. Tuttle's stations 14 and 15 flank the north and south sides of the Rohner property, respectively (see Figures 2 and 6). At both stations he measured the distance from the top-of-bluff to the centerline of Roundhouse Creek Road.

In a nutshell, Tuttle found that the bluffs near Big Lagoon had retreated from 40 to 100 ft in the 50 years preceding his report (1981). Since then, retreat has continued in the same type of punctuated equilibrium that he recorded: decade-long periods of essentially no erosion have been broken by episodes of rapid erosion, the most recent occurring in response to the El Nino winter of 1997-98 (Tuttle, 2003, personal commun.).

Tuttle's data for 1941 to 1974 indicate that the bluff retreat rate near the Rohner site (stations 14 and 15) averages ~1.5 ft/yr. However, the next stations to the south (stations 16a and 16b) recorded a bluff retreat rate of 2.1 ft/yr and 2.7 ft/yr, respectively. The highest bluff retreat rate recorded was 4.6 ft/yr at station 18 (~900 ft south of the Rohner property). Tuttle's work indicates that by 1974, erosion had removed about one third of the depth of Lot 12, and half of the depth of the adjacent lot to the north (Lot 16). Since 1974, seemingly only a few feet of erosion have occurred there (Tuttle, 2003, personal commun.).

For this project, we expanded on Tuttle's work by reviewing additional sets of aerial photographs. Our goal was to use the photos to attempt to quantify bluff retreat rates during specific time intervals per the methodology of Johnsson (in press), and to provide additional data for the time between 1974 and today. We gathered all stereo pairs of aerial photographs that were readily available from Humboldt County (the Department of Natural Resources) and the State (the California Geological Survey, Eureka office). The photos were taken in 1942, 1948, 1954, 1958, 1962, 1966, 1970, 1974, 1981, 1982, 1984, 1988, 1996, and 2000. We then measured the distance from the centerline of Roundhouse Creek Road, through the center of Lots 14 and 15, to the top of the bluff. We also measured the length of an object visible on all photographs (a field bordered by roads). We used the length of the field, which is at the same approximate elevation as the Rohner site, to determine the actual scale of each photo. We did this for the photo at the original scale and as enlarged ~400% (see Table 1).

Standard textbooks (e.g., Avery, 1968) indicate that the mensuration of objects using aerial photographs is accurate only within limits. However, the degree of uncertainty can be quantified. To estimate the error on this job, we compared our

measurement of the distance from the centerline of Roundhouse Creek Road to the top-of-bluff on the 1974 and 1981 photographs with the distance shown on the survey-controlled project base map (Van Fleet, 1976). In each case, our measurement was greater than the distance as recorded on the map. We used the discrepancy (11 ft) to establish an error bar (+/- 11 ft.) around our measurements from the aerial photographs (Figure 5). On the Rohner site, our accuracy was limited by several factors:

1) **Scale limitations and variations:** Before enlargement, the scale of the air photos ranges from 1"=2,500' (1:30,000) to 1"=614' (1:7,368). After enlargement, the scale ranges from 1"=700' (1:8,400 to 1"=150' (1:1,800). On the 1:30,000-scale photographs, trying to measure 5 ft of bluff retreat requires measuring to an accuracy of two thousandths of an inch. Our best ruler is accurate only to 1/60th of an inch. In addition, the field we used to scale the photos is about 100 ft lower in elevation than the Rohner site. This change in elevation alters a 1:12,000 scale to 1:11,800 or 1:12,200, depending on which of these elevations the scaling targets were located (Avery, 1968).
2) **Variable position of the road centerline:** The location of the centerline of Roundhouse Creek Road has varied over time. Today, multiple painted centerlines are present on the road, and the location of the line varies by up to ~5 ft at the Rohner driveway.
3) **Reproduction distortion:** Even on an excellent Xerox machine, enlarging a photo might introduce distortion of 1 or 2% in at least one dimension. Because the field we used to scale the photos is not next to the Rohner properties, the two objects may have been distorted unequally.

The measurements made by Tuttle (1981) were subject to the same types of intrinsic inaccuracies. For example, Tuttle's measurement of the position of the bluff edge was accurate for the south side the Rohner property, but there is a ~19 ft discrepancy on the north side of the property. We determined this by comparing his data to the survey-controlled Rohner site map (Van Fleet, 1976) (see Figure 6).

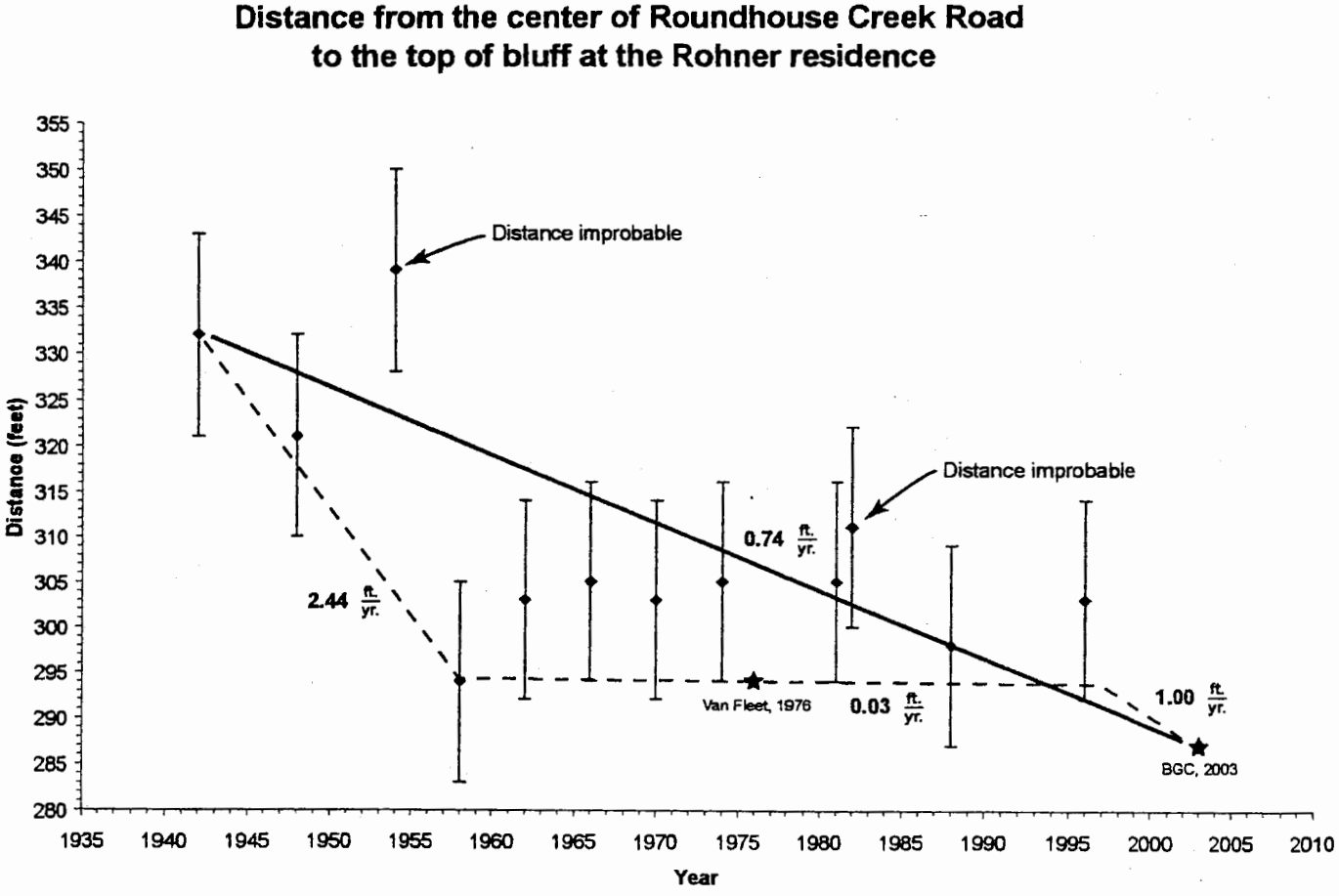
Applying a uniform error bar (+/- 11 ft.) to our data points (Figure 5), we drew "best fit lines" through the data field to estimate various possible "short term" erosion rates. We calculated the "long term" erosion rate for the site using the two end member data points (1942, 2003). Our estimates of the "short-term" erosion rates are 2.44 ft/yr between ~1942 and ~1958; 0.03 ft/yr from ~1958 through ~1997; and ~1.00 ft/yr from ~1997 through the present (2003). 17 of 39

Table 1. Bluff retreat data for the Rohner property.

Year	Distance from the centerline of Roundhouse Creek Road to the top edge of the bluff (in ft) through the center of the Rohner properties.	Source of measurement	Scale 1"=original/enlarged
2003	287	Map	30'
1996	303	Air photo	1,001'/275'
1988	298	Air photo	2,502'/345'
1982	311	Air photo	614'/321'
1981	305	Air photo	1,844'/323'
1976	294	Map	10'
1974	305	Air photo	973'/300'
1970	303	Air photo	973'/292'
1966	305	Air photo	1,030'/300'
1962	303	Air photo	947'/300'
1958	294	Air photo	1,001'/309'
1954	339	Air photo	1,523'/292'
1948	321	Air photo	1,592'/305'
1942	332	Air photo	1,668'/306'

Maps = Van Fleet, 1976; BGC, this report (Figure 6).

Figure 5. Graph showing the distance from the center of Roundhouse Creek Road to the top edge of the bluff seaward of the Rohner home. All distances were measured through the center of the Lots 14 and 15 (Profile A-A' of Figure 2). See text for discussion.



Distance measured from aerial photographs.
The vertical lines are a nominal error bar associated with the measurement (+/- 11 ft).
Statistical analysis would be necessary for each flight year to determine the actual error.

★ Data point measured from a survey-controlled map.

0.74 ft./yr. Long-term erosion rate (1942-2003).

2.44 ft./yr. Short-term erosion rates (1942-1958; 1958-1997; 1997-2003).

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Although the calculated "long term" erosion rate (1942-2003) is 0.74 ft/yr, our recommended minimum setback distance is based on an erosion rate of 1.00 ft/yr (see **RECOMMENDATIONS**). Although 1.0 ft/yr is less than the rate Tuttle recorded for the general site vicinity based on the period 1941-1975, we believe it is appropriate to use because: it is conservative rather than liberal; it is based on 61 years (Tuttle's was based on ~34 years); and the bluff face currently is "unstable."

In summary, our work confirms that bluff erosion has been episodic and unpredictable in the strand of bluffs south of Big Lagoon. At the Rohner property, a significant episode of retreat began during the winter of 1940-41, and rapid-rate erosion apparently continued until about 1958. Then, the bluff remained relatively stable until late in the winter of 1997-1998, even though the coastline was subjected to numerous El Ninos, including the very strong El Nino of 1982-1983.

Although the intrinsic error associated with measuring the bluff position using air photos makes it nearly impossible to document small-scale (10-ft-deep) bluff failures with a high degree of confidence, the photos do allow a qualitative evaluation of the condition of the bluff. That is, we can see changes in vegetation on bluff face so can recognize periods of relative stability and instability of the bluff face and top.

Quantitative Slope Stability Assessment

Introduction

Previously, SHN Consulting Engineers and Geologist Inc. provided a geologic evaluation of the site (SHN, 2003a). That report did not include elements considered necessary by the California Coastal Commission. Specifically, the report did not include a "factor-of-safety" (FOS) analysis or detailed erosion rate information for the site*. Ultimately, that is why this report was necessary.

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*The SHN report also included factual errors, including the statement that the Rohner home had been condemned, when, in fact, it was neither "red-tagged" nor "yellow-tagged" [Binder, 2003, personal communication]. A subsequent report [SHN, 2003b] provided limited erosion rate data and a rationale for not performing a FOS analysis. Interestingly, the report authors argued that the profile used in any FOS analysis would be only a "snapshot" of the "dynamic, ever-changing environment," yet their Figure 2 shows identical conceptualized profiles for 1941, 1962, 1974, and 2003. That figure supports our thesis, not theirs: although the bluff face is a dynamic environment, an equilibrium profile develops on a bluff as a function of the rock or sediment types, their strength characteristics, and the unit geometries. As long as these factors remain relatively constant, the established profile maintains itself as the bluff backwastes over time. Consequently, a FOS analysis of a bluff is useful for an analysis of the bluff over time.

Description of Our FOS Model

The bluff on the Rohner property is ~126 ft high. The upper 19 ft is near-vertical. Below that, the slope of the face averages ~70°. A pile of talus estimated to be up to ~40 ft thick rests against the lower 55 ft of the face (see Figure 4).

To evaluate the level of risk the bluff might pose to the relocated Rohner home, we completed a preliminary quantitative slope stability analysis of a slope profile (Figure 4). Our analysis is "preliminary" because a "final" analysis, if required, must be done by an engineer registered in California. The purpose of a preliminary analysis is to determine whether or not the stability conditions are so marginal that a final analysis is required. A preliminary analysis often uses assumed soil parameters whereas a final analysis often uses site-specific parameters derived from appropriately tested soil samples. Conditions are not marginal on the Rohner site, so a final analysis is unnecessary.

The mathematical analysis, which is called a "factor-of-safety" (FOS) analysis, assesses the stability of a slope by comparing the forces resisting failure to the forces driving failure. In a stable slope, the forces resisting failure exceed the driving forces, so the FOS is > 1.0. When the two forces are equal, the FOS = 1.0 and slope failure is imminent. The greater the FOS, the greater the stability of the slope. We used the modified Janbu method, the computer program XSTABL, version 4.0, and a 5-layer model. Based on our understanding of the site, we divided the bluff into five separate soil units and modeled the characteristics of each. To model extreme winter conditions, we saturated the soil profile to the surface, providing a "worst-case" scenario for the site. However, because the granular soils and free face facilitate drainage, it is improbable that the soils within many tens of feet of the face of the bluff could ever become saturated. Consequently, the FOS generated by our model is conservative (is lower that the true FOS, which would be determined by setting the groundwater table at the winter high level determined by over-winter groundwater monitoring).

The minimum allowable value for the static factor-of-safety (FOSs) of a slope depends on the following (Duncan and Buchignani, 1975; SCEC, 2002):

(1) The degree of uncertainty in the shear strength measurements, slope geometry, and other conditions;

(2) The cost of flattening or lowering the slope to make it more stable;

(3) The cost and consequence of a slope failure; and

(4) Whether the slope is temporary (e.g., a construction cutbank) or permanent.

Typical practice is to recommend that the minimum static stability of an area of concern be FOS_s = 1.2 (Fang and Mikroudis, 1991) to 1.25 (Duncan and Buchignani, 1975), or greater (ibid.; Huang, 1983; SCEC, 2002; Johnsson, in press). The better the soil stratigraphy and strength data are known, the lower the FOS_s can be because there is greater certainty in the "truthfulness" of the FOS analysis.

To model the Rohner bluff we broke out and described various soil units exposed in the bluff face, then picked appropriate assumed soil parameters based in part on a nearby study (LACO, 2002), in part on our understanding of similar late Pleistocene marine terrace deposits we have studied elsewhere in Humboldt County (e.g., BGC, 1996a,b,c,d), and in part on published literature (Hunt, 1984). We ran reiterative analyses using different soil parameters until we were able to model a failure of approximately the same size ("bite back" depth) as the largest failure we observed on any aerial photograph.

In summary, our FOS work attempts to model the largest failures that occurred in the bluff during the past ~60 years. Our model is conservative because we set the groundwater table at the surface, a situation that cannot happen because of the steep bluff face and free-draining natural of the sediments.

Conclusions from Preliminary FOS Analysis

Figure 4 graphically present the results of our preliminary FOS analysis of the critical profile using the slope geometry, stratigraphy, and water table shown on the figure. The soil parameters we used are listed on the figure. We do not show or discuss constraints (such as failure segment length) that we used. The figure illustrates the 10 most probable failure surfaces for the conditions evaluated; the

failure surface with the asterisks is the surface with the lowest FOS. We did multiple other "runs" to model slightly different soil parameters and conditions. We selected this analysis as most representative of the site conditions as we understand them.

Our analysis suggests that the minimum static FOS for the critical profile is FOS_s = 1.02, and that the dynamic FOS for the same profile during the design basis earthquake (DBE) is FOS_d = 0.84. **The results of our preliminary FOS analysis indicate that the outermost ~24 ft of the edge of the bluff are Provisionally Stable. In plain English, the bluff edge is marginally stable. This is consistent with our air photo review of ~3200 linear ft of the Big Lagoon coastal strand bluff. None of the photos showed a failure that removed more than ~40 ft of bluff.**

Setback Philosophies and The Concept of Economic Lifespan

(Excerpted and edited from prior BGC reports)

To provide an oceanside setback distance for new construction or the relocation of an existing home, a consultant—at minimum—must specify a project lifespan (usually 75 years on the California coast), a known long-term average rate or a more conservative "predicted" rate (in feet or inches per year), and "an acceptable level of risk" (usually stated subjectively as LOW, MODERATE, or HIGH). The "acceptable level of risk" usually is specified is LOW, meaning that the probability of loss is low enough that "a prudent person of average economic means" would accept the risk (i.e., would buy or build the home) (see Appendix IV). Sometimes a MODERATE level of risk is acceptable, for example, when the owner is of above average economic means and can afford to repair or move a structure or other improvement. Even a HIGH level of risk might be acceptable to an owner, as long as the hazard is the destruction of personal property, <u>not</u> injury or loss of life. Thus building on or near a slow-moving landslide that could destroy the home might be acceptable, but building on or near a site that could suffer a nearly instantaneous, catastrophic failure <u>never</u> is.

In Oregon, a setback determined using the preceding approach usually is acceptable. However, on the California coast, a "minimum setback" generally is the sum of three components: (1) the erosion-rate component, (2) a component determined by calculating the location of the FOS_s = 1.5 line based on a critical

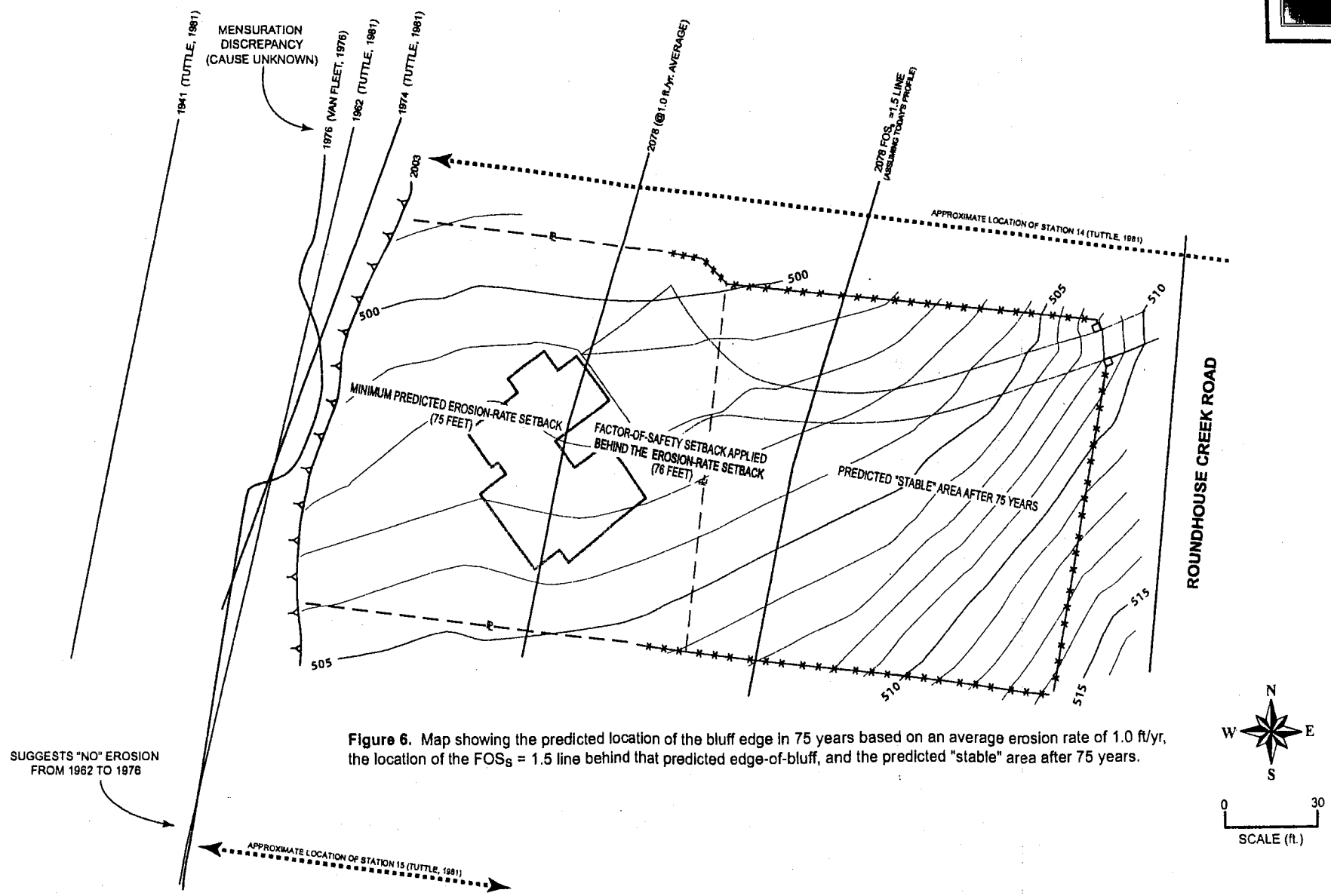

Figure 6. Map showing the predicted location of the bluff edge in 75 years based on an average erosion rate of 1.0 ft/yr, the location of the FOS_S = 1.5 line behind that predicted edge-of-bluff, and the predicted "stable" area after 75 years.

profile, which is assumed to be a dynamic equilibrium profile (as discussed earlier), and (3) a component whose purpose is to further compensate for the uncertainties inherent in the analysis procedure.

A consultant calculates the probable economic lifespan of an existing home by dividing its distance from the encroaching bluff top by the known (or assumed) annual erosion rate. The result is a predicted economic lifespan. The greater the erosion rate used, the shorter the predicted lifespan; the smaller the erosion rate, the longer the lifespan. For example, if a home sits back 100 feet and the annualized erosion rate is 4/ft yr, the predicted economic lifespan is 25 years (less the time lost by the necessity of moving the house before the bluff top is at the back door).

Because consultants' opinions vary, one consultant might believe that a home built 100 ft back from a cliff edge eroding at 4 ft/yr is exposed to a LOW level of risk, whereas another might believe the risk exposure is HIGH.

After a prediction is made and a period of time actually passes, e.g., 10 yrs, it is possible to reassess the risk to the home using revised numbers. For example, in the same example, if the predicted lifespan of 25 years was based on a 4.0 ft/yr average erosion rate, but 10 years after the prediction it is obvious that the realized erosion rate actually averages 5.0 ft/yr, an unbiased observer would have to conclude that the home is exposed to a greater risk of damage than was originally thought. Using the example numbers, the predicted lifespan—as recalculated based on the more accurate, 5 ft/yr erosion rate—would be reduced to 16 years (80 ft original setback distance divided by 5 ft/yr average erosion = 16 yrs). The larger the realized average erosion rate, the shorter the actual economic lifespan of the structure. The smaller the rate, the longer the economic lifespan.

Proposed Location of the Relocated Rohner Home, And Its Predicted Economic Lifespan

Figure 6 shows the "minimum setback line" for the Rohner home. It is 151 feet eastward of the present top-of-bluff. The figure also shows the predicted location of the bluff in 75 years (in 2078), assuming an average erosion rate of 1.0 ft/yr. We used this slightly conservative rate (rather than the calculated 0.74 ft/yr rate) because there is uncertainty in the calculated rate, the bluff edge currently is Unstable on the lot, and the beach does not appear to have rebuilt to its "normal," pre-1996-97 winter

width. The "minimum setback line" is the sum of the setback component due to the predicted erosion and the component due to our FOS calculations. The figure also shows the location of the FOS_s=1.5 line (plotted as 76 ft behind the calculated position of the top-of-bluff 75 years in the future). The ground east of the FOS line (the "minimum setback line") represents the ground predicted to be "stable" after 75 years. This "stable area" is about three-fourths of Lot 14.

If the CCC approves, the Rohner home will be setback 160 ft from the present top-of-bluff (see RECOMMENDATIONS and Figure 7). This distance provides for 75 years of erosion, a catastrophic bluff failure back to the FOS_s = 1.5 line, and an extra measure of prudence (9 ft).

To calculate the possible economic lifespan for the relocated Rohner home if the realized annualized erosion rate is greater than the anticipated 1.0 ft/yr, we divided the component of the bluff-top setback derived from the annualized erosion rate (75 ft) plus the "safety factor" distance (9 ft) by two different hypothesized future average erosion rates (2 ft/yr and 4 ft/yr). Each of the two results is a "predicted alternative scenario economic lifespan." The greater the hypothesized future erosion rate selected, the higher the probability of loss during the desired economic lifespan (75 yrs). In our examples, using a hypothesized future average erosion rate of 2.0 ft/yr for the relocated Rohner home decreases the predicted economic lifespan from 75 + 9 = 84 yrs to 75/2 + 9/2 = 42 yrs. Using 4.0 ft/yr as the erosion rate decreases the lifespan to 75/4 + 9/4 = 18.75 + 2.25 = 21 yrs. Note that none of these calculations consider the 76 ft component of the setback due to the FOS calculations. Also note that if the long-term erosion rate calculated for the site based on the 1941-2003 data (0.74 ft/yr) is realized in the future, the economic lifespan of the relocated Rohner home will exceed 75 years by over 25 years.

RECOMMENDATIONS

REC 1. Set the home back a minimum of 155 feet from the flag pole stanchion, which was 5 feet back from the bluff edge when we worked, and 243 feet west of the east property line fence. This converts to a recommended setback distance of 160 feet from the bluff edge in September, 2003.

REC 2. Use a home foundation that facilitates moving the home in the future.

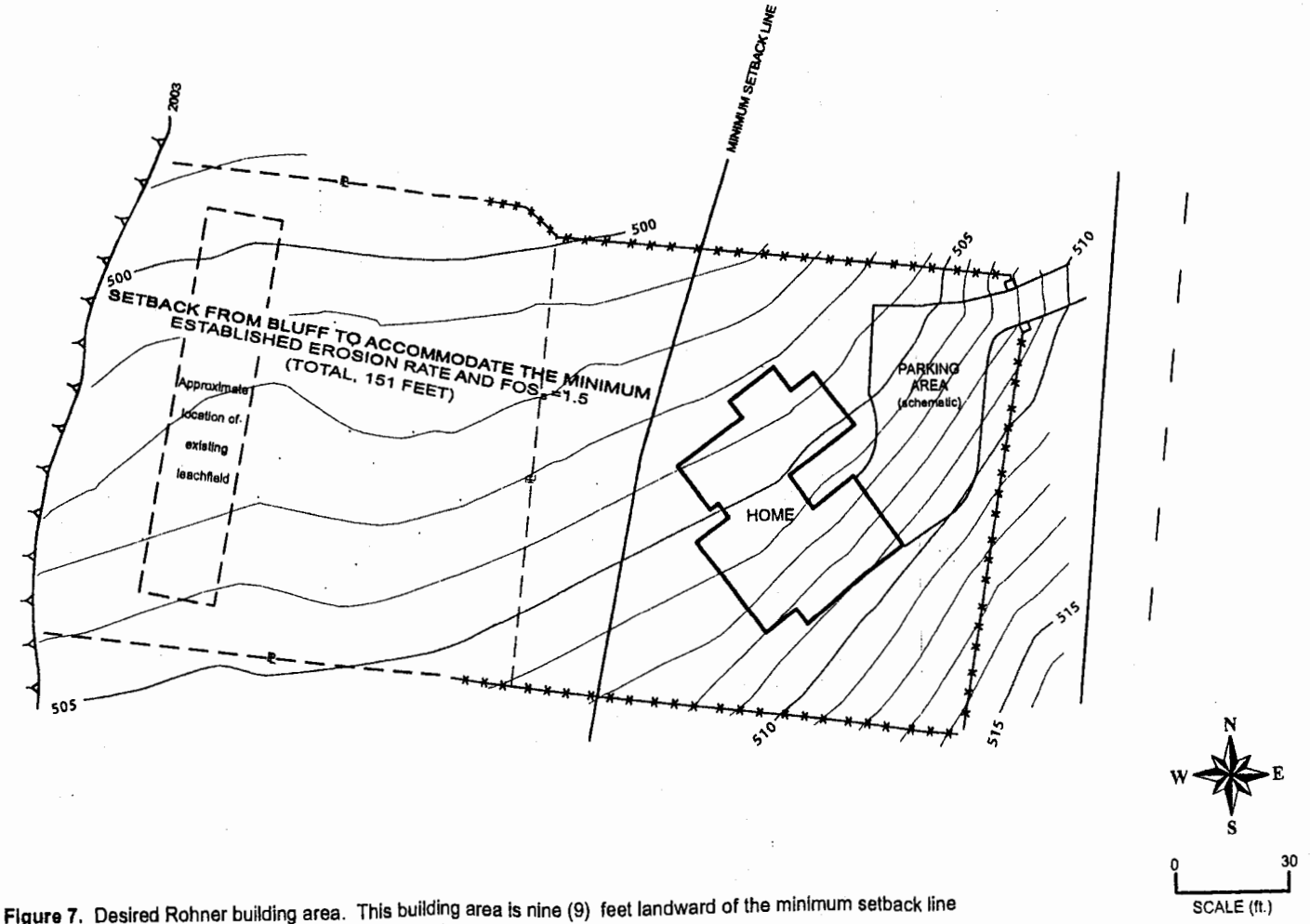

Figure 7. Desired Rohner building area. This building area is nine (9) feet landward of the minimum setback line determined using the methodology discussed in the text.

LIMITATIONS, CLOSURE, and AUTHENTICATION

Although we have used standard engineering geologic practices and professional standards of care to provide erosion-rate estimates, predictions, and a risk assessment, nothing in this report should be construed to state or imply a guarantee of safety of the home for any specific duration of time. Bluff retreat occurs in a largely unpredictable fashion, and it will continue to occur in the Big Lagoon area into the foreseeable future. Even if we have overstated the risk at the proposed site, and the future realized rate of bluff failure is less than the minimum rate we predict, it is important to understand that LOW risk is not the same as NO risk: rapid-rate bluff failure could occur before the calculated minimum economic lifespan is realized (herein stated as ~75 years).

In conclusion, although the evaluation presented herein is based on a consideration of the geologic, geodetic, tectonic, and nearshore marine processes active at Big Lagoon, greater or lesser retreat rates than those documented in the past and predicted for the future may be realized in the next 75 years.

Thank you for hiring us. Please call if you have questions or we can help you in some other way.

Respectfully submitted this sixth day of October, 2003,

Busch Geotechnical Consultants

Bryan Dussell
Project Geologist

R. E. Busch, Jr., Ph.D.
C. E. G. #1448

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Attached: **REFERENCES CITED**
Appendix IA. Soil Logs (4 pp.)
Appendix IB. Unified Soils Classification System (1 p.)
Appendix III. BGC's Slope Stability Classification System (1 p.)
Appendix IV. Risk Terminology (1 p.)

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APPENDIX IA

SOIL LOG **BUSCH GEOTECHNICAL CONSULTANTS**

Job: Rohher **Job #:** 03-053 **By:** REB / BBW **Log #:** BGC-1
Equipment: Hand Auger **Date:** 08/26/2003
Page: 1 of 2

Datum: Ground Surface

Laboratory Data						
Uc (tsf)	shear strength (psf)	% water	dry density (pcf)	sample	depth in feet	**Unified Soil Classification** texture, consistency, moisture, color, symbol
					0	
						Silt, slightly sandy (fine), soft, dry, dark brown, ML.
					1	
					2	
				tube		Silt, slightly sandy (fine), sort, dry, yellowish brown, ML.
						becomes sandy...
					3	
				tube		Sand, silty, loose, dry, yellowish brown, SM; contains concretions (<1" diameter), local Fe cementation.
					4	
				tube	5	
					6	
						Sand, loose, dry, light yellowish brown to olive brown, SP.
					7	
					8	very rare coarse rounded sand grains
						Sand, silty, loose, moist, light yellowish brown to olive brown, SM.
					9	
					10	

Notes: Uc (unconfined compressive strength) measured by penetrometer
"Quick" shear strength measured by torvane

SOIL LOG

BUSCH GEOTECHNICAL CONSULTANTS

Job: Rohher **Job #:** 03-053 **By:** REB / BBW **Log #:** BGC-1

Equipment: Hand Auger **Date:** 08/26/2003

Page: 2 of 2

Datum: Ground Surface

Laboratory Data						
Uc (tsf)	shear strength (psf)	% water	dry density (pcf)	sample	depth in feet	**Unified Soil Classification** texture, consistency, moisture, color, symbol
					-	Sand, loose, moist, dark yellowish brown, olive, and strong brown, SP.
					-	
					-	
					11	fine pebbles
					-	
					-	grading to
					-	
					12	
				bulk	-	
					-	Sand, gravelly, loose, moist, multi-colored, SW-GW
				bulk	-	
					13	
					-	Bottom of hole at 13'
					-	
					-	
					14	
					-	
					-	
					-	
					15	
					-	
					-	
					-	
					16	
					-	
					-	
					-	
					17	
					-	
					-	
					-	
					18	
					-	
					-	
					-	
					19	
					-	
					-	
					-	
					20	
					-	

Notes: Uc (unconfined compressive strength) measured by penetrometer
"Quick" shear strength measured by torvane

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SOIL LOG **BUSCH GEOTECHNICAL CONSULTANTS**

Job: Rohher **Job #:** 03-053 **By:** REB / BBW **Log #:** BGC-2
Equipment: Hand Auger **Date:** 08/26/2003
Page: 1 of 2

Datum: Ground Surface

Laboratory Data						
Uc (tsf)	shear strength (psf)	% water	dry density (pcf)	sample	depth in feet	Unified Soil Classification texture, consistency, moisture, color, symbol
					0 - 1	Silt, slightly sandy (fine), soft, dry, dark brown, ML.
					2 - 4	Silt, slightly sandy (fine), sort, dry, yellowish brown, ML.
					4 - 5	becomes sandy
					5 - 6	Sand, silty, loose, dry, yellowish brown, SM; contains
					6 - 10	Sand, loose, dry, light yellowish brown to olive brown, SP.

Notes: Uc (unconfined compressive strength) measured by penetrometer
"Quick" shear strength measured by torvane

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SOIL LOG **BUSCH GEOTECHNICAL CONSULTANTS**

Job: Rohher **Job #:** 03-053 **By:** REB / BBW **Log #:** BGC-2
Equipment: Hand Auger **Date:** 08/26/2003
Page: 2 of 2

Datum: Ground Surface

Laboratory Data						
Uc (tsf)	shear strength (psf)	% water	dry density (pcf)	sample	depth in feet	**Unified Soil Classification** texture, consistency, moisture, color, symbol
					11	
					12	Sand, slightly clayey, medium, moist, yellowish brown, SW; partially cemented.
					13	
					14	
					15	
					16	
					17	Bottom of hole in same.
					18	
					19	
					20	

Notes: Uc (unconfined compressive strength) measured by penetrometer
"Quick" shear strength measured by torvane

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APPENDIX 1B 1

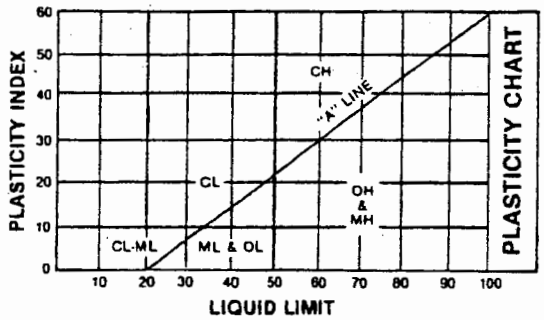
UNIFIED SOILS CLASSIFICATION SYSTEM

MAJOR DIVISIONS		SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS (More than ½ of soil > no. 200 sieve size)	GRAVELS (More than ½ of coarse fraction > no. 4 sieve size)	GW	Well graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (More than ½ of coarse fraction < no. 4 sieve size)	SW	Well graded sands or gravelly sands, little or no fines.
		SP	Poorly graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS (More than ½ of soil < no. 200 sieve size)	SILTS & 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 & CLAYS Liquid limit greater than 50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silty clays, organic silts.
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils.

CLASSIFICATION CHART

CLASSIFICATION	U.S. STANDARD SIEVE SIZE
BOULDERS	Above 12"
COBBLES	12" to 3"
GRAVEL	3" to No. 4 sieve
Coarse	3" to ¼"
Fine	¼" to No. 4
SAND	No. 4 to No. 200
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 to No. 200
SILT & CLAY	Below No. 200 sieve

GRAIN SIZE CHART



PLASTICITY CHART

MOISTURE CONTENT (VISUAL CLASSIFICATION)
Dry – Damp – Moist – Wet

CONSISTENCY OF FINE GRAINED SOILS		DENSITY OF COARSE GRAINED SOILS	
CLASSIFICATION	COHESION (PSF)	CLASSIFICATION	STANDARD PENETRATION (BLOW COUNT)
Very Soft	0-250	Very Loose	0-4
Soft	250-500	Loose	4-10
Medium Stiff	500-1000	Medium	10-30
Stiff	1000-2000	Dense	30-50
Very Stiff	2000-4000	Very Dense	50 +
Hard	4000 +		

DENSITY - CONSISTENCY

APPENDIX III

BGC's QUALITATIVE SLOPE-STABILITY CLASSIFICATION
(Young, 1978, modified by Busch, 1980b)

VS - Very Stable (NEGLIGIBLE risk):
negligible and gently sloping interfluves, seepage slopes, and some convex creep slopes (e.g., ridge crests and knolls) underlain by intrinsically strong rocks; flat and gently rolling terraces away from the edges.

S - Stable (NEGLIGIBLE to VERY LOW risk):
slightly less stable areas of the same land-forms as in VS; gentle to low-moderate slopes of strong rocks.

MS - Moderately Stable (LOW to MODERATE risk):
gentle to low-moderate slopes of soft topographies (e.g., ridge edges, noses, and upper flanks); high-moderate slopes on most intermediate and hard topographies (e.g., some convex creep slopes and transportational midslopes).

PS - Provisionally Stable (MODERATE to HIGH risk):
moderate and high-moderate slopes in soft topographies (e.g., transportational midslopes, usually with relic mass-movement landforms) and steep slopes on hard topographies.

U - Unstable (HIGH risk):
temporarily inactive or slightly active sites of chronic mass wasting (e.g., earthflows, complex slump-earthflows, slumps, slopes with many soil slip scars, failing terrace edges).

VU - Very Unstable (HIGH to VERY HIGH risk):
extremely steep areas of soft topography and actively failing mass-wasting sites.

These categories qualitatively evaluate the intrinsic slope stability of a landscape. They take into account various structural, topographic, stratigraphic, geologic, hydrologic, and vegetative influences on stability. The categories necessarily are subjective, and naturally are gradational. Developmental activities subsequent to classification can detrimentally affect stability and can correspondingly increase levels of risk.

APPENDIX IV

EXPLANATION OF RISK ZONES

(Paraphrased from Moore & Taber, 1978; standardized with BGC's slope-stability classification)

The level of risk associated with a geologic hazard that potentially could cause a loss is described in terms of risk classes ranked in the following ascending scale:

NONE, NEGLIGIBLE, LOW, MODERATE, HIGH, VERY HIGH

The risk or probability of loss due to an action of a recognized geologic hazard is directly related to the level of risk associated with the hazard and to the nature of the potentially affected facility. A "reasonable risk" is defined as a probability of significant loss that is low enough to be acceptable to a prudent person (owner) of average economic means.

The nature, cost, and projected economic lifespan of an improvement, the economic means of the owner, the type and level of site maintenance, the feasibility of making potentially necessary repairs, public policy, etc., are factors that collectively established an acceptable (a "reasonable") level of risk. The definition of "reasonable risk" for a present owner/user must be compatible with "reasonable risk" for projectable successor owners and/or users.

For fixed improvements susceptible to permanent damaging effects of ground movement—such as a typical single family residence, a "reasonable level of risk" for a prudent person of average economic means generally is considered to be NEGLIGIBLE or LOW. For similar improvements, a MODERATE risk level generally is a level of risk that exceeds "a reasonable level of risk" with respect to loss of property, not of life. However, this level of risk sometimes may be acceptable to a prudent person of above-average economic means. HIGH and VERY HIGH levels of risk almost always pose a level of risk that exceeds a "reasonable risk" and would be unacceptable to any prudent person for such improvements.

For improvements of low cost that are readily amenable to repair or are not susceptible to the damaging affects of ground movement, or for land uses that might not be affected seriously by ground movement (i.e., some roads, picnic areas, or campgrounds, etc.), a MODERATE or HIGH level of risk may be considered to be a "reasonable risk."