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original staff report

P.O. Box 1750
Aptos CA 95001

June 3, 2015

F21a
Application Numbers: A-3-SCO-09-001 and A-3-SCO-09-001

Dear Coastal Commissioners and Staff.

Thank you for your effort and persistence on these project(s). Your care and preparation have benefitted the public and protected, as far as possible, this beach/bluff treasure.

The majority of the concerns that caused me to request Coastal Commission review of the project(s) have been addressed. It appears that development impact on the public view shed of the bluff from both the beach and the public access path will be minimized by the requirements of this settlement.

I request that the Coastal Commission remain vigilant to see that all of the requirements continue to be met. Because Santa Cruz County seems incapable of following or enforcing its own LCPs, I believe the periodic review by the Coastal Commission is required.

Sincerely,

William J. Comfort

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May 29, 2015

Charles Lester
Executive Director
California Coastal Commission
45 Fremont Street, Suite 2000
San Francisco, CA 94105

Re: Donald Neil Frank, Arnold Land Company, LLC, and Baltimore Land Company, LLC
Our File: 33200.31097

Dear Mr. Lester:

Our firm represents the above-referenced persons. An agreement in principal has been reached for settlement in Santa Cruz County Superior Court Case Nos. CV 170282, CV 170297, and CV 170298 in which the above persons are the petitioners and the California Coastal Commission is the defendant. The modified projects pursuant to that settlement are scheduled for hearing before the Commission on June 12, 2015, and a Commission Staff report recommending approval is being published and disseminated.

The above-referenced parties agree that, in the event that the Commission does not approve the modified projects with conditions acceptable to each of them, none of them will introduce as evidence in the pending lawsuits, the staff report or other documents related to the hearing on June 12, 2015 (or on such date to which the hearing may be continued) for the proposed modified projects.

Very truly yours,

FENTON & KELLER
A Professional Corporation

Thomas H. Jamison

Thomas H. Jamison by TOB

THJ:tob

Cc: Tara Mueller, Deputy Attorney General

{THJ-470998;1}

From: fayjoe1@comcast.net [mailto:fayjoe1@comcast.net]
Sent: Thursday, June 04, 2015 8:30 AM
To: Craig, Susan@Coastal
Cc: fay levinson; bill comfort
Subject: Re. Application A-3-SCO-09-001 and 002, Neil Frank

Susan: please forward this to whomever should receive this for the hearing to be held in Newport Beach on June 12. Thank you very much. Fay Levinson

I have received the Hearing Notice re. development of the Neil Frank property in Aptos, California. I was very pleased to see that the negotiations have resulted in development of only two parcels, instead of three, and that one parcel (Lot 3) will remain undeveloped. I do, however, wish to express concern over a couple of items, which are addressed but may need further investigation.

It appears that the drainage issues on Lot 1 are addressed; I am, however, concerned about runoff into the arroyo and the cliff face along the arroyo trail. Please be sure to monitor the development of the drainage plan to avoid runoff into the arroyo side of the development. The trail and cliff could be compromised negatively; in addition, the creek in the arroyo could be impacted negatively.

Re. Lot 2 setback: I have observed the cliff face for 30 years now; regardless of the report from Dr. Weber, there has been significant erosion on the cliff face over the years, especially when we have had high surf and storms. There have been winters where there has been NO beach at all, just a lake area, which has definitely affected the cliff face and beach access from both the arroyo and paved trail from Hidden Beach Park. A setback of only 45 feet from the cliff face for development of Lot 2 will be detrimental to the occupants of a house as the cliff does continue to erode annually. I would ask that the Coastal Commission require a larger setback for Lot 2 development. Secondly, I would recommend that landscaping be overseen to assure that the beach view shed of the house is not highly visible from Hidden Beach. As you know, the bluff area is very visible from the beach.

Thank you for your diligent work on this project.

Sincerely,
Fay Levinson
650 Hidden Beach Way
Aptos, Ca. 95003

CALIFORNIA COASTAL COMMISSION
CENTRAL COAST DISTRICT OFFICE
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F21a

Appeals Filed:	1/8/2009
Substantial Issue Found:	7/7/2010
First Commission Action:	12/17/2010
Staff:	Ryan Moroney - SC
Staff Report:	5/28/2015
Hearing Date:	6/12/2015

STAFF REPORT: DE NOVO HEARING ON REMAND

Application Numbers:	**A-3-SCO-09-001 and A-3-SCO-09-002 (Frank et al SFDs)**
Applicant:	**Donald Neil Frank, Arnold Land Company LLC, and Baltimore Land Company**
Project Location:	On the undeveloped and vacant blufftop above Hidden Beach where it slopes down toward a coastal arroyo adjacent to Hidden Beach County Park downcoast from Bayview Drive in the unincorporated Aptos area of south Santa Cruz County.
Project Description:	Construct two two-story single family dwellings with associated improvements.
Staff Recommendation:	Approval with Conditions

PROCEDURAL NOTE

In 2008, Santa Cruz County authorized construction of three single-family residences ranging in size from 3,207 sq. ft. to 5,547 sq. ft. on three separate lots (Lots 1, 2 and 3) under three separate Coastal Development Permit (CDP) actions. The County's approvals were appealed to the Commission on the grounds that the proposed developments were inconsistent with LCP policies related to coastal hazards, public views and public access. On July 7, 2010, the Commission found that a substantial issue existed with respect to the grounds on which the appeals were filed, and held a consolidated de novo hearing on the CDP applications on December 17, 2010. At that hearing, the Commission approved a CDP for the residence on Lot 1, and denied CDPs for the other two proposed residences, finding that the proposed development on Lots 2 and 3 did not conform with LCP policies related to the siting of new development in geologically hazardous areas and the protection of public viewsheds. Following this decision, the original Applicant

Donald Neil Frank[1] sued the Commission. On May 5, 2013, the Santa Cruz Superior Court held a consolidated hearing on the matter and announced its intention to rule in favor of the Applicant. However, rather than issuing a final ruling, the Court provided the parties with additional time to facilitate a potential settlement. The parties thereafter entered into settlement discussions, and the Applicant has since proposed a revised version of the development that, among other things, eliminates the proposed residence on Lot 3 and increases the bluff setback for the proposed residence on Lot 2 by an additional 15 feet for a total bluff setback of about 45 feet. The Commission and Applicant agreed to the terms of a settlement agreement so that the Applicant could present this modified version of the project to the Commission.[2] Under the terms of the settlement agreement, the Commission retains its full discretion to approve, approve with conditions, or deny the proposed modified project. If the Commission approves CDPs for the modified project subject to terms and conditions agreed to by both parties, the litigation would be dismissed.

SUMMARY OF STAFF RECOMMENDATION

The project site consists of three undeveloped blufftop lots located above Hidden Beach in the unincorporated Aptos area of south Santa Cruz County. The original project proposed a single family residence on each of the three lots. The now modified project proposes to construct two single family residences, the originally approved 3,207 square foot residence on Lot 1, and a 3,721 square foot residence on Lot 2, along with associated improvements for parking, landscaping and drainage. The owner of Lot 3 is voluntarily dedicating a permanent conservation easement over this lot, thereby ensuring that it will never be developed with anything other than the minor parking, sewer, drainage and landscaping allowed by these CDPs. The standard of review for the modified project is the certified Santa Cruz County LCP and the public access and recreation policies of the Coastal Act.

With respect to coastal hazards, the project site is located on top of an actively eroding bluff fronting a sandy beach and a coastal arroyo. The Santa Cruz County LCP requires that risks be minimized and long-term stability and structural integrity be provided, and that development be sited, designed, and built to allow for natural shoreline processes to occur without the need for protective devices or other shoreline-altering construction. In this case, one residence (on Lot 1) would be located approximately 120 feet from the bluff edge, and the second residence (on Lot 2) would be setback approximately 45 feet from the bluff edge.[3] Staff's recommendation includes conditions designed to ensure that such development will not be allowed shoreline protection, and to ensure that natural processes are allowed to continue. Recommended special conditions also require the Applicant to assume all of the risk for developing in an area of coastal

[1] Santa Cruz County approved three separate CDPs and thus there were three separate appeals/CDP applications. However, the Applicant was the same for each CDP/appeal and the property involved is in one contiguous location and owned entirely by the Applicant. On July 7, 2010, two of the three lots were transferred from the Applicant to Arnold Land Company, LLC (Lot 2) and Baltimore Land Company (Lot 3). However, evidence available to the Commission indicates that Mr. Frank is authorized to act on behalf of these corporations and continues to control the development of all three parcels. As a result, these CDP/appeal matters were combined into a single staff report, and the hearing was combined as well. Consequently, Mr. Frank, the Arnold Land Company LLC and the Baltimore Land Company are referred to collectively herein as the "Applicant."

[2] Per the terms of the settlement, the Applicant has agreed to withdraw one of the CDP applications, for the largest of the previously proposed three residences (that would have been on Lot 3), and there are now two applications instead of three.

[3] Approximately 15 feet farther back than the project originally denied by the Commission.

hazards, to monitor bluff retreat and to remove development that becomes threatened by such hazards, to limit residential redevelopment, and to implement landscaping and drainage plans on the site. In short, development on the site would be removed over time to allow natural shoreline processes to continue as they would otherwise, as much as possible, to avoid the loss of beach and other attendant impacts associated with shoreline structures and development at the shoreline interface more broadly. Thus, as modified and conditioned for the unique circumstances of this particular case, the project can be considered consistent with the overall purpose of the LCP with respect to coastal hazards.

With respect to public viewshed impacts, the Santa Cruz County LCP has multiple provisions that require development be sited and designed to ensure protection of significant visual resources, including views within mapped scenic resource areas. The proposed development site is located within an LCP-mapped scenic resource area and is prominent in the foreground of views out towards the ocean from significant public use areas at adjacent Hidden Beach County Park, including from the main beach/ocean overlook and the beach access trail, as well as from Hidden Beach itself. Views from beaches and parks are protected visual resources under the LCP. The residences have been sited way from the beach viewshed as far as possible while still allowing for the residential development, and development would be limited to the most upcoast portion of the site thereby protecting the main public views from the overlook and the beach access trail as much as possible. With screening and landscaping, the residential development should not block significant public views, and can be made to blend effectively into the back-beach portion of the viewshed. In addition, the most sensitive portion of the site visually (i.e., the most downcoast parcel, Lot 3) would be placed in a permanent conservation easement thereby maintaining a natural buffer between the most prominent public viewing areas and the proposed development. As such, the proposed development can be found consistent with the LCP.

In light of the above, staff recommends that the Commission approve conditioned CDPs for the modified project. The motions are found on page 5 below.

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APPENDICES

EXHIBITS

I. MOTIONS AND RESOLUTIONS

Staff recommends that the Commission, after public hearing, approve CDP applications A-3-SCO-09-001 and A-3-SCO-09-002 for the proposed development subject to the standard and special conditions below. The Commission must act on two motions to effect this recommendation.

A. CDP Determination for A-3-SCO-09-001 (SFD on Lot 1 and related development on Lot 3)

Motion: *I move that the Commission approve Coastal Development Permit Number A-3-SCO-09-001 pursuant to the staff recommendation, and I recommend a yes vote.*

Resolution to Approve CDP: *The Commission hereby approves Coastal Development Permit Number A-3-SCO-09-001 and adopts the findings set forth below on grounds that the development as conditioned will be in conformity with Santa Cruz County Local Coastal Program policies and Coastal Act access and recreation policies. 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.*

B. CDP Determination for A-3-SCO-09-002 (SFD on Lot 2 and related development on Lot 3)

Motion: *I move that the Commission approve Coastal Development Permit Number A-3-SCO-09-002 pursuant to the staff recommendation, and I recommend a yes vote.*

Resolution to Approve CDP: *The Commission hereby approves Coastal Development Permit Number A-3-SCO-09-002 and adopts the findings set forth below on grounds that the development as conditioned will be in conformity with Santa Cruz County Local Coastal Program policies and Coastal Act access and recreation policies. 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

This permit is granted subject to the following 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 Applicant 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 of interpretation of any condition will be resolved by the Executive Director or 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 Applicant to bind all future owners and possessors of the subject property to the terms and conditions.

III. SPECIAL CONDITIONS

This permit is granted subject to the following special conditions:

1. Revised Final Plans. PRIOR TO ISSUANCE OF THE CDP, the Applicant shall submit two sets of Revised Final Plans to the Executive Director for review and approval. The Revised Final Plans shall be substantially in conformance with the Site Plan prepared by Matson Britton Architects dated May 21, 2015 (Site Plan), attached hereto as Exhibit 3, but shall show the following changes and clarifications to the projects:

(a) Approved Building Envelope. All development (including but not limited to residences, driveways, parking areas, drainage systems and septic systems) shall be located on Lots 1, 2 and the portion of Lot 3 directly in between Lots 1 and 2, within the building envelope and in the general configuration shown on Exhibit 3 (the Site Plan). Development shall be prohibited outside of the approved building envelope except for restoration, drainage improvements (consistent with Special Condition 1(e)), landscaping to create a visual buffer (consistent with Special Condition 1(f)), underground utilities (including sewer, gas, electrical, plumbing and cable), temporary activities and facilities necessary for construction of the houses as shown (including but not limited to grading and excavation), and a patio on Lot 2 provided that the construction activities are minimized to the maximum extent feasible and are kept as close to Bayview Drive as possible, and all impacted areas outside the building envelope are restored and landscaped following completion of construction, pursuant to Special Condition 1(f).

(b) Lot 1. The plans for the residence on Lot 1 shall be in substantial conformance with the project plans approved by the County pursuant to County Application Number 08-0221 with respect to house size, height, style, and orientation; the setback from the coastal arroyo blufftop edge; and the setback from the coastal blufftop edge, and shall incorporate design elements that help the project to blend into the natural bluff aesthetic to the maximum extent feasible (e.g., through use of natural materials and colors, non-reflective windows and surfaces, lighting minimization, etc.).

(c) Lot 2. The plans for the residence on Lot 2 shall be in substantial conformance with the project plans approved by the County pursuant to County Application Number 08-0223 with respect to house size, height, style, and orientation, and the setback from the coastal arroyo blufftop edge except that the residence shall be set back an additional 15 feet from the 100-year bluff setback line shown on the approved County plans, as indicated on the Site Plan. The plans shall show the residence set back from the coastal blufftop edge as shown in Exhibit 3. The plans shall also incorporate design elements that help the project to blend into the natural bluff aesthetic to the maximum extent feasible (e.g., through use of natural materials and colors, non-reflective windows and surfaces, lighting minimization, etc.).

(d) Lot 3. The plans for Lot 3 shall show only:

1. **Inside of the Building Envelope**. A two-car parking area, underground utilities and landscaping located within the approved building envelope described in Special Condition 1(a).

2. **Outside of the Building Envelope**. Drainage and landscaping measures consistent with Special Conditions 1(e) and 1(f) below.

(e) Drainage Plan. The plans shall modify the drainage system to provide an engineered drainage system that retains all drainage from the lots on Lots 1, 2, and/or 3 through infiltration, where such drainage apparatus is installed and maintained as close to the approved residences and Bayview Drive as possible. The drainage system may include, but not be limited to, curtain drains, french drains, tile drains, swales, vegetated wetlands, engineered stormwater treatment devices, and similar measures or some combination of these devices and methods. To ensure the stability of the site, multiple small drainage components may be utilized over a single drainage system. The drainage system shall be designed such that drainage will not flow over the coastal blufftop edge to the beach below or over the arroyo blufftop edge to the arroyo below. The drainage system shall not contribute to coastal bluff or arroyo bluff erosion. The drainage system shall be visually unobtrusive, including through use of planted features and screening (see also Special Condition 1(f) below) to protect public views of the site from the Hidden Beach County Park path and overlook and the beach. All drainage system components shall be maintained in good working order for the life of the project.

(f) Landscape Plan. The landscape plan shall provide for the following:

- The landscape plan shall be designed to maintain, protect and enhance the existing natural vegetative state on and adjacent to the site, particularly in the undeveloped

blufftop area, and to provide a transitional buffer between vegetated blufftop areas and authorized development. Landscaping (at maturity) shall also be capable of partial/mottled screening and softening of the appearance of new development as seen from the Hidden Beach County Park overlook and path and the beach as much as possible and shall be clustered as close to residential development as feasible to ensure that the views of the Lots in their natural state outside of the building envelopes are preserved to the maximum extent feasible. All landscaped areas shall be continuously maintained by the Applicant; all plant material shall be continuously maintained in a litter-free, weed-free, and healthy growing condition, including providing for replacement plantings as necessary to meet screening requirements. Drip irrigation lines shall be allowed for watering necessary to maintain newly planted material in a healthy growing condition.

- Identification of all plantings and irrigation details for the site.
- No plant species that are listed on the California Invasive Plant Council's list.
- Removal of any invasive non-native plant species (as defined in the California Invasive Plant Council's List) that are present on the site.

All requirements above and all requirements of the approved Revised Final Plans shall be enforceable components of this CDP. The Applicant shall undertake development in accordance with this condition and the approved Revised Final Plans.

2. **Construction Plan.** PRIOR TO ISSUANCE OF THE CDP, the Applicant shall submit two sets of a Construction Plan to the Executive Director for review and approval. The Construction Plan shall, at a minimum, include the following:

   (a) Construction Areas. The Construction Plan shall identify the specific location of all construction areas, all staging areas, all storage areas, and all construction access corridors (to the construction site and staging areas). All such areas within which construction activities and/or staging are to take place shall be minimized in order to minimize construction visibility from public viewing areas to the maximum extent feasible.

   (b) Construction Methods and Timing. The Construction Plan shall specify the construction methods to be used, including all methods to be used to minimize visibility from public viewing areas (including using the space available on Bayview Drive for staging, storage, and construction activities to the maximum extent feasible), and including all methods to be used to protect coastal waters, including the arroyo area and the Monterey Bay. All erosion control/water quality best management practices (BMPs) to be implemented during construction and their location shall be noted. These BMPs shall be selected and designed in accordance with the California Storm Water Best Management Practices Handbook.

   (c) Construction Requirements. The Construction Plan shall include the following construction requirements specified by written notes on the Construction Plan. Minor adjustments to the following construction requirements may be allowed by the Executive

Director if such adjustments: (1) are deemed reasonable and necessary; and (2) do not adversely impact coastal resources.

- All construction work shall take place during daylight hours, and construction (including but not limited to construction activities, and materials and/or equipment storage) is prohibited outside of the defined construction, staging, and storage areas.
- The extent of land disturbance shall be limited to the minimum amount necessary to construct the project.
- Areas for the staging of construction equipment and materials, including receptacles and temporary stockpiles of graded materials, which shall be covered on a daily basis, shall be designated.
- Silt fences, straw wattles, temporary detention basins, and/or other appropriate controls shall be installed prior to commencement of construction to intercept, filter, and remove sediments and other pollutants contained in the runoff from construction, staging, and storage/stockpile activities and areas.
- Runoff and/or construction debris shall be contained on the blufftop and such runoff and/or debris shall be prevented from extending over the blufftop edge onto the arroyo, the beach, or the Pacific Ocean.
- Good construction housekeeping measures shall be applied, including the use of dry cleanup measures whenever possible; collecting and filtering cleanup water when dry cleanup methods are not feasible; cleaning and refueling construction equipment at designated offsite maintenance areas; and the immediate clean-up of any leaks or spills.
- The Plans shall indicate that PRIOR TO THE COMMENCEMENT OF GRADING, the Applicant shall delineate the approved construction areas with fencing and markers to prevent land-disturbing activities from taking place outside of these areas, and shall ensure that all erosion control/water quality BMPs are in place.

All requirements above and all requirements of the approved Construction Plan shall be enforceable components of this CDP. The Applicant shall undertake development in accordance with the approved Construction Plan.

3. **Construction Site Documents & Construction Coordinator.** DURING ALL CONSTRUCTION:

   (a) Construction Site Documents. Copies of the signed CDP and the approved Construction Plan shall be maintained in a conspicuous location at the construction job site at all times, and such copies shall be available for public review on request. All persons involved with the construction shall be briefed on the content and meaning of the CDP and the approved Construction Plan and public view requirements applicable to them, prior to commencement of construction.

(b) Construction Coordinator. A construction coordinator shall be designated as the primary person to be contacted during construction should questions arise regarding the construction (in case of both regular inquiries and emergencies), and the coordinator's contact information (i.e., address, phone numbers, email, etc.) including, at a minimum, a telephone number that will be made available 24 hours a day for the duration of construction, shall be conspicuously posted at the job site where such contact information is readily visible from public viewing areas, along with an indication that the construction coordinator should be contacted in the case of questions regarding the construction (in case of both regular inquiries and emergencies). The construction coordinator shall record the name, phone number, and nature of all complaints received regarding the construction, and shall investigate complaints and take remedial action, if necessary, within 24 hours of receipt of the complaint or inquiry.

4. Coastal Hazards Risk. By acceptance of the CDP, the Applicant acknowledges and agrees, on behalf of itself and all successors and assigns, to the following:

(a) Coastal Hazards. That the site is subject to coastal hazards including but not limited to episodic and long-term shoreline retreat and coastal erosion, high seas, ocean waves, storms, tsunami, tidal scour, coastal flooding, liquefaction and the interaction of same;

(b) Assume Risks. To assume the risks to the Applicant and the properties that are the subject of this CDP of injury and damage from such coastal hazards in connection with the permitted development;

(c) Waive Liability. To unconditionally waive any claim of damage or liability against the Coastal Commission, its officers, agents, and employees for injury or damage from such coastal hazards;

(d) Indemnification. To indemnify and hold harmless the Coastal Commission, its officers, agents, and employees with respect to the Commission's approval of the development 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 coastal hazards; and

(e) Property Owner Responsible. That any adverse effects to property caused by the permitted development shall be fully the responsibility of the property owner.

5. Coastal Hazards Response. By acceptance of the CDP, the Applicant acknowledges and agrees, on behalf of itself and all successors and assigns, that:

(a) Intent of CDP. The intent of this CDP is to allow for the approved development to be constructed and used consistent with the terms and conditions of the CDP for only as long as the approved development remains safe for occupancy and use without additional measures beyond ordinary repair and/or maintenance to protect it from coastal hazards. The intent is also to ensure that development is removed and the affected area restored under certain circumstances (including as further described and required in this

condition), including that endangered development is required to be removed as described in this condition.

(b) Shoreline Protective Structures Prohibited. Shoreline protective structures that protect the approved development (including but not limited to seawalls, revetments, retaining walls, tie backs, caissons, piers, groins, etc.) shall be prohibited.

(c) Section 30235 and LCP Waiver. Any rights to construct such shoreline protective structures, including rights that may exist under Public Resources Code Section 30235, the Santa Cruz County Local Coastal Program, or any other applicable law are waived.

(d) Reporting Requirement/Ten-foot Trigger. In the event the blufftop edge (whether ocean or arroyo side) recedes to within ten feet of residential development, but no government agency has yet ordered that the residence not be occupied, the Applicant shall retain a licensed geologist or civil engineer with experience in coastal processes and hazard response to prepare a geotechnical investigation that addresses whether any portions of the residence and related development are threatened by coastal hazards. The report shall identify all those immediate or potential future ordinary repair and/or maintenance measures that could be applied to address the threat without shoreline protective structures, or relocation of threatened development. The investigation shall be submitted to the Executive Director and appropriate local government officials for review and approval. If the approved geotechnical investigation concludes that the residence or any portion of the residence is unsafe for occupancy, the Applicant shall submit a Removal and Restoration Plan (see subsection (e) below).

(e) Removal and Restoration. If an appropriate government agency or the above-referenced approved geotechnical investigation determines that any portion of the approved development is not to be occupied or used due to any coastal hazards, and such safety concerns cannot be abated by ordinary repair and/or maintenance or relocation, the Applicant shall remove such development or portions of such development. Prior to removal, the Applicant shall submit two copies of a Removal and Restoration Plan to the Executive Director for review and approval. If the Executive Director determines that an amendment to the CDP or a separate CDP is legally required in order to accomplish the removal and restoration, the Applicant shall immediately submit the required application, including all necessary supporting information to ensure it is complete. The Removal and Restoration Plan shall clearly describe the manner in which such development is to be removed and the affected area restored so as to best protect coastal resources, and shall be implemented immediately upon Executive Director approval, or Commission approval of the CDP or CDP amendment application, if necessary.

6. Future Redevelopment. Redevelopment of approved development subject to this CDP shall be sited and designed to ensure geologic and engineering stability without reliance on shoreline protective devices. As used in this condition, "redevelopment" is defined to include: (1) additions to an existing structure, (2) exterior and/or interior renovations, and/or (3) demolition of an existing blufftop home or other principal structure, or portions thereof, which result in:

(a) Alteration of 50% or more of major structural components including exterior walls, floor and roof structure, and foundation, or a 50% increase in floor area. Alterations are not additive between individual major structural components; however, changes to individual major structural components are cumulative over time from the date of approval of this CDP as described in 6(b) below, or

(b) Demolition, renovation or replacement of less than 50% of a major structural component where the proposed alteration would result in cumulative alterations exceeding 50% or more of a major structural component, taking into consideration previous alterations approved on or after the date of approval of this CDP; or an alteration that constitutes less than 50% increase in floor area where the proposed alteration would result in a cumulative addition of greater than 50% of the floor area, taking into consideration previous additions approved on or after the date of approval of this CDP.

7. **Liability for Costs and Attorneys' Fees.** By acceptance of this CDP, the Applicant acknowledges and agrees, on behalf of itself and all successors and assigns, to indemnify and hold harmless the Coastal Commission, its officers, agents, and employees with respect to the Commission's approval of the CDP against any and all liability, claims, demands, damages, costs (including costs and fees incurred in defense of same), expenses, and amounts paid in settlement arising from any injury or damage due to coastal hazards, and that any adverse effects to the property caused by the permitted development shall be fully the responsibility of the Applicant. The Applicant further agrees to reimburse the Coastal Commission in full for all Coastal Commission costs and attorneys' fees (including but not limited to such costs/fees that are: (1) charged by the Office of the Attorney General; and (2) required by a court) that the Coastal Commission incurs in connection with the defense of any action brought by a party other than the Applicant against the Coastal Commission, its officers, employees, agents, successors and assigns challenging the approval or issuance of this CDP. The Applicant shall reimburse the Coastal Commission within 60 days of being informed by the Executive Director of the amount of such costs/fees. The Coastal Commission retains complete authority to conduct and direct the defense of any such action against the Coastal Commission.

8. **Deed Restriction.** PRIOR TO ISSUANCE OF THE CDP, the Applicant shall submit to the Executive Director for review and approval documentation demonstrating that the Applicant has executed and recorded against the parcels governed by this CDP, a deed restriction in a form and content acceptable to the Executive Director: (1) indicating that, pursuant to the CDP, the Coastal Commission has authorized development on the subject properties subject to terms and conditions that restrict the use and enjoyment of those properties; and (2) imposing the special conditions of the CDP as covenants, conditions and restrictions on the use and enjoyment of the properties. The deed restriction shall include a legal description and site plan of the entire properties governed by the CDP. 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 the CDP shall continue to restrict the use and enjoyment of the subject property so long as either the CDP or the development it authorizes, or any part, modification, or amendment thereof, remains in existence on or with respect to the subject properties.

9. **Conservation Easement.** PRIOR TO ISSUANCE OF THE CDP, the record owner of Lot 3 shall submit proof to the Executive Director that such owner has voluntarily recorded a conservation easement over Lot 3. The easement shall have been accepted by a public entity or non-profit conservation organization and shall require Lot 3 to be maintained in substantially its natural state, subject only to the development authorized by this CDP. Recordation of a conservation easement is not a condition of this CDP. However, recordation of a conservation easement will help to carry out the intent of this CDP.

IV. FINDINGS AND DECLARATIONS

The Commission finds and declares as follows:

A. PROJECT LOCATION

The project site consists of three legal lots of record located on an undeveloped and vacant blufftop located just downcoast from the end of Bayview Drive in the unincorporated Aptos area of south Santa Cruz County. Lot 1 is approximately 12,610 square feet and slopes down towards the coastal bluff and arroyo to the east. Lot 2 is approximately 7,354 square feet and is located adjacent to an existing single-story residence at 660 Bayview Drive. Lot 2 has the highest elevation of any of the three lots (about 65 to 90 feet above sea level). Lot 2 slopes down towards Lot 3 to the east, with the seaward coastal bluff located to the south. Lot 3 is about 13,601 square feet and is located farthest from Bayview Drive and nearest to the beach and arroyo. Lot 3 is at the lowest elevation of the three lots (50 to 60 feet above sea level), with the coastal bluff and arroyo surrounding the lot on three sides. Lot 1 is designated in the LCP Land Use Plan (LUP) as partially R-UL (Urban Low Density Residential) and partially O-U (Urban Open Space) and is zoned partially R-1-6 (Single-Family Residential – 6,000 square foot minimum lot size) and partially PR (Parks, Recreation, and Open Space). Lots 2 and 3 are designated in the LUP as R-UL and are zoned R-1-6. All three lots are located within the LCP-designated and mapped scenic resource area associated with the public beach, park, and access path.

The blufftop area at issue overlooks Hidden Beach and slopes down into a coastal arroyo adjacent to the property. Just downcoast of, and partially including a portion of the arroyo, is Hidden Beach County Park, including its blufftop coastal overlook and a heavily-used public access path that connects to the sand at Hidden Beach.[4] A second publicly-used path extends along the bluff on the upcoast side of the arroyo extending from the sand at Hidden Beach inland to Hidden Beach Way. The bluff, beach, arroyo, and park area are located between the Beach Drive residential area (beach level) and Bayview Drive residential area (blufftop level) upcoast, and the terraced Aptos-Seascape residential area extending above the beach inland of the Via Gaviota seawall downcoast. This undeveloped bluff area between these built environments provides a natural landform respite from the more urban back-beach and bluff developments up and down coast, including because the Beach Drive and Via Gaviota neighborhoods are constructed on top of what was historically beach sand and extend onto the beach landform.

Although the sloping blufftop area where the two residences are proposed is undeveloped, there is substantial residential development located upcoast and downcoast of Hidden Beach County Park from the project site. On the upcoast side, residential neighborhoods on the blufftop extend back toward Aptos Creek. Most of this existing residential blufftop development is at 110 to 130 feet above sea level. However, the elevation of the coastal bluff begins to drop dramatically in the vicinity of the proposed project site as the bluff drops down into the arroyo itself. In addition, although there is no residential development located on the beach directly below the project sites, the ocean fronting residences roughly at beach level on Beach Drive (just upcoast from the

[4] Hidden Beach County Park is a 1.5-acre public park facility maintained by the County that provides a tot play area, lawn area, picnic tables, and public parking. The park extends linearly along the arroyo edge to the blufftop overlook and sandy beach at Hidden Beach.

project sites) extend upcoast to the Aptos Creek area as well. Opposite the arroyo on the downcoast side, the natural bluffs were altered into a series of terraces and developed with residences starting in the 1960s. As a result, the natural bluff no longer exists and has been replaced with terraced residential development extending upslope from the Via Gaviota seawall, which is located downcoast of the arroyo and Hidden Beach.

It should also be noted that the beach area at Hidden Beach between Beach Drive and Via Gaviota, as well as the arroyo area extending inland along Hidden Beach County Park, were the subject of a settlement agreement associated with prescriptive rights litigation between the Coastal Commission and the then fee-title landowner of this area. Per the settlement agreement, the property owner was permitted to construct a "bunker house" at the downcoast end of Beach Drive, provided that the owner offered to dedicate fee title to the Hidden Beach property and arroyo property to the State or other public entity to be maintained as open space for public recreational use. As a result of that settlement, the residence was built and this entire area was offered to the public as open space land for public recreational use. The settlement agreement and the resultant fee offer prohibit new structures or improvements within this property.

See **Exhibit 1** for location maps. **See Exhibit 2** for photographs of the project sites, the arroyo, the two public access paths on either side of the arroyo, and the existing upcoast and downcoast residential development.

B. PROJECT DESCRIPTION

The proposed project includes construction of two single-family residences, one residence on Lot 1, one residence on Lot 2, and associated improvements (e.g., parking and utilities) on a portion of Lot 3, and drainage and landscaping on the remainder of Lot 3:

- Lot 1: Construct a three-bedroom, two-story single-family residence of about 3,207 square feet on a 12,610 square-foot lot.

- Lot 2: Construct a three-bedroom, two-story single-family residence of about 3,721 square feet on a 7,354 square-foot lot.

- Lot 3: This 13,601 square foot lot will be voluntarily placed into a conservation easement dedicated to preservation of open space to protect public views and the natural bluff. A small portion of Lot 3 (about 1,857 square feet located between the two single-family residences) will be reserved for uses by Lots 1 and 2 (e.g., parking and utilities). The Applicant will also implement a Drainage Plan and Landscaping Plan on this lot for the life of the proposed developments on Lots 1 and 2.

See proposed Site Plan in **Exhibit 3.**

C. COASTAL DEVELOPMENT PERMIT DETERMINATION

The standard of review for these applications is the certified Santa Cruz County LCP and the Coastal Act's public access and recreation policies. The relevant policies, summarized below, are set forth in full in **Exhibit 4**.

1. Geological Conditions and Hazards

Applicable Policies

The LCP requires that a coastal bluff building site be stable for a minimum of 100 years in its pre-development application condition, and that any development on it be set back an adequate distance to provide stability for the development's lifetime, and at least 100 years. The minimum 100 years of stability must be established through the use of appropriate setbacks and siting, and without reliance on engineering measures "such as shoreline protection structures, retaining walls, or deep piers" (IP Section 16.10.070(h)(3)). Also, the LCP allows shoreline protection structures only "to protect existing structures from a significant threat" (LUP Policy 6.2.16). Thus, the LCP has a two-part minimum 100-year stability requirement: first, there must be a portion of the site in question that itself will be stable for at least 100 years in a pre-development (i.e., no project) scenario, without reliance on structural development to make it so; and second, ostensibly if the first test is met, any development then introduced onto the site must also be stable for its lifetime measured for at least 100 years without reliance on engineering measures. On the whole, these LCP policies recognize that development is not appropriate in coastal hazard areas for which 100 years (minimum) of site and structural stability cannot be guaranteed (without relying on engineering measures) and allows shoreline protection in only very specific and limited circumstances for already existing structures.

Reports Submitted

The Applicant has submitted the following geologic and geotechnical engineering reports for the site:

- *Geologic Investigation, Lands of Frank, Aptos, California, County of Santa Cruz APN's 043-161-51, -40, & -39* by Zinn Geology, dated August 16, 2006 (Zinn 2006).

- *Response to Comments by County of Santa Cruz Planning Department, Parcels Southeast of Bayview Drive, Aptos, California, County of Santa Cruz APNs 043-161-51, -40, & 39* by Zinn Geology, dated July 23, 2007 (Zinn 2007).

- *Geotechnical Investigation for Lands of Frank, Bayview Drive, Rio del Mar, California* by Pacific Crest Engineering Inc., dated August 2006 (PCEI 2006).

In addition, the following documents (see **Exhibit 6**) were submitted in response to initial verbal comments from the Commission's staff geologist, Dr. Mark Johnsson, regarding the above reports:

- *Projecting Future Sea-Level Rise: What is a Reasonable Estimate for the Next Century?* by G.E. Weber, Geologic Consultant, dated February 24, 2009 (Weber 2/2009) (see pages 1-8 of **Exhibit 6**).

- *Response to California Coastal Commission comments, Lands of Frank, Bayview Drive, A.P.N. 043-161-51, -40, -39, Rio del Mark, Santa Cruz County, California* by Pacific Crest Engineering, Inc., dated February 26, 2009 (PCEI 2009) (see pages 52-55 of **Exhibit 6**).

- *Supplemental Analysis in Response to California Coastal Commission comments, Parcels southeast of Bayview Drive, Aptos California, County of Santa Cruz, APN's 043-161-51,*

-40, & -39 by Zinn Geology, dated February 26, 2009 (Zinn 2009) (see pages 43-51 of **Exhibit 6**).

Dr. Johnsson reviewed all of the above documents and reports and developed a Geotechnical Review Memorandum, dated June 18, 2009 that synthesized his comments and recommendations on the geologic conditions and hazards applicable to the proposed projects (see **Exhibit 5**). Subsequent to Dr. Johnsson's memorandum, the Applicant submitted the following additional correspondence regarding the proposed projects (see **Exhibit 6**):

- *Appeal Numbers A-3-SCO-09-001, -002, -003 (Frank),* letter and attachments from G.E. Weber, Geologic Consultant, dated December 15, 2009 (Weber 12/2009) (see pages 9-28 of **Exhibit 6**).

- *Projections of Sea-Level Rise in the 21st Century,* letter from G.E. Weber, Geologic Consultant, dated February 2, 2010 (Weber 2010) (see pages 29-42 of **Exhibit 6**).

The geologic description of the site that follows derives primarily from the Zinn 2006 and PCEI 2006 reports.

Site Geologic Characteristics

The project site includes three undeveloped lots located along the top of an ancestral fluvial[5] terrace surface that slopes gently to the southeast. The terrace is bordered to the east by a thickly-vegetated, nearly flat-bottomed arroyo, which has incised up to 40 feet into the terrace, creating a steepened 45-50 degree slope. The southwest edge of the terrace faces the sea and drops near vertically toward the beach for about the upper 6 to 8 feet, then tapers off to a shallower gradient of about 45 to 50 degrees, and then tapers again to between 37 and 40 degrees of slope between 10 and 30 feet above the broad sandy beach located below the project sites.

The project site lies on top of a wedge of poorly consolidated fluvial terrace sands ranging in thickness between about 12 and 35 feet, which in turn overlie an ancestral stream-cut terrace in the underlying Purisima formation sandstone bedrock. The coastal bluff side of the properties is partially buttressed by a steeply-dipping wedge of colluvium[6] that is likely an accumulation of many years of materials sloughing from the bluff.

Drainage at the site is primarily by sheet flow toward the arroyo, other than some minor rilling. No significantly large erosional landforms, such as gullies, aside from the arroyo itself, appear to be actively developing within the fluvial terrace surface of the project site. Surface borings done at the site encountered groundwater between 27 and 37 feet below the ground surface, where it appears to be perched on top of the bedrock shelf within the fluvial terrace deposits. The bedrock below the encountered groundwater does not appear to be saturated.

[5] Defined in the *Glossary of Geology* as: a) Of or pertaining to a river or rivers. b) Existing, growing, or living in or about a stream or river. c) Produced by the action of a stream or river. (J.A. Jackson, 1997, *Glossary of Geology*, Fourth edition: Alexandria, Virginia, American Geological Institute, 769 pp.)

[6] Defined in the *Glossary of Geology* as: a) A general term applied to any loose, heterogeneous, and incoherent mass of soil material and/or rock fragments deposited by rainwash, sheetwash, or slow continuous downslope creep, usually collected at the base of gentle slopes or hillsides. b) Alluvium deposited by unconcentrated surface runoff or sheet erosion, usually at the base of a slope. (J.A. Jackson, 1997, *Glossary of Geology*, Fourth edition: Alexandria, Virginia, American Geological Institute, 769 pp.)

Future Sea Level Rise

The premise that sea level will continue to rise is based on a number of factors, including the warming of the earth that has taken place over the past several hundred years, and the projections that the earth will continue to warm over the next 100 years. This slow increase in temperature results in sea level rise due to thermal expansion of ocean water, which leads to a greater volume of water in the oceans, and also due to the melting of glacial ice and ice sheets, which increases the volume of the oceans as a result of the addition of water to the oceans. Estimating sea level rise is important with respect to the proposed projects because such changes in sea level will exacerbate the frequency and relative ferocity with which the ocean waves, including storm waves, impact the coastal bluff, resulting in accelerated coastal erosion and an increase in the rate of bluff retreat at the site.

The Applicant's sea level rise report (Weber 2/2009; see pages 1-8 of **Exhibit 6**) evaluated the amount of sea level rise that may occur over the next 100 years. The Weber report referenced recent literature on sea level rise while emphasizing the uncertainty in predicting future sea level rise. Regarding uncertainty in estimating future sea level rise, this report states that the rates of change in the warming of the atmosphere and the oceans, and the relationship between these rates of change and the volume of carbon dioxide in the atmosphere, are not clear, and therefore all projections of the total amount of sea level rise that will occur in the next 100 years are based on interpretations and assumptions. The Weber report determined that the least conservative estimate for sea-level rise should apply to single-family residences (such as the proposed development) while "critical facilities" should assume a more conservative level (i.e., a higher rate) of sea level rise. Weber concluded that:

> *…a reasonable assumption for sea level rise in the next century, to be applied to geological hazard and risk analyses for single family residences…should be equal to or greater than the total sea level rise in the 20th century and consistent with the rate of rise (acceleration) over the past 20-30 years. This number would lie someplace between 300-340 mm, approximately 11 to 13 inches.*

Dr. Johnsson notes in his 2009 memorandum (again, see **Exhibit 5**) that this amount of sea level rise is at the low end of what most researchers are predicting for sea level rise over the next 100 years. Dr. Johnsson's 2009 memorandum also notes that the Commission has been recommending that analysis for the effects of sea level rise with respect to proposed development assume a minimum rate of 3 feet of sea level rise per century and evaluate higher rates in order to determine the amount of sea level rise that could put the proposed project at risk. In this case, Dr. Johnsson estimated a minimum of 3 feet of sea level rise over the next century in his 2009 memo. Currently, the ocean reaches the base of the bluff during storms and periods of higher tides. For this site, the expected result of an increase in sea level is that the higher water level will result in wave/tidal impacts against the bluff taking place on a more frequent basis. An increase in the frequency of waves and the ocean hitting the bluff face will lead to greater erosion of the bluff and an increase in the bluff retreat rate.

Since the Commission's action on the projects in December 2010, the National Research Council issued "Sea Level Rise for the Coasts of California, Oregon and Washington: Past, Present and

Future,"[7] (NRC Report) prepared in partial response to then Governor Schwarzenegger's Executive Order S-13-08 that directed state agencies to plan for sea level rise and coastal impacts. One of the main purposes of the NRC Report is to inform and assist state agencies as they develop approaches for incorporating sea level rise into planning decisions with the most recent and best available science. The NRC Report used a year 2000 baseline and produced sea level rise projections for 2030, 2050 and 2100, taking into account geophysical differences north and south of Cape Mendocino attributed to vertical land movement.[8] The Coastal Commission's Draft Sea Level Rise Policy Guidance document recommends using the NRC Report as the current best available science for sea level rise. Other state agencies have also adopted the sea level rise projections and recommendation of the NRC Report, including the Ocean Protection Council (OPC), which adopted the NRC Report's sea level rise projections in March 2013. Based on the NRC Report projections, the estimated range of sea level rise for 2065 and 2090 (appropriate for a 50-year or 75-year project life respectively) can be interpolated between the projections for 2050 and 2100 to be from 7 inches to 35 inches (0.19 m to 0.88 m) for 2065 and from 14 inches to 56 inches (0.36 m to 1.4 m) for 2090. The observed trend for global sea level has been a long-term, persistent rise, and the reports have considered the 56-66 inches of rise to be useful in encompassing the probable rise that could occur by 2100.[9]

Coastal Bluff Retreat

The retreat of the slopes and the bluffs along this portion of Monterey Bay results from erosion, which occurs at the base of sea cliffs by hydraulic impact and scour from wave action, as well as from episodic landsliding processes associated with intense rainfall, seismic shaking, and lower bluff retreat/undermining. Using aerial photographs, the Zinn 2006 report found that the top of the coastal bluff at the project site has eroded at an average rate of between 0.27 and 0.30 feet per year since 1928. In a more recent report (dated February 26, 2009), Zinn assumes that if the ocean attacks the toe of the bluff, the bluff will retreat at a rate of approximately one foot per year. The 2006 report additionally found that the arroyo that borders the properties to the east has eroded at an average rate of 0.05 feet per year since 1928. Regarding landslides, this report noted that the upper coastal bluff above the beach has retreated episodically through the process of terrestrial landsliding.

According to Dr. Johnsson's memorandum (**Exhibit 5**):

> *The Zinn reports assume that in order for the proposed structures to be threatened, the beach fronting the coastal bluff would need to be removed by coastal erosion or drowned by rising sea level; then the colluvial wedge at the base of the bluff would need to be eroded; and finally the coastal bluff would need to be eroded until a vertical projection of the base of the bluff would intersect the buildings' foundations. Working backwards from the latter condition, and assuming a bedrock erosion rate of 1 to 2 feet per year, the reports* [specifically the Zinn 2009 report – see pages 43-51 of **Exhibit 6**] *estimate the buildings sited as proposed would be threatened in…107 to 161.5 years.*

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[7] National Research Council 2012, Sea Level Rise for the Coasts of California, Oregon and Washington: Past, Present and Future; ISBN 978-0-309-25594-3, 250 pages.

[8] North of Cape Mendocino, geologic forces are causing much of the land to uplift, resulting in a lower rise in sea level, relative to the land, than has been observed farther south.

[9] The 56 – 66 inches identified represents the upper range of potential sea level rise change estimated for 2090.

Dr. Johnsson disagrees with a number of assumptions built into the Applicant's analysis. First, he notes that the reports by Zinn Geology use the estimated sea level rise figure from the Weber 2/2009 report (11 to 13 inches over the next century) instead of the 3 feet of sea level rise more commonly accepted for Commission siting decisions at the time of his memo.[10] Second, Dr. Johnsson notes that the assumption that the buildings will be threatened by upper bluff retreat at the same time that the bedrock has been eroded to a point located vertically beneath the buildings' foundations is inappropriate. Coastal bluffs are typically not vertical. In fact, as described in the Zinn 2006 report, although the top of the bluff at this site is near vertical for the first 6 to 8 feet, it tapers off to a shallower gradient of about 45 to 50 degrees, and then tapers again to between 37 and 40 degrees of slope between 10 and 30 feet above the beach. In other words, the bluff at this location is not vertical, but rather exhibits retreat and a configuration that is typical and indicative of a combination of erosive processes that leave the bluff materials with insufficient strength to retain a vertical profile. In short, the upper bluff edge will intersect the building foundations long before the toe of the bluff lies vertically beneath the foundations.

Although the colluvial wedge at the base of the bluff will help to reduce the erosion rate of the bluff, its gradual removal will ultimately result in increased instability of the upper bluff. Dr. Johnsson concluded that this increased instability may result in future bluff failures that area likely to cause the bluff to retreat far faster than the 1 to 2 feet per year long-term average cited by the Applicant in the Zinn 2009 report (see pages 43-51 of **Exhibit 6**).

Slope Stability

The field of slope stability encompasses the analysis of static and dynamic stability of natural and artificial slopes. If the forces available to resist movement are greater than the forces driving movement, then the slope is considered stable. A factor of safety is calculated by dividing the forces resisting movement by the forces driving movement. A higher factor of safety means that a slope is less likely to fail; a lower factor of safety indicates slope instability. Generally, a factor of safety of 1.5 is considered suitable for new development (sometimes referred to as the "static" factor of safety). In earthquake-prone areas, such as the project site, an additional analysis is typically included where the seismic forces from a potential earthquake are added to the analysis (sometimes referred to as the "pseudo-static" factor of safety). Generally, a pseudo-static factor of safety of 1.1 is considered adequate for new development.

The initial slope stability analysis for the project site (PCEI 2006) did not determine a minimum factor of safety for all potential failure modes. The calculated factor of safety for the assumed failure surface was deemed to be 2.54 for the project site. According to Dr. Johnsson, this is a much higher factor of safety than typically reported for coastal bluffs of this height and inclination. Indeed, a failure of the upper bluff below the project sites that occurred in early 2009 (see page 10 of **Exhibit 5**) demonstrates that the bluffs at this location do not have such an unusually high factor of safety. Such a bluff failure indicates that, at that time, the forces driving the slide exceeded the forces resisting the slide, meaning that the factor of safety dropped below 1.0.

Dr. Johnsson requested that the project's geotechnical engineer provide additional information

[10] As discussed above, in the time since Dr. Johnsson's memorandum, the observed trend for global sea level has been a long term, persistent rise, and the most recent reports have considered the 56-66 inches of rise to be useful in encompassing the probable rise that could occur by 2100.

regarding the calculation of the factor of safety with respect to the soil strength parameters used and the minimum factor of safety for a circular failure surface. PCEI 2009 (see pages 52-55 of **Exhibit 6**) provided supporting documentation for the soil strength parameters, and Dr. Johnsson reviewed this documentation and concluded that the parameters were reasonable. The PCEI 2009 report contained an analysis of a circular failure of the upper bluff terrace deposits (which is the most likely type of failure to occur and is the analysis that was requested by Dr. Johnsson) but did not include an analysis of the global stability of the entire bluff. In addition, the Applicant provided a pseudo-static analysis, but not a static analysis. In any event, the Applicant's slope stability analysis under pseudo-static conditions indicates that a factor of safety of 1.1 was found to be located about 8 feet landward of the bluff edge. For the arroyo-facing slope, the static factors of safety were 1.6 to 2.2, indicating that the arroyo bluffs are currently stable.

Regional Studies by the U.S. Geological Survey and the California Energy Commission
In 2007 the U.S. Geological Survey (USGS) released a report that evaluated the long-term average bluff erosion rate along the California coast. For the stretch of coast located adjacent to the project sites, the rates were generally 0.66 to 0.98 feet per year.[11] These numbers are consistent with those previously reported by other experts in the field[12] and are consistent with those ultimately used by the Applicant's geologist (Zinn 2009; see pages 43-51 of Exhibit 5).[13] In March 2009, the California Energy Commission released a report that evaluated the impacts of future sea level rise on the California coast. This report cited sea level rise forecasts between 1.0 meter (about 3 feet) and 1.4 meters (about 4.5 feet) of rise by 2100. The report included a set of hazard maps showing the project area at high risk from coastal erosion using the erosion rate from the 2007 USGS study in combination with the predicted increase in wave attack based on the 1.4 meter sea-level rise scenario. For the project sites, this "erosion high hazard area" included the first 112 feet inland from the current bluff edge.

Commission's Original Action
In the original proceedings before the Commission on the subject applications, there was a difference of opinion between the Applicant's experts and Commission staff as to what the LCP-required setback should be for the development proposed at this site. After consideration of the site characteristics, including site geological conditions, slope stability requirements, future sea level rise and bluff retreat, discussed above, Dr. Johnsson recommended a minimum 116-foot setback to ensure that new development would be safe from coastal hazards for the LCP required minimum 100 years. By contrast, the Applicant's experts asserted that a 28-32 foot setback would be sufficient to satisfy this LCP requirement. The Commission ultimately adopted findings in support of 116 feet being the appropriate setback over 100 years.

Analysis
Bluff Setback
Because the proposed residence on Lot 1 would be set back approximately 120 feet from the edge of the coastal bluff, it meets the minimum 100 years of stability for new development.

[11] Hapke, C.J., and Reid, D., 2007, National Assessment of Shoreline Change, Part 4: Historical Coastal Cliff Retreat along the California Coast, U.S. Geological Survey, 51 pp.

[12] For example: Griggs, G., Patsch, K., and Savoy, L., 2005, *Living with the changing California Coast:* Berkeley, California, University of California Press, 540 pp.

[13] Zinn originally estimated long-term average erosion between 0.09 and 0.3 feet per year at the top of the bluff (Zinn 2006) and later adjusted this estimate to be 1 to 2 feet per year over the whole bluff (Zinn 2009).

Development on Lot 2 would place new development in a location that is subject to numerous coastal hazards. There is conflicting evidence in the record, however, with respect to the appropriate bluff setback for Lot 2. Dr. Johnsson determined that that the appropriate 100-year bluff setback for Lot 2 equaled a minimum of 116 feet and the Applicant's experts opined that 28-32 feet was adequate. This issue was one of the subjects of the litigation between the Applicant and the Commission, and the court signaled its intention to rule that the Applicant's expert's setback was adequate in this case. In order to facilitate settlement of this litigation, the Applicant proposes an approximate 45-foot setback, or some 15 feet more setback than the original project. With conditions designed to ensure that the proposed development here will not be allowed shoreline protection, and to ensure that natural processes are allowed to continue, and in an effort to settle this litigation, the Commission agrees to site the residence on Lot 2 approximately 45 feet from the bluff edge. The LCP hazards provisions are implemented through requirements for the Applicant to assume all of the risk for developing in an area of coastal hazards, to monitor bluff retreat and to remove development that becomes threatened by such hazards (as opposed to pursuing armoring), to limit residential redevelopment, and to implement drainage and landscaping plans on the most downcoast portion of the site. In short, development on the site would be removed over time to allow natural shoreline processes to continue as they would otherwise, as much as possible, to avoid the loss of beach and other attendant impacts associated with shoreline structures and development at the shoreline interface more broadly. Thus, as modified and conditioned for the unique circumstances of this particular case, and to settle litigation, the Commission approves the proposed project, consistent with the overall purpose of the LCP with respect to coastal hazards.

Specifically, for both Lot 1 and Lot 2, **Special Condition 1** requires the submission of revised plans that are in substantial conformance with the submitted site plan (**Exhibit 3**) including a defined building envelope for Lots 1 and 2 and a portion of Lot 3. The projects are also conditioned to require that the Applicant acknowledge that the sites are subject to extreme coastal hazards, including episodic and long-term shoreline retreat and coastal erosion, high seas, ocean waves, storms, etc., and that the Applicant and all successors in interest assume all risks for development in an area subject to coastal hazards (See **Special Conditions 4, 5 and 6**). Furthermore, **Special Condition 5(b)** expressly prohibits the use of any type of shoreline protective device for the purpose of protecting the proposed development and **Special Condition 5(c)** waives any future right to a shoreline protective structure for the proposed development. **Special Conditions 5(d) and (e)** further require that the Applicant report to the Commission in the event the edge of the bluff recedes to within ten feet of either residence, and require the property owner to remove and/or relocate any development that becomes threatened by coastal hazards and restore the site. **Special Condition 6** ensures that any redevelopment of the approved development be sited and designed to ensure geologic and engineering stability without reliance on shoreline protective devices. Finally, **Special Condition 9** requires the record owner of Lot 3 to submit proof to the Executive Director that the owner has voluntarily recorded a conservation easement over Lot 3.

Drainage Plan

The originally proposed drainage plan included shared drainage improvements with a drainage line to be bored through the coastal bluff that would empty out into a rock dissipater that would

be constructed in the adjacent arroyo on property not owned by the Applicant. Development of such a drainage system raises a number of LCP-conformity issues, including those related to arroyo resource protection. Perhaps more importantly in this case, such arroyo development is currently prohibited, and thus such a drainage apparatus could not be sited as proposed. Specifically, the arroyo area is subject to an easement offer, which requires that this area be protected as public open space, and which prohibits the installation of structures such as the drainage structures proposed. Fortunately, the Applicant indicates that all drainage can be handled on site, thus eliminating the need for a drainage line extending to the arroyo. **Special Condition 1(e)** requires submission of a drainage plan that shows all drainage retained through infiltration or other means on the undeveloped portions of the project site in such a way that does not exacerbate geologic hazards or degrade visual resources (see also visual resource findings that follow). **Special Condition 2** requires submission and maintenance of a Construction Plan to ensure Best Management Practices are implemented during construction to avoid water quality and other impacts during construction. **Special Condition 3** requires a construction coordinator to be available to respond to any inquiries that arise during construction.

Coastal Act Section 30620(c)(1) authorizes the Commission to require applicants to reimburse the Commission for expenses incurred in processing CDP applications.[14] Thus, the Commission is authorized to require reimbursement for expenses incurred in defending its action on the pending CDP application in the event that the Commission's action is challenged by a party other than the Applicant. Therefore, consistent with Section 30620(c), the Commission imposes requiring reimbursement for any costs and attorneys' fees that the Commission incurs in connection with the defense of any action brought by a party other than the Applicant challenging the approval or issuance of these permits (**Special Condition 7**).

The terms and conditions of this approval are meant to be perpetual. In order to inform future owners of the requirements of the permit, this approval is conditioned to require recordation of deed restrictions that will record the project conditions against the affected properties (see **Special Condition 8**).

2. Visual Resources

Applicable Policies

The LCP has multiple provisions that require development to be sited and designed to ensure protection of significant visual resources, including views within mapped scenic resource areas. Such policies and protections specifically protect areas having regional public importance for their natural beauty by ensuring that new development is appropriately sited and designed to have minimal to no adverse impact upon identified visual resources. Views from beaches and parks (including the public access overlook and path associated with Hidden Beach County Park in this case) are protected visual resources under the LCP.

Analysis

The proposed project site is located on a section of undeveloped coastal bluff that forms a peninsula of sorts between the County Park's public access path, overlook, and the beach. This

[14] See also California Code of Regulations Title 14 Section 13055(g).

peninsula slopes down from the higher coastal bluff (110 to 130 feet above sea level) located just upcoast, and terminates in the beach-level arroyo just east of the project sites. The elevation of the three lots ranges from about 50 to 90 feet above sea level. Thus, these lots are more visible from the adjacent beach and path compared to the blufftop lots located just upcoast on Bayview Drive that are at a higher elevation (110 to 130 feet above sea level). In addition, the existing residence directly upcoast of the project site is single-story and less intense than the residential development located farther upcoast and downcoast of the project sites, and this residence is the first seen from the beach and park extending upcoast along the bluff.

Lot 1
The proposed residence on Lot 1 is consistent with the LCP's visual resources policies due to its smaller size and its location approximately 120 feet back from the edge of the coastal bluff, and also because it is fairly removed from the Hidden Beach County Park public access path and overlook area (i.e., Lot 1 is an inland lot that is closest to Bayview Drive). While it is acknowledged that development at this location would be visible from within the public viewshed, its location away from the bluff and near Bayview Drive (and directly adjacent to inland residential development) should temper its public viewshed impact, including because of intervening vegetation and topography. Landscape screening consistent with **Special Condition 1(f)** will ensure that any residual viewshed impacts associated with single-family residential development on Lot 1 are consistent with the LCP.

Lots 2 and 3
Lot 3 is the closest to the Hidden Beach County Park Path and overlook. Only a very small portion of Lot 3 (i.e., located between the two proposed single-family dwellings (SFDs) on Lots 1 and 2) will be developed with parking and infrastructure. Lot 2 is located farther away from the path, but will still be visible from the public path and the beach. Therefore the proposed development could have a negative impact on the natural setting and viewshed as seen from the beach and the Hidden Beach Park public access trail and overlook area. In order to mitigate this impact, the Applicant proposes to set the residence back some 45 feet from the bluff top, and the project has been conditioned to require screening of the residence to protect public views (see **Special Condition 1(f)**.) Moreover, the Applicant's proposal to permanently preserve the majority of Lot 3 in an undeveloped state through recordation of a conservation easement will preserve the most visually prominent portion of the site as a natural buffer area, and ensure that Lot 3 is never developed with a single-family dwelling.

In short, the residences have been sited way from the beach viewshed as far as possible while still allowing for the residential development, and development would be limited to the most upcoast portion of the site, thereby protecting the main views from the overlook and the beach access trail as much as possible. With screening and landscaping, the residential development should not block significant public views, and can be made to blend effectively into the backbeach portion of the viewshed. In addition, the most sensitive portion of the site visually (i.e., the most downcoast parcel, Lot 3) would be voluntarily placed in a permanent conservation easement, thereby maintaining a level of natural buffer between the most prominent public viewing areas and the proposed development. With these conditions and project elements, the development can be found consistent with the visual resource protection policies of the certified LCP.

3. Public Access and Recreation

Applicable Policies

Coastal Act Section 30604(c) requires that every CDP issued for any development between the nearest public road and the sea "shall include a specific finding that the development is in conformity with the public access and public recreation policies of [Coastal Act] Chapter 3." The proposed project is located seaward of the first through public road and thus such a finding is required for a CDP approval. Coastal Act Sections 30210 through 30213 and 30221 specifically protect public access and recreation. Likewise the LCP provides similar and related protection for such public recreational resources. See **Exhibit 4** for these applicable Coastal Act and LCP policies.

Analysis

Public access to and from the beach is provided by two existing well-used public access trails, one located on each side of the arroyo. On the upcoast side of the arroyo, the path is a narrow unpaved footpath that extends primarily adjacent to residential fences and related development from the sandy beach back to Hidden Beach Way. Downcoast is the wider and partially paved Hidden Beach County Park trail. These trails provide public access to the beach from the existing residential neighborhood and through Hidden Beach County Park. In addition, the sandy beach at Hidden Beach is well used. Within this context, although clearly the subject property could augment and enhance public access in relation to existing public use areas, it is not required for Coastal Act and LCP consistency. Access, including over the offered arroyo, is adequate, and there is not a compelling need for use of the subject property for this purpose.

Thus, the project site is not necessary for direct public access, and thus development on Lots 1 and 2 and a portion of Lot 3 can also be found consistent with Coastal Act and LCP public access and recreation requirements.

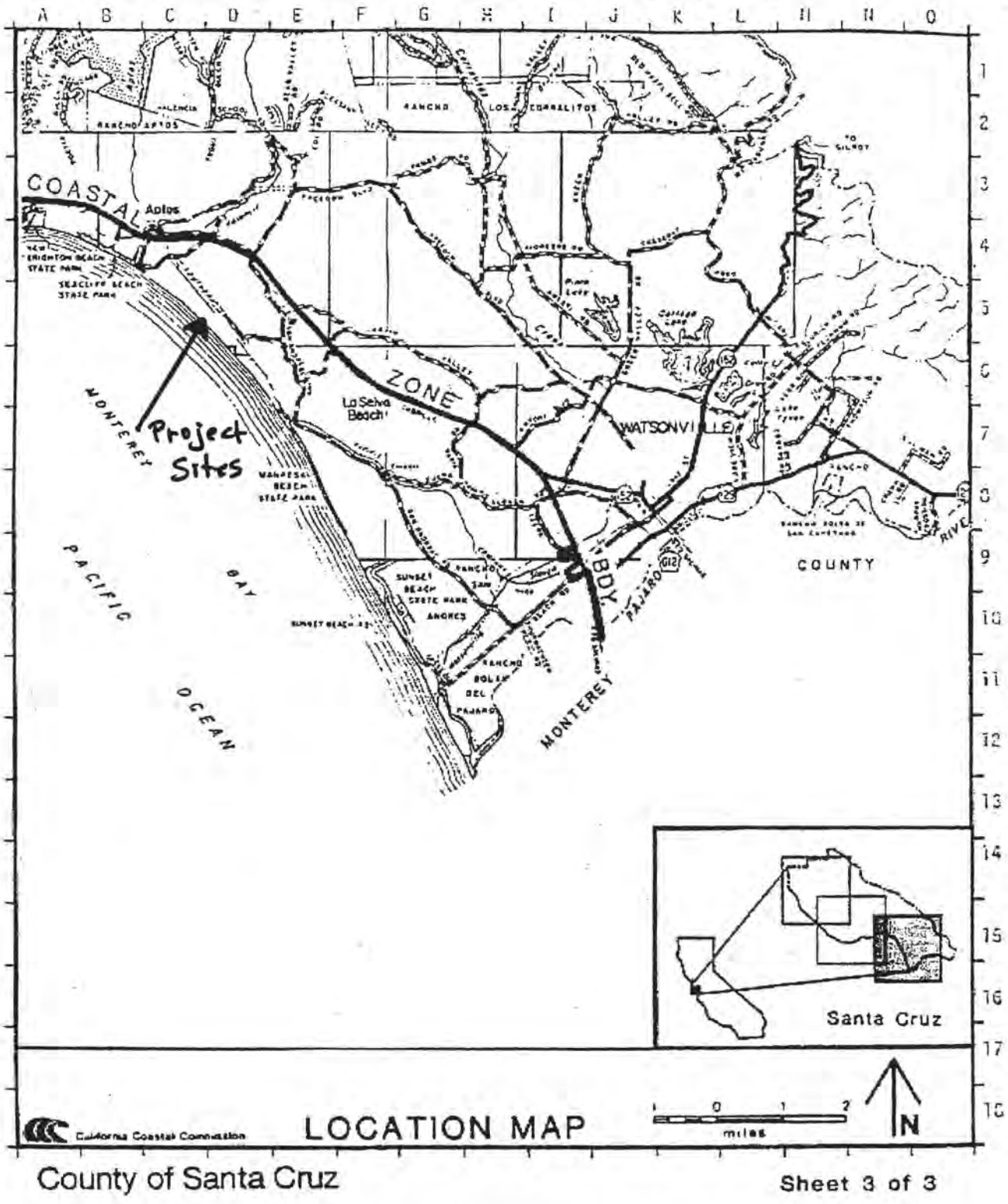
4. California Environmental Quality Act (CEQA)

Section 13096 of the California Code of Regulations requires that a specific finding be made in conjunction with coastal development permit applications showing the application to be consistent with any applicable requirements of 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 which the activity may have on the environment.

Santa Cruz County, acting as the lead CEQA agency, exempted the development from environmental review pursuant to Section 15303 of CEQA.

The Coastal Commission's review and analysis of land use proposals has been certified by the Secretary of Resources as being the functional equivalent of environmental review under CEQA. The Commission has reviewed the relevant coastal resource issues associated with the proposed development, and has identified appropriate and necessary modifications to address adverse impacts to such coastal resources. All public comments received to date have been addressed in the findings above. All above findings are incorporated herein in their entirety by reference.

The Commission finds that only as modified and conditioned by this CDP will the proposed development avoid significant adverse effects on the environment within the meaning of CEQA. As such, there are no additional feasible alternatives or feasible mitigation measures available which would substantially lessen any significant adverse environmental effects that approval of the proposed development, as modified, would have on the environment within the meaning of CEQA. If so modified, the proposed development will not result in any significant environmental effects for which feasible mitigation measures have not been employed consistent with CEQA Section 21080.5(d)(2)(A).



County of Santa Cruz

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Exhibit 1
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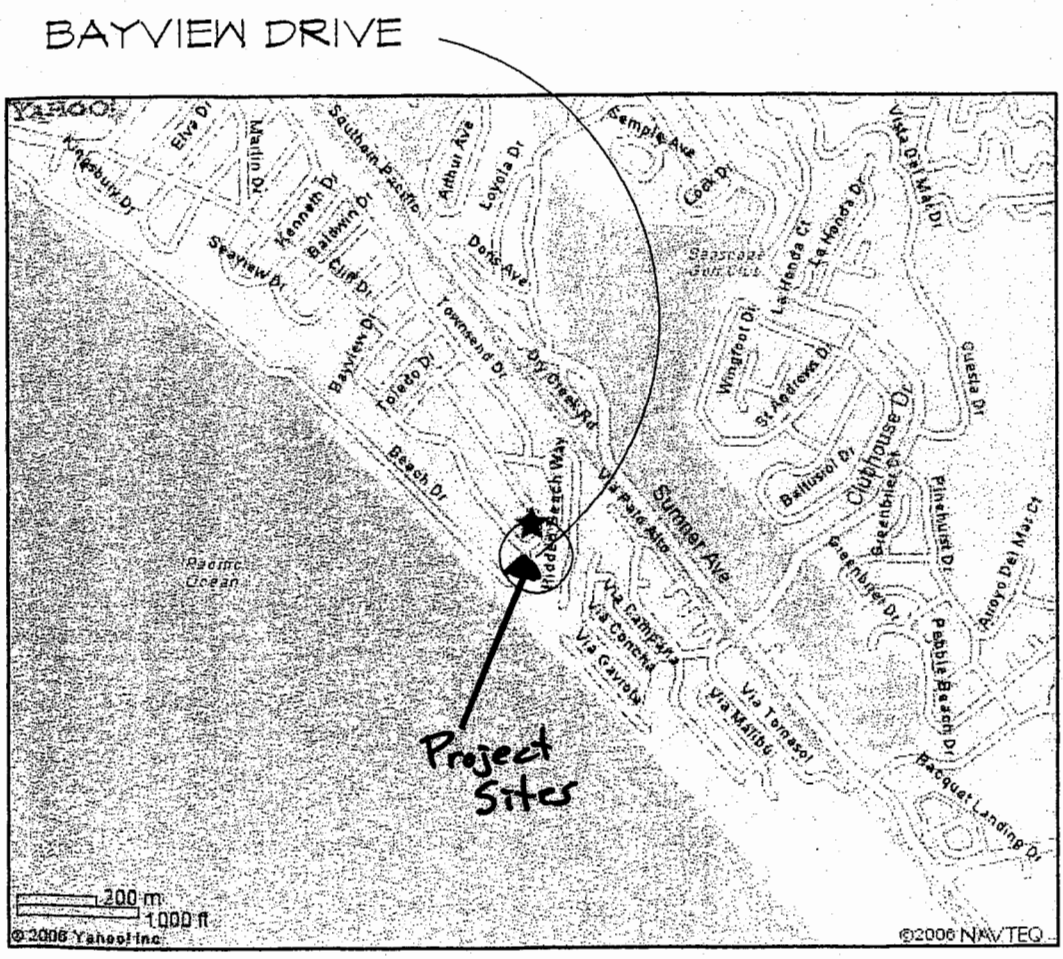

VICINITY MAP

Exhibit 1
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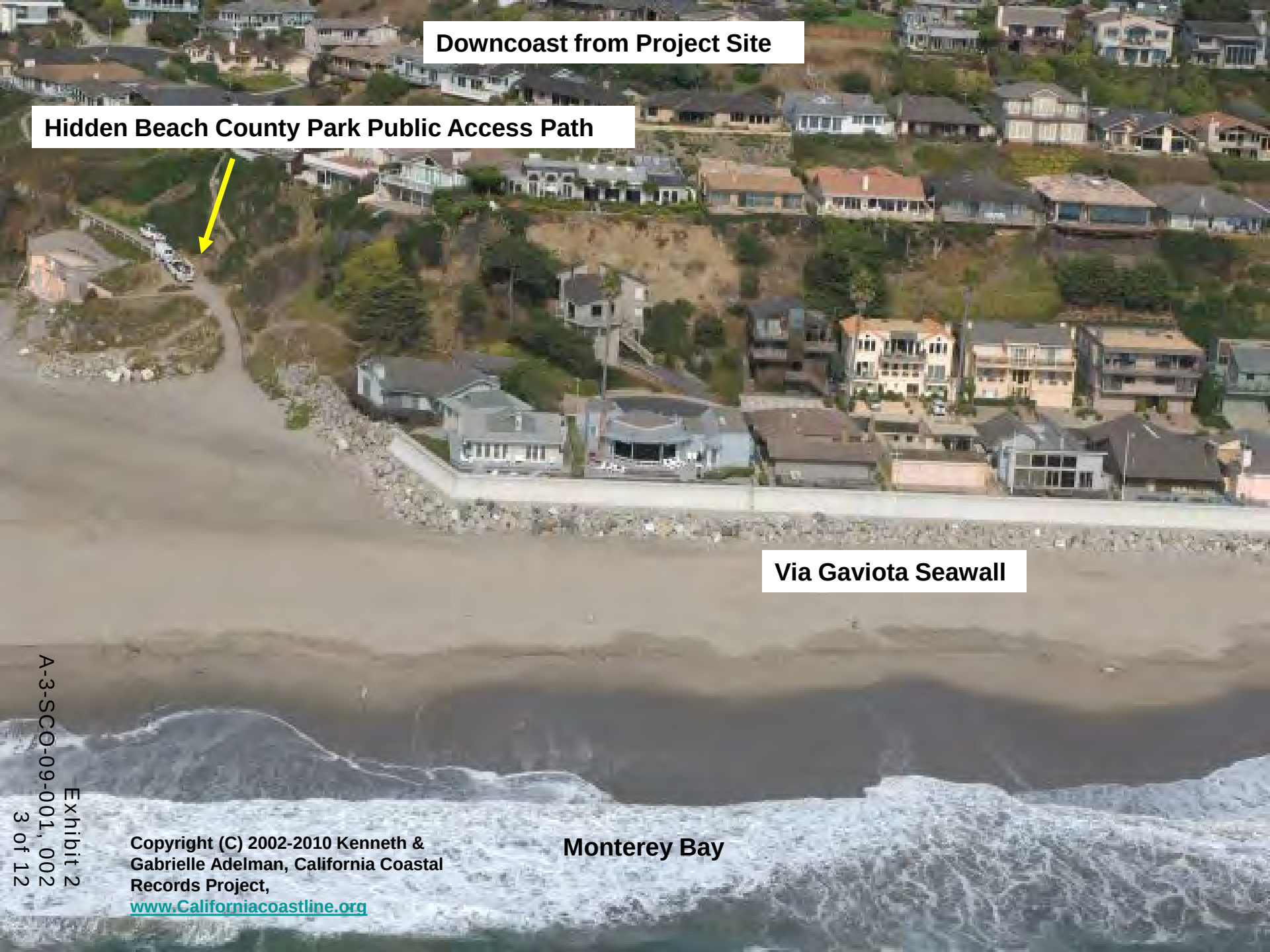

Exhibit 2
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View of Project Site from Public Access Path

Exhibit 2
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Exhibit 2
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Piles of kelp and logs at base of bluff
(photo taken 1.26.2010)

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Beach, coastal bluff, and arroyo entrance at base of project sites, February 2010


Base of bluff below
project site,
February 2010
Ocean water line
at base of bluff

Public Access path to Hidden Beach Way (path is located on the upcoast side of the arroyo)

2009 Bluff Failure
(photo taken 3.4.2009)

SITE PLAN

SCALE: 1" = 16'

SITE LEGEND

PL	PROPERTY LINE
SL	SETBACK LINE
	LINE OF DEVELOPMENT ENVELOPE
	(N) BUILDING FOOTPRINT
	(N) CONCRETE DRIVEWAY OR WALKWAY
	(N) SAND PAVERS
TREE	EXISTING TREE TO BE REMOVED. SEE ARBORIST'S REPORTS DATED JULY 11, 2007 & NOV. 7, 2007 FOR MORE INFORMATION. TREE NUMBERS INDICATED REFERENCE THOSE REPORTS.
	(N) RESIDENCE

NOTES:
THE PLAN IS PREPARED WITH INFORMATION PROVIDED BY THE SURVEY PREPARED BY GARY IFLAND & ASSOC. SEE ORIGINAL SURVEY LOCATED AS THE LAST SHEET OF THIS SET.

MATSON BRITTON ARCHITECTS
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SANTA CRUZ
CA 95062

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REVISION

FRANK RESIDENCE
NEW RESIDENCES
SEAVIEW DRIVE
APTOS, CA 95003
A.P.N. 043-161-39, 40 & 50

SITE PLAN

DATE: 5/21/15
DRAWN:
JOB: FRANK SEAVIEW
SHEET: P1

Exhibit 3
A-3-SCO-09-001, -002
1 of 1

APPLICABLE COASTAL ACT PUBLIC ACCESS AND RECREATION POLICIES

30210: *In carrying out the requirement of Section 4 of Article X of the California Constitution, maximum access, which shall be conspicuously posted, and recreational opportunities shall be provided for all the people consistent with public safety needs and the need to protect public rights, rights of private property owners, and natural resource areas from overuse.*

30211: *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.*

30212.5: *Wherever appropriate and feasible, public facilities, including parking areas or facilities, shall be distributed throughout an area so as to mitigate against the impacts, social and otherwise, of overcrowding or overuse by the public of any single area.*

30213 (in relevant part): *Lower cost visitor and recreational facilities shall be protected, encouraged, and, where feasible, provided. Developments providing public recreational opportunities are preferred.*

30214: ***(a)*** *The public access policies of this article shall be implemented in a manner that takes into account the need to regulate the time, place, and manner of public access depending on the facts and circumstances in each case including, but not limited to, the following: (1) topographic and geologic site characteristics. (2) The capacity of the site to sustain use and at what level of intensity. (3) The appropriateness of limiting public access to the right to pass and repass depending on such factors as the fragility of the natural resources in the area and the proximity of the access area to adjacent residential uses. (4) The need to provide for the management of access areas so as to protect the privacy of adjacent property owners and to protect the aesthetic values of the area by providing for the collection of litter.* ***(b)*** *It is the intent of the Legislature that the public access policies of this article be carried out in a reasonable manner that considers the equities and that balances the rights of the individual property owner with the public's constitutional right of access pursuant to Section 4 of Article X of the California Constitution. Nothing in this section or any amendment thereto shall be construed as a limitation on the rights guaranteed to the public under Section 4 of Article X of the California Constitution.*
(c) In carrying out the public access policies of this article, the commission and any other responsible public agency shall consider and encourage the utilization of innovative access management techniques, including, but not limited to, agreements with private organizations which would minimize management costs and encourage the use of volunteer programs.

30220: *Coastal areas suited for water-oriented recreational activities that cannot readily be provided at inland water areas shall be protected for such uses.*

30221: *Oceanfront land suitable for recreational use shall be protected for recreational use and development unless present and foreseeable future demand for public or commercial recreational activities that could be accommodated on the property is already adequately provided for in the area.*

30223: Upland areas necessary to support coastal recreational uses shall be reserved for such uses, where feasible.

30240 (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.

Applicable Santa Cruz County LCP Policies and Implementation Plan Standards

LCP VISUAL RESOURCE OBJECTIVES

Objective 5.10a Protection of Visual Resources
(LCP) To identify, protect and restore the aesthetic values of visual resources.

Objective 5.10b New Development in Visual Resource Areas
(LCP) To ensure that new development is appropriately designed and constructed to have minimal to no adverse impact upon identified visual resources.

LCP VISUAL RESOURCE POLICIES AND IP STANDARDS

5.10.1 Designation of Visual Resources
(LCP) Designate on the General Plan and LCP Resources Maps and define visual resources as areas having regional public importance for their natural beauty or rural agricultural character. Include the following areas when mapping visual resources: vistas from designated scenic roads, Coastal Special Scenic Areas, and unique hydrologic, geologic and paleontologic features identified in Section 5.9.

5.10.2 Development Within Visual Resource Areas
(LCP) Recognize that visual resources of Santa Cruz County possess diverse characteristics and that the resources worthy of protection may include, but are not limited to, ocean views, agricultural fields, wooded forests, open meadows, and mountain hillside views. Require projects to be evaluated against the context of their unique environment and regulate structure height, setbacks and design to protect these resources consistent with the objectives and policies of this section. Require discretionary review for all development within the visual resource area of Highway One, outside of the Urban/Rural boundary, as designated on the GP/LCP Visual Resources Map and apply the design criteria of Section 13.20.130 of the County's zoning ordinance to such development.

5.10.3 Protection of Public Vistas
(LCP) Protect significant public vistas as described in policy 5.10.2 from all publicly used roads and vista points by minimizing disruption of landform and aesthetic character caused by grading operations, timber harvests, utility wires and poles, signs, inappropriate landscaping and structure design. Provide necessary landscaping to screen development which is unavoidably sited within these vistas. (See policy 5.10.11.)

5.10.6 Preserving Ocean Vistas
(LCP) Where public ocean vistas exist, require that these vistas be retained to the maximum extent possible as a condition of approval for any new development.

5.10.7 Open Beaches and Bluff-tops
(LCP) Prohibit the placement of new permanent structures which would be visible from a public beach, except where allowed on existing parcels of record, or for shoreline protection and for public beach access. Use the following criteria for allowed structures:
(a) Allow infill structures (typically residences on existing lots of record) where compatible with the pattern of existing development.
(b) Require shoreline protection and access structures to use natural materials and finishes to blend with the character of the area and integrate with the landform.

IP Section 13.20.130(b)(1)
Entire Coastal Zone. The following Design Criteria shall apply to projects sited anywhere in the coastal zone: 1. Visual Compatibility. All new development shall be sited, designed and landscaped to be visually compatible and integrated with the character of surrounding neighborhoods or areas.

IP Section 13.20.130(d)
Beach Viewsheds. The following Design Criteria shall apply to all projects located on blufftops and visible from beaches. 1. Blufftop Development. Blufftop development and landscaping (e.g., decks, patios, structures, trees, shrubs, etc.) in rural areas shall be set back from the bluff edge a sufficient distance to be out of sight from the shoreline, or if infeasible, not visually intrusive. In urban areas of the viewshed, site development shall conform to (c) 2 and 3 above.

IP Sections 13.20.130(c)(2)(3)
2. Site Planning. Development shall be sited and designed to fit the physical setting carefully so that its presence is subordinate to the natural character of the site, maintaining the natural features (streams, major drainage, mature trees, dominant vegetative communities). Screening and landscaping suitable to the site shall be used to soften the visual impact of development in the viewshed.
3. Building Design. Structures shall be designed to fit the topography of the site with minimal cutting, grading, or filling for construction. Pitched, rather than flat roofs, which are surfaced with non-reflective materials except for solar energy devices shall be encouraged. Natural materials and colors which blend with the vegetative cover of the site shall be used, or if the structure is located in an existing cluster of buildings, colors and materials shall repeat or harmonize with those in the cluster.

LCP GEOLOGICAL HAZARDS POLICIES

6.2.10 Site Development to Minimize Hazards
(LCP) Require all developments to be sited and designed to avoid or minimize hazards as determined by the geologic hazards assessment or geologic and engineering investigations.

6.2.11 Geologic Hazards Assessment in Coastal Hazard Areas
(LCP) Require a geologic hazards assessment or full geologic report for all development activities within coastal hazard areas, including all development activity within 100- feet of a coastal bluff. Other technical reports may be required if significant potential hazards are identified by the hazards assessment.

6.2.12 Setbacks from Coastal Bluffs
(LCP) All development activities, including those which are cantilevered, and non-habitable structures for which a building permit is required, shall be set back a minimum of 25 feet from the top edge of the bluff. A setback greater than 25 feet may be required based on conditions on and adjoining the site. The setback shall be sufficient to provide a stable building site over the 100- year

lifetime of the structure, as determined through geologic and/or soil engineering reports. The determination of the minimum 100 year setback shall be based on the existing site conditions and shall not take into consideration the effect of any proposed shoreline or coastal bluff protection measures.

6.2.15 New Development on Existing Lots of Record
(LCP) Allow development activities in areas subject to storm wave inundation or beach or bluff erosion on existing lots of record, within existing developed neighborhoods, under the following circumstances:
(a) A technical report (including a geologic hazards assessment, engineering geology report and/or soil engineering report) demonstrates that the potential hazard can be mitigated over the 100-year lifetime of the structure. Mitigations can include, but are not limited to, building setbacks, elevation of the structure, and foundation design;
(b) Mitigation of the potential hazard is not dependent on shoreline or coastal bluff protection structures, except on lots where both adjacent parcels are already similarly protected; and
(c) The owner records a Declaration of Geologic Hazards on the property deed that describes the potential hazard and the level of geologic and/or geotechnical investigation conducted.

6.2.16 Structural Shoreline Protection Measures (in relevant part)
(LCP) Limit structural shoreline protection measures to structures which protect existing structures from a significant threat, vacant lots which through lack of protection threaten adjacent developed lots, public works, public beaches, or coastal dependent uses.

6.2.19 Drainage and Landscape Plans
(LCP) Require drainage and landscape plans recognizing potential hazards on and off site to be approved by the County Geologist prior to the approval of development in the coastal hazard areas. Require that approved drainage and landscape development not contribute to offsite impacts and that the defined storm drain system or Best Management Practices be utilized where feasible. The applicant shall be responsible for the costs of repairing and/or restoring any off-site impacts.

6.4.3 Development on or Adjacent to Coastal Bluffs and Beaches
(LCP) Allow development in areas immediately adjacent to coastal bluffs and beaches only if a geologist determines that wave action, storm swell and tsunami inundation are not a hazard to the proposed development or that such hazard can be adequately mitigated. Such determination shall be made by the County Geologist, or a certified engineering geologist may conduct this review at applicant's choice and expense. Apply Coastal Bluffs and Beaches policies.

APPLICABLE LCP IMPLEMENTATION PLAN STANDARDS RE: HAZARDS

Section 16.10.070(e) Slope Stability.
1. Location: All development activities shall be located away from potentially unstable areas as identified through the geologic hazards assessment, full geologic report, soils report or other environmental or technical assessment.

2. Creation of New Parcels: Allow the creation of new parcels in areas with potential slope instability as identified through a geologic hazards assessment, full geologic report, soils report or other environmental or technical assessment only under the following circumstances: (i) New building sites, roadways, and driveways shall not be permitted on or across slopes exceeding thirty (30) percent grade. (ii) A full geologic report and any other appropriate technical report shall demonstrate that each proposed parcel contains at least one building site and access which are not subject to significant slope instability hazards, and that public utilities and facilities such as sewer,

gas, electrical and water systems can be located and constructed to minimize landslide damage and not cause a health hazard. (iii) New building sites shall not be permitted which would require the construction of engineered protective structures such as retaining walls, diversion walls, debris walls or slough walls designed to mitigate potential slope instability problems such as debris flows, slumps or other types of landslides.

3. Drainage: Drainage plans designed to direct runoff away from unstable areas (as identified from the geologic hazards assessment or other technical report) shall be required. Such plans shall be reviewed and approved by the County Geologist.

16.10.070(h) Coastal Bluffs and Beaches.

1. Criteria in Areas Subject to Coastal Bluff Erosion: Projects in areas subject to coastal bluff erosion shall meet the following criteria: (i) for all development and for non-habitable structures, demonstration of the stability of the site, in its current, pre-development application condition, for a minimum of 100 years as determined by either a geologic hazards assessment or a full geologic report. (ii) for all development, including that which is cantilevered, and for non-habitable structures, a minimum setback shall be established at least 25 feet from the top edge of the coastal bluff, or alternatively, the distance necessary to provide a stable building site over a 100-year lifetime of the structure, whichever is greater. (iii) the determination of the minimum setback shall be based on the existing site conditions and shall not take into consideration the effect of any proposed protection measures, such as shoreline protection structures, retaining walls, or deep piers. (iv) foundation replacement and/or foundation upgrades that meet the definition of development per Section 16.10.040(s) and pursuant to Section 16.10.040(r), shall meet the setback described in Section 16.10.070(h)(1), except that an exception to the setback requirement may be granted for existing structures that are wholly or partially within the setback, if the Planning Director determines that: a) the area of the structure that is within the setback does not exceed 25% of the total area of the structure, OR b) the structure cannot be relocated to meet the setback because of inadequate parcel size. (v) additions, including second story and cantilevered additions, shall comply with the minimum 25 foot and 100 year setback. (vi) The developer and/or the subdivider of a parcel or parcels in an area subject to geologic hazards shall be required, as a condition of development approval and building permit approval, to record a Declaration of Geologic Hazards with the County Recorder. The Declaration shall include a description of the hazards on the parcel and the level of geologic and/or geotechnical investigation conducted. (vii) approval of drainage and landscape plans for the site by the County Geologist. (viii) service transmission lines and utility facilities are prohibited unless they are necessary to serve existing residences. (ix) All other required local, state and federal permits shall be obtained.

16.10.070(h)(3)(i) Shoreline Protection.

3. Shoreline protection structures shall be governed by the following: (i) Shoreline protection structures shall only be allowed on parcels where both adjacent parcels are already similarly protected, or where necessary to protect existing structures from a significant threat, or on vacant parcels which, through lack of protection threaten adjacent developed lots, or to protect public works, public beaches, and coastal dependent uses.

16.22.070 Runoff control.

Runoff from activities subject to a building permit, parcel approval or development permit shall be properly controlled to prevent erosion. The following measures shall be used for runoff control, and shall be adequate to control runoff from a ten-year storm:

(a) On soils having high permeability (more than two inches/hour), all runoff in excess of predevelopment levels shall be retained on the site. This may be accomplished through the use of

infiltration basins, percolation pits or trenches, or other suitable means. This requirement may be waived where the Planning Director determines that high groundwater, slope stability problems, etc., would inhibit or be aggravated by onsite retention, or where retention will provide no benefits for groundwater recharge or erosion control.

(b) On projects where onsite percolation is not feasible, all runoff should be detained or dispersed over nonerodible vegetated surfaces so that the runoff rate does not exceed the predevelopment level. Onsite detention may be required by the Planning Director where excessive runoff would contribute to downstream erosion or flooding. Any policies and regulations for any drainage zones where the project is located will also apply.

(c) Any concentrated runoff which cannot be effectively dispersed without causing erosion, shall be carried in nonerodible channels or conduits to the nearest drainage course designated for such purpose by the Planning Director or to on-site percolation devices. Where water will be discharged to natural ground or channels, appropriate energy dissipators shall be installed to prevent erosion at the point of discharge.

(d) Runoff from disturbed areas shall be detained or filtered by berms, vegetated filter stips, catch basins, or other means as necessary to prevent the escape of sediment from the disturbed area.

(e) No earth or organic material shall be deposited or placed where it may be directly carried into a stream, marsh, slough, lagoon, or body of standing water.

CALIFORNIA COASTAL COMMISSION
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18 June 2009

GEOTECHNICAL REVIEW MEMORANDUM

To: Susan Craig, Coastal Program Analyst
From: Mark Johnsson, Staff Geologist
Re: Appeals A-3-SCO-08-029, A-3-SCO-08-042, A-3-SCO-09-001, A-3-SCO-09-002, A-3-SCO-09-003 (Trousdale, Frank)

In connection with the above-referenced appeals, I have reviewed the following documents:

G.E. Weber Geologic Consultant, 2009, "Projecting future sea-level rise: What is a reasonable estimate for the next century?" 8 p. report dated 24 February 2009 and signed by G.E. Weber (CEG 1495).

Pacific Crest Engineering, 2009, "Response to California Coastal Commission comments, Trousdale residence, A.P.N. 043-161-57, 660 Bayview Drive, Rio del Mar, Santa Cruz County, California", 18 p. Geotechnical Report dated 26 February 2009 and signed by E.M. Mitchell (GE 2718).

Pacific Crest Engineering, 2009, "Response to California Coastal Commission comments, Lands of Frank, Bayview Drive, A.P.N. 043-161-51, -40, -39, Rio del Mar, Santa Cruz County, California", 27 p. Geotechnical Report dated 26 February 2009 and signed by E.M. Mitchell (GE 2718).

Zinn Geology, 2009, "Supplemental analysis in response to California Coastal Commission comments, Bayview Drive, Aptos, California, County of Santa Cruz APN 043-161-57 and 043-161-50", 9 p. letter report to Kelley and Cindy Trousdale dated 26 February 2009 and signed by E.N. Zinn (CEG 2139).

Zinn Geology, 2009, "Supplemental analysis in response to California Coastal Commission comments, Parcels southeast of Bayview Drive, Aptos, California, County of Santa Cruz APN's 043-161-51, -40, & -39", 9 p. letter report to Neil Frank dated 26 February 2009 and signed by E.N. Zinn (CEG 2139).

As is apparent from their titles, these reports were written in response to questions that I raised in an earlier review of geotechnical reports related to the proposed development of these parcels. Specifically, a request was made to evaluate future coastal erosion and bluff retreat to be expected on these parcels over the 100-year design life of the proposed development taking into account anticipated acceleration of the current rate of sea level rise. Further, I requested refined quantitative slope stability analyses that would supplement earlier analyses which I felt were too restrictive of potential failure mechanisms.

Future Sea Level Rise

The report by Weber, referenced above, is an evaluation of the amount of sea level rise that may occur over the next century. The report references much of the recent literature on sea level rise, and emphasizes estimates by the Intergovernmental Panel on Climate Change (2007) that range between 9 and 87 cm of sea level rise (with 90% confidence limits on the range 18-60 cm) by the year 2100. Weber states that "These ranges are generally consistent with the findings of other workers (Rahmsdorf [sic], 2007; Cayan et al., 2006)." Weber then goes on to emphasize the uncertainty in predicting future sea level rise, particularly pointing out uncertainty discussed in papers by Jevrejeva, Moore and Grinsted (2008), Church and White (2006), and Jevrejeva et al. (2008). Citing such uncertainty, he concludes that the least conservative estimate for sea-level rise should apply to single family residences (such as the proposed development), while "critical facilities" should assume a more conservative amount of sea-level rise. Weber concludes that for the proposed development

> "a reasonable assumption for sea level rise in the next century, to be applied to geologic hazard and risk analysis for single family residences is … equal to or greater than the total sea level rise in the 20th century and consistent with the rate of rise (acceleration) over the past 20-30 years. This number would lie someplace between 300-340 mm, approximately 11 to 13 inches."

I note that this amount of sea level rise is at the low end of what most researchers are now predicting for sea level rise over the next century. Indeed, as reported in a New York Times editorial (21 February 2009), the assumptions behind the 2007 IPCC estimates already appear to be outdated.

Commission staff has recently been recommending that analysis for the effects of sea level rise take a "sensitivity analysis" approach; assuming a minimum rate of 3 feet per century and a maximum of 6 feet per century. This recommendation is based on staff's research into the recent literature. The Commission recently adopted such an approach in an amendment to the City of Crescent City Local Coastal Plan, and it is staff's recommendation that this approach be adopted into future Local Coastal Programs as they are revised.

The rationale for this approach is explained in the findings for the City of Crescent City LCP Amendment No. CRC-MAJ-1-09:

> Sea level rise is an important consideration for the planning and design of projects in coastal settings. Such changes in sea level will exacerbate the frequency and intensity of wave energy received at shoreline sites, including both storm surge and tsunamis, resulting in accelerated coastal erosion and flooding in such locales. There are many useful records of historic sea level change, but little certainty about how these trends will change with possible large increases in atmospheric greenhouse gas emissions and air temperatures. Notwithstanding the controversy and uncertainties about future global or local sea levels, guidance on how to address sea level rise in planning and permitting process is evolving as new information on climate change and related oceanic responses become available.
>
> The Commission, like many others permitting agencies, have undertaken past assessments of sea level rise effects using the principal of "uniformitarianism" as guidance — that natural processes such as erosion, deposition, and sea level changes occur at relatively uniform rates over time

rather than in episodic or sudden catastrophic events. As a result, future ocean surface elevations have been extrapolated from current levels using historical rates of sea level rise measured over the last century. For much of the California coast, this equates to a rate of about eight inches per 100 years. Rates of up to one foot per century have typically been used to account for regional variation and to provide for some degree of uncertainty in the form of a safety factor. This rate of rise is then further adjusted upward or downward as needed depending upon other factors, such as localized subsidence or tectonic uplift

…

Most climate models now project that the historic trends for sea level rise, or even a 50% increase over historic trends, will be at the very low end of possible future sea level rise by 2100. Satellite observations of global sea level have shown sea level changes since 1993 to be almost twice as large as the changes observed by tide gauge records over the past century. Recent observations from the polar regions show rapid loss of some large ice sheets and increases in the discharge of glacial melt. The 2007 Fourth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC) notes that sea level could rise by 7 to 23 inches from 1990 to 2100, provided there is no accelerated loss of ice from Greenland and West Antarctica.[1] Sea level rise could be even higher if there is a rapid loss of ice in these two key regions.

The IPCC's findings were expanded to incorporate some increase in sea level rise by accelerated ice melt through a 2007 report prepared by Dr. Stefan Rahmstorf of the Potsdam Institute for Climate Impact Research (hereinafter "Rahmstorf Report"). This report has become the central reference point for much of recent sea level rise planning. The Rahmstorf Report developed a quasi-empirical relationship between historic temperature and sea level change. Using the temperature changes projected for the various IPCC scenarios, and assuming that the historic relationship between temperature and sea level would continue into the future, he projected that by 2100 sea level could be between 20 inches and 55 inches (0.5 to 1.4 meters) higher than the 1990 levels (for a rate of 0.18 to 0.5 inches/year). These projections for future sea level rise anticipate that the increase in sea level from 1990 to 2050 will be from about 8 inches to 17 inches (for a rate of 0.13 to 0.28 inches/year); from 1990 to 2075, the increase in sea level would be from about 13 inches to 31 inches (for a rate of 0.15 to 0.36 inches/year) and that the most rapid change in sea level will occur toward the end of the 21st century. Most recent sea level rise projections show the same trend as the projections by Rahmstorf — that as the time period increases the rate of rise increases and that the second half of the 21st century can be expected to have a more rapid rise in sea level than the first half.

Several recent studies have projected future sea level to rise as much as 4.6 feet from 1990 to 2100. For example, in California, the Independent Science Board (ISB) for the Delta Vision Plan has used the Rahmstorf Report projections in recommending that for projects in the San Francisco Delta, a rise of 0.8 to 1.3 feet by 2050 and 1.7 to 4.6 feet by 2100 be used for planning purposes.[2] This report also recommends that major projects use the higher values to be conservative, and that some projects might even consider sea level projections beyond the year 2100 time period. The ISB also recommends "developing a system that can not only withstand a design sea level rise, but also minimizes damages and loss of life for low-probability events or unforeseen circumstances that exceed design standards. Finally the board recommends the specific incorporation of the potential for higher-than-expected sea level rise rates into long term infrastructure planning and design."

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[1] The IPCC is a scientific intergovernmental body established by the World Meteorological Organization (WMO) and the United Nations Environmental Programme to provide the decision-makers and others interested in climate change with an objective source of information about climate change; http://www.ipcc.ch/ipccreports/assessments-reports.htm

[2] Independent Science Board, 2007. Sea Level Rise and Delta Planning, Letter Report from Jeffrey Mount to Michael Healey, September 6, 2007, CALFED Bay-Delta Program: http://deltavision.ca.gov/BlueRibbonTaskForce/Sept2007/Handouts/Item_9.pdf

The Rahmstorf Report was also used in the California Climate Action Team's Climate Change Scenarios for estimating the likely changes range for sea level rise by 2100.[3] Another recent draft report, prepared by Philip Williams and Associates and the Pacific Institute for the Ocean Protection Council, the California Energy Commission's Public Interest Energy Research (PIER) Climate Change Research Program, and other agencies also identifies impacts from rising sea level, especially as relate to areas vulnerable to future coastal erosion and flooding.[4] This report used the Rahmstorf Report as the basis to examine the flooding consequences of both a 40-inch and a 55-inch centurial rise in sea level, and the erosion consequences of a 55-inch rise in sea level.

On November 14, 2008, Governor Schwarzenegger issued Executive Order S-13-08, directing various state agencies to undertake various studies and assessments toward developing strategies and promulgating development review guidelines for addressing the effects of sea level rise and other climate change impacts along the California coastline.[5] Consistent with the executive order, at its June 4, 2009 meeting the governing board of the Coastal Conservancy will consider the adoption of interim sea level rise rates: (a) 16 inches (40 cm) by 2050; and (b) 55 inches (140 cm) by 2100 for use in reviewing the vulnerability of projects it funds [adopted 4 June 2009]. These rates are based on the PEIR climate scenarios. If adopted, these criteria would be utilized until the study being conducted by the National Academy of Sciences regarding sea level rise, requested by a consortium of state resource and coastal management agencies pursuant to the executive order, is completed.

Concurrently, in the Netherlands, where flooding and rising sea level have been national concerns for many years, the Dutch Cabinet-appointed Deltacommissie has recommended that all flood protection projects consider a regional sea level rise (including local subsidence) of 2.1 to 4.2 ft by 2100 and of 6.6 to 13 ft. by 2200.[6] Again, the Rahmstorf Report was used by the Delta Committee as a basis in developing their findings and recommendations.

Given the general convergence of agreement over the observed and measured geodetic changes world wide in ocean elevations over the last several decades, most of the scientific community has ceased debating the question of whether sea level will rise several feet higher than it is today, but is instead only questioning the time period over which this rise will occur. However, as the conditions causing sea level rise continue to change rapidly, prognostications of sea level rise are similarly in flux. As a result of this dynamism, anticipated amounts and rates of sea level rise used in project reviews today may be either lower or higher than those that will be utilized ten years from now. This degree of uncertainty will continue until sufficient feedback data inputs are obtained to allow for a clear trend to be discerned from what is now only a complex and highly variable set of model outputs. Accordingly, in the interest of moving forward from the debate over specific rates and amounts of rise to a point where the effects of sea level rise greater than those previously assumed in the past may be considered, one approach is to undertake an analysis on the development project and site to ascertain the point when significant changes to project stability would result based on a series or a range of sea level rise amounts. The analysis would be structured to use a variety of sea level rise projections, ranging from the relatively gradual rates of

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[3] Cayan et al. 2009. Draft Paper: Climate Change Scenarios and Sea Level Estimates for the California 2008 Climate Change Scenarios Assessment; CEC-500-2009-014-D, 62 pages; http://www.energy.ca.gov/2009publications/CEC-500-2009-014/CEC-500-2009-014-D.PDF

[4] Heberger, et al. 2009. Draft Paper: The Impacts of Sea Level Rise on the California Coast; California Climate Change Center, California Energy Commission; CEC-500-2009-024-D, March 2009, 99 pages; http://www.pacinst.org/reports/sea_level_rise/index.htm

[5] Office of the Governor of the State of California, 2008. Executive Order S-13-08; http://gov.ca.gov/index.php?/print-version/executive-order/11036/

[6] Delta Committee of the Kingdom of the Netherlands, 2008. Working Together with Water: A Living Land Builds for its Future, Findings of the Deltacommissie, 2nd Ed. November 2008; http://www.deltacommissie.com/en/advies

rise indicated by the IPCC and Rahmstorf models, to scenarios involving far more rapid rates of sea level rise based upon accelerated glacial and polar sea and shelf inputs.

For example, for the most typical development projects along the coast (i.e., residential or commercial), consideration of a two to three foot rise in level rise over 100 years could be assumed to represent the minimum rate of change for design purposes. However, in the interest of investigating adaptive, flexible design options, sensitivity testing should also include assessing the consequences of sea level rise at three to five times greater rates, namely five to six feet per century, for critical facilities or development with a long expected project life. The purpose of this analysis is to determine, if there is some "tipping point" at which a given design would rapidly become less stable, and to evaluate what would be the consequences of crossing such a threshold. This type of analysis would make the property owner aware of the limitations, if any, of the initial project design early in the planning process. Depending upon the design life of the development, the economic and technical feasibility of incorporating more protective features, and levels of risk acceptance, the project proponent could propose, or the permitting agency may require, that greater flexibility be provided in the design and siting of the development, or other mitigation be identified, to accommodate the higher rates of sea level rise.

This sea level range approach would allow accelerated rates of sea level rise to be considered in the analysis of projects. Such evaluations provide some flexibility with regard to the uncertainty concerning sea level rise, providing an approach to analyze project in the face of uncertainty that would not involve the imposition of mandatory design standards based upon future sea level elevations that may not actually be realized, and allowing flexibility in the acceptable amount of sea level rise for specific projects and for the best available scientific information at the time of review. Given the nonobligatory and adaptive nature of this approach to hazards avoidance and minimization, as necessitated by such scientific uncertainty, it will remain important to include new information on sea level trends and climate change as iterative data is developed and vetted by the scientific community. Accordingly, any adopted design or siting standards that may be applied to development projects should be re-examined periodically to ensure the standard is consistent with current estimates in the literature before being reapplied to a subsequent project.

Regardless of its particular rate, over time elevated sea level will have a significant influence on the frequency and intensity of coastal flooding and erosion. Accordingly, rising sea level needs to be considered to assure that full consistency with Section 30253 can be attained in the review and approval of new development in shoreline areas.

Staff has always recommended consideration of sea level rise when evaluating future erosion rates. Until recently, this has been done only qualitatively and was based on historic trends in sea level rise. Given our evolving understanding of the mechanisms of sea level rise, staff is now recommending an upward revision of the rate of sea level rise, to a minimum of 3 ft/century.

Coastal bluff retreat

The reports by Zinn Geology use the recommended sea level rise figure from the Weber report to estimate the amount of coastal bluff retreat to be expected over the next century at the subject sites. Given the discrepancy between the Weber value of sea level rise and the value recommended by staff, it is not surprising that the amount of upper bluff retreat estimated in these reports differs than what I estimate below.

The Zinn reports assume that in order for the proposed structures to be threatened, the beach fronting the coastal bluff would need to be removed by coastal erosion or drowned by rising sea

level; then the colluvial wedge at the base of the bluff would need to be eroded; and finally the coastal bluff would need to be eroded until a vertical projection of the base of the bluff would intersect the buildings' foundations. Working backwards from the latter condition, and assuming a bedrock erosion rate of 1 to 2 feet per year, the reports estimate that buildings sited as proposed would be threatened in 120.5 to 176 years (for the Trousdale parcels) and 107 to 161.5 to years (for the Frank parcels).

There are several assumptions built into this analysis with which I disagree. Most important is the assumption that the buildings will be threatened by *upper* bluff retreat at the same time as the bedrock has been eroded to a point vertically beneath the buildings' foundations. The bluffs at these locations, like most areas in coastal California, are not vertical. According to the cross sections in the Zinn reports, the entire bluff, including the colluvial wedge mantling its base, has an overall angle of approximately 48 degrees from the vertical; the inferred angle of the bedrock and marine terrace deposits beneath the colluvial wedge is approximately 30 degrees from the vertical. The bluffs are not vertical because of a combination of subaerial erosion processes and the fact that the bluff materials have insufficient strength to stand vertically. Accordingly, the upper bluff edge will intersect the building foundation long before the toe of the bluff lies vertically beneath them.

Second, the buildings will be "threatened" long before the upper bluff edge actually intersects the foundations. The LCP requires that stability be assured for the 100-year economic life of the development. The industry standard definition of stability for natural and artificial slopes is generally taken as a factor of safety against sliding of 1.5; that is, the forces tending to resist slope movement (essentially the strength of the bluff materials) must exceed the forces tending to initiate slope movement (essentially, the weight of the bluff materials as projected onto the most likely slide plane) by 50%. As discussed below, the point at which this level of stability is achieved is some distance landward of the bluff edge

Finally, this "working backward" approach does not account for the episodicity of coastal bluff erosion. Although there currently is a colluvial wedge mantling the site, reducing the rate of erosion of the toe of the bluff, its gradual removal will result in increased instability of the upper bluff, likely leading to catastrophic failure during which the bluff will retreat far faster than the 1 to 2 feet per year long term average cited in the report.

In my opinion, it is far preferable to evaluate the movement of the upper bluff edge through time and, taking account the distance from the upper bluff edge that a factor of safety of 1.5 is achieved, evaluate setbacks with respect to the upper bluff edge.

Slope Stability

During an initial assessment of slope stability of these properties, Pacific Crest Engineering assumed a particular failure surface based on "the project geologist's understanding and experience with bluff failures along this area of coastline." Unlike typical slope stability analyses, a minimum factor of safety of all potential failure modes was not determined. The factor of safety calculated for these assumed failure surfaces ranged from 2.54 (for the Frank

parcels) to1.89 (for the Trousdale parcels). These are much higher factors of safety than typically reported for coastal bluffs of this height and inclination. Indeed, a failure of the upper bluff on the southernmost Frank parcel that occurred in late February or early March 2009 (see attached photos, taken 4 March 2009) demonstrates that these bluffs have no such unusually high factors of safety. A bluff failure indicates that, at that location and time, the forces driving the slide exceed the resisting forces; that is, the factor of safety has dropped below 1.0.

Accordingly, I asked the project geotechnical engineer to 1) provide justification for the soil strength parameters used and; 2) calculate the minimum factor of safety for a circular failure surface through these materials. The two referenced Pacific Crest Engineering reports were subsequently prepared. Supporting material was provided for the soil strength parameters, with which I concur. However, only a circular failure of the upper bluff terrace deposits was calculated. While this is the most likely type of failure, it would have been useful to also have examined the global stability of the entire bluff.

The results of these slope stability analyses indicate that a factor of safety of 1.5 is reached about 18 feet landward of the bluff edge on the Trousdale parcels. A pseudostatic analysis showed that the 1.1 factor of safety line is seaward of this point, indicating that the static condition is determinative for stability. On the Frank parcels, no static factor of safety was calculated for the coastal bluff; but the 1.1 factor of safety line for the pseudostatic condition was found to be about 8 feet landward of the bluff edge. On two different cross sections of the arroyo-facing slope on the Frank parcels, static factors of safety were 1.6 to 2.2, indicating that the bluffs are stable at their current configurations.

Regional studies by the U.S. Geological Survey and the California Energy Commission

A 2007 report released by the U.S. Geological Survey, as part of its National Assessment of Shoreline Change used historic T-sheets and 1997 LIDAR data to evaluate the long-term bluff erosion rate along the cliffed portion of the California coast. For this stretch of the coast, erosion rates were generally 0.2-0.3m (0.66-0.98 ft)/yr. These numbers are consistent with those previously reported (as, for example, in Griggs et al. (2005) “Living with the Changing California Coast,” and are consistent with those used by the applicants.

In March 2009 the California Energy Commission released a report prepared by the Pacific Institute with the help of Phillip Williams and Associates that evaluated the impacts of future sea level rise on the California coast. Citing sea-level rise forecasts developed at the Scripps Institute of Technology of 1.0 and 1.4meters by 2100 (for low- and moderate-greenhouse-gas-emissions scenarios, respectively), it evaluated the effects of sea level rise on the area inundated by a 100-year storm event and on increased dune and bluff erosion rates. A key product was a set of hazard maps showing the area inundated by the 100-year storm event today and in the year 2100, and the zone at high risk from coastal erosion by the year 2100. The erosion high hazard zone was calculated by prorating the historic bluff retreat rate (taken from the 2007 USGS study) by the increased amount of time that the base of the bluff would be subjected to wave attack under the 1.4 meter sea level rise scenario.

For the subject sites, the erosion high hazard area on these maps lies approximately 112 feet from the current bluff edge.

Staff Recommendation for 100-year bluff top setback

The USGS National Assessment of Shoreline Change (2007) reports long-term erosion rates of 0.2-0.3m (0.66-0.98 ft)/yr for this stretch of coastline. Using the higher value (to make some allowance for potential increase in the historic rate due to, for example, accelerated sea level rise), this would predict about 98 feet of bluff top recession over the course of the next 100 years.

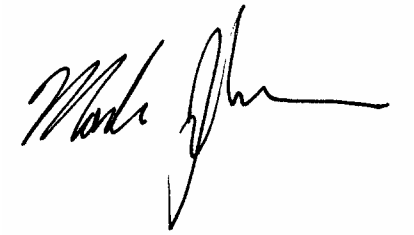
The applicant, when pressed, presented slope stability analyses indicating that, for a circular failure of the upper terrace deposits, a static factor of safety of 1.5 is attained about 18 feet landward of the present bluff edge. A factor of safety of 1.1 for a pseudostactic (earthquake analysis) lies seaward of this, making the static factor of safety determinative for a stability setback.

Following the method outlined in Johnsson (2005); the staff recommended setback would thus be 116 feet. Note that this value does not explicitly include increases in bluff retreat rate due to sea level rise; however, the conservative use of the upper end of observed historic long-term bluff retreat rates serves as a proxy. This value is, indeed, in close agreement with the erosion high hazard area mapped in the Pacific Institute report.

Because the slopes on the arroyo side of the Frank parcels exceed a 1.5 factor of safety (static) and 1.1 (pseudostatic), and because they are seldom subject to wave attack, a much smaller setback is necessary. Ideally, long-term bluff retreat data could provide guidance as to the amount of bluff retreat expected due to stream and subaerial erosion over the next 100 years, but these data have not been provided. Nevertheless, my own judgment is that the 25-foot setback recommended by the applicant's consultants should be sufficient.

I hope that this review is helpful. Please do not hesitate to contact me with any further questions.

Sincerely,



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Changing Climate Numbers

New York Times
February 21, 2009

In 2007, the Intergovernmental Panel on Climate Change released its fourth assessment report, summarizing evidence collected and weighed by scientists around the world. At the time, it was the best estimate of where the planet was, climatically speaking, and where it was likely to be going, and the news the report offered was daunting.

There was unequivocal evidence of a warming climate, with human activity the dominant cause. The panel warned that further warming could have devastating consequences for societies around the world, including rising seas and widespread drought.

The 2007 assessment established a base line of expectation, but it is already looking outdated. From all over the globe, in bits and pieces, data are accumulating that suggest we may have already left behind the world of possibilities portrayed in the panel's report. Sea ice has melted more quickly than expected. And, according to a recent report from the United States Geological Survey, sea levels in 2100 could increase by more than double the 1.5 feet rise projected by the Intergovernmental Panel on Climate Change (it chose not to add in water from eroding ice sheets because they remain poorly understood). Add to that the hard reality that carbon dioxide is a long-lived gas, and the picture of global warming is both volatile and forbidding.

The authors of the climate-change panel's report knew that events could overtake their findings. A fifth assessment is currently under way. And while the worldwide recession might provide a slight breather, population pressures and energy demands are likely to drive emissions inexorably higher without a major shift to new energy sources.

It is imperative, of course, that the Obama administration — and every other government around the world — keep abreast of the changing data. What is equally imperative is that the governments tailor any prescriptions to the possibility of more ominous news in the future.

Recent bluff failure on APN 043-161-51; photos taken 4 Mar 2009

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Projecting Future Sea-level Rise:

What is a Reasonable Estimate for the Next Century?

Introduction

This report presents a brief discussion of recently published scientific literature regarding the magnitude of sea-level rise that is expected to occur over the next 100 years. The premise that sea-level is going to continue to rise is based on: 1) the slow warming of the earth over the past several hundred years as we emerged from the Little Ice Age; 2) the clearly measurable historic rise of sea level during that time period; and 3) the projections that the earth will continue to warm over the next 100 years. The driving force in the rise of sea-level is "global warming" which warms the earth's oceans and atmosphere.

This slow increase in temperature results in two processes that contribute to the rise of sea-level. These are:

1) Thermal expansion of ocean water which leads to a greater volume of water.
2) Melting of glacial ice and ice sheets which increases the mass of the oceans by adding water.

If the earth's atmosphere and oceans continue to warm, both thermal expansion and glacial melt will continue and sea-level will continue to rise. Consequently predictions of sea-level rise must take into account projections of anticipated global warming and how this may affect the two processes noted above. I believe it should be clearly stated that this analysis is based on the following premises: First, global temperature is presently increasing and has been increasing for the past several hundred years. Second, evidence from both tide gauges and more recently from satellite studies indicates that sea level has been slowly rising over the past two centuries (Jevereva et al., 2008; Church and others 2008; Cayan et al, 2006; and Cabanes, et al, 2001).

Unfortunately, what are not clear are the rates of change in both the warming of the atmosphere and the oceans; and the relationship between these rates of change and the volume of CO_2 in the atmosphere. Therefore, all projections of the total amount of sea-level rise that will occur over the next century are based on interpretations and/or assumptions of how rates of global warming, thermal expansion of the oceans, and mass increase of the oceans from melting glaciers will change over time.

Projections of Sea-level Rise

There is considerable uncertainty in how global warming affects melting of alpine glaciers, the Greenland and Antarctic ice sheets, and the thermal expansion of the oceans; and how these in turn affect sea-level. The wide range in the estimates of how much

sea-level will rise in the next century is shown in Figure 6 of Church and others (2008). Their graph is reproduced as Figure 1 of this report, which shows the projected sea-level rise for the 21st century.

Note that the IPCC (International Panel on Climate Change) projections with 90% confidence limits project somewhere between 18 to 60 centimeters (7 inches to 2 feet) of sea-level rise by 2100. The outermost lines on the graph, those that *include an allowance for additional land-ice uncertainty,* range from 9 centimeters (about 4 inches) of sea-level rise to as much as 0.875 meters (34 inches – about 3 feet). These ranges are generally consistent with the findings of other workers (Rahmsdorf, 2007; Cayan et al, 2006). In general most projections of sea-level rise contain caveats regarding what could possibly occur. These usually take the form of stating that sea-level rise in the next century could be considerably higher than the models predict.

Although there is general agreement among researchers as to the range of sea-level rise over the next century, there is also agreemeent that problems and inconsistencies are present in their analysis. A desire for more and better data pervades all of the publications cited in this report. Some of the problems and inconsistencies that shed doubt on the robustness of the projections are discussed below, from several relevant recent articles.

Jevrejeva, Moore and Grinsted, 2008: ***Relative importance of mass and volume changes to glacial sea level rise.*** Journal of Geophysical Research

In this study the authors examine the relationship between global sea level rise, thermal expansion of sea water due to warming, and increased mass related to melting of glacial ice and ice sheets. The goal of the study is to determine the role of each of these mechanisms in the rise of sea level over a period of 47 years (1955-2003). The results of the study are:

1. The average rate of sea-level rise as measured from tide gauges was 1.6 mm/year. (6.2 inches per hundred years)
2. The average rate of sea-level rise due to thermal expansion was 0.41 mm/year (26% of global sea-level rise). (1.6 inches per hundred years)
3. The average rate of sea-level rise due to increased mass from melting ice was 0.75 mm/year (47% of global sea-level rise). (2.9 inches per hundred years)
4. **This leaves 0.44 mm/year of sea-level rise (27%) not adequately explained. (1.7 inches per hundred years)**

The authors discuss the unexplained residual and conclude that to some extent it could be accounted for by a variety of changes in continental water storage as snow pack, soil moisture and ground water – which could range between 0.1 and 0.25 mm/year. However, it is probable that the unexplained residual is even greater than 27%. From page 5:

"It has also been suggested recently (Gouretski and Koltermann, 2007) that due to instrument related biases the global ocean heat content might be overestimated by Levitus et al. (2005). That would lead to the reduction of 25% in the sea-level rise contribution from ocean heat content, increasing unexplained residuals."

In summation, this study clearly indicates it is impossible at present to fully explain the existing sea-level rise in light of what we know about ocean heat content and ocean volume changes due to mass increases.

Church and White, 2006: *A 20th century acceleration in global sea-level rise.* Geophysical Research Letters

The authors state that an acceleration in sea-level rise is present in tide gauge data for the 20th century. The reconstruction indicates that between 1870 and the end of 2004 the total sea-level rise is 195 mm – an average rate of 1.44 mm/year. For the 20th century the rise is about 160 mm, a rate of 1.7 mm/year. However, they note a clear change in the rate of sea-level rise at about 1930, and by fitting liner regressions to the lines come up with a result *"...implying an acceleration of 0.017 ± 0.007 mm/ year/ year (95%)."*

They conclude that if the acceleration is maintained through the 21st century, sea-level in 2100 would be 310 ± 30 mm higher than in 1990. Once again this is generally consistent with other projections of sea-level over the 21st century. This is because they assume a constant rate of acceleration. However, the authors also point out that the acceleration in the 20th century was not uniform over time but variable. Periods of more rapid sea-level rise appear to be related to periods of low volcanic activity (with about a 20-year lag). For example, the 1930s through 1960s acceleration occurred during a period of little volcanic activity. Contrastingly, the volcanic eruptions of Mt. Agung (1963), El Chichon (1982) and Mt. Pinatubo (1991) were all followed by short periods of reduction in global mean sea-level or in the rate of rise. They suggest that the volcanic eruptions may explain why little acceleration of sea-level rise has been observed over the second half of the 20th century.

Jevrejeva, Moore, Grinsted and Woodworth, 2008: *Recent global sea level acceleration started over 200 years ago?* Geophysical Research Letters

The authors present a reconstruction of global sea-level since 1700 in an attempt to determine when the acceleration started and to understand how it changed through the past 300 years. They conclude that *"...global sea level acceleration up to the present has been about 0.01 mm/yr² and appears to have started at the end of the 18th century."* They also point out that the time variable trend suggests that there are periods of slow and fast sea level rise including a 60-year variability that appears to be global. The causative mechanism for this cycle is not well understood. Refer to Figure 2 of this report which is reproduced from Figure 3 of the article. The 60-65 year cycle is clearly visible in the bottom half of the figure.

They note that the fastest sea-level rise during the 20th century was between 1920-50 and appears to have been a combination of the peaking of the 60-65 year cycle and a period of low volcanic activity.

The authors conclude that sea-level rose 28 cm (about 11 inches) between 1700-2000; and that a simple extrapolation of their data leads to a 34 cm (13 inches) sea-level rise between 1990 and 2090. This is consistent with the projections shown in Figure 1 of this report. However, the authors note that this projection (34 cm) is probably too low and that sea-level will probably rise faster, once again reflecting uncertainty in what might or will happen.

Discussion and Conclusions

The difficult portion of this review follows. We must now make a decision on: What is a reasonable rate of sea-level rise to utilize in performing coastal geologic hazard and risk analyses for proposed single-family residential development?

The recent scientific literature clearly indicates that there are some apparently significant uncertainties in respect to predicting how fast sea-level will rise. These uncertainties include, but are not limited to the following:

1. The relationship between the volume of CO_2 in the atmosphere and the rate of change in the warming of the atmosphere and the oceans is not well understood or quantified.

2. Attempts to explain the existing sea-level rise in light of what we know about volumetric increase of the ocean due to ocean heat content and ocean volume changes due to mass increases are clearly inaccurate. As much as 25% and probably more of the volumetric change cannot be explained.

3. Rates of sea-level rise vary greatly through time. Researchers see a 60-65 year cycle in the rate of sea-level rise, which again is not easily explained or clearly understood. In addition there is good evidence that the rate of change can be significantly changed depending upon the frequency of large volcanic eruptions.

Other uncertainties also exist, but those stated above are sufficient to cast some doubt on the estimates of global sea-level rise during the next century. Despite the uncertainties there appears to be agreement among researchers in respect to the "best estimates for sea-level rise in the coming century." Most of the projections fall within the envelope presented as Figure 1 of this report – from the IPCC 2001 report, with updated AR4 IPCC projections. This graph indicates that sea-level will most likely rise somewhere between 18 to 60 centimeters (7 inches to 2 feet) by 2100. It also includes an allowance for additional land-ice uncertainty, which increases the range from 9 centimeters (about 4 inches) of sea-level rise to as much as 0.875 meters (34 inches – about 3 feet), almost an order of magnitude difference.

It seems reasonable to deal with the uncertainty that exists in projected sea-level rise in the same way the definition of "active fault" is used in geologic hazard evaluation. The definition varies in respect to the nature of the construction; in that critical facilities must use a more conservative definition of "active fault" than single family residences.

The amount of sea–level rise that should be planned for in next century should be based on the nature of the proposed construction and a future sea-level rise that can be reasonably well-defined. Consequently, the least conservative estimate for sea-level rise should apply to single family residences, while facilities with a lower acceptable risk threshold, such as "critical facilities" should have to assume a more conservative amount of sea-level rise. Clearly, critical facilities such as government infrastructure, highways, port facilities, hospitals, fire stations, etc. should have to assume the most conservative estimates (the highest estimates) of sea level rise.

Based on the range shown in Figure 1, I suggest that a reasonable assumption for sea level rise in the next century, to be applied to geological hazard and risk analyses for single family residences, is as follows:

It should be equal to or greater than the total sea level rise in the 20th century and consistent with the rate of rise (acceleration) over the past 20-30 years. This number would lie someplace between 300-340 mm, approximately 11 to 13 inches.

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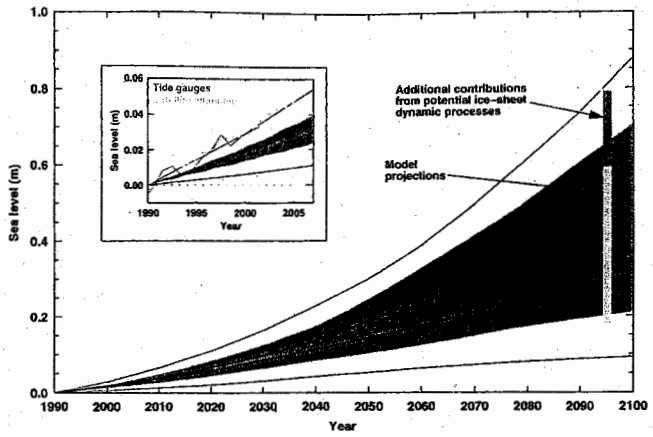

Fig. 6 Projected sea-level rise for the 21st century. The projected range of global-averaged sea-level rise from the IPCC (2001) assessment report for the period 1990–2100 is shown by the *lines* and *shading* (the *dark shading* is the model average envelope for all SRES greenhouse gas scenarios, the *light shading* is the envelope for all models and all SRES scenarios, and the *outer lines* include an allowance for an additional land-ice uncertainty). The updated AR4 IPCC projections (90% confidence limits) made in 2007 are shown by the *bars* plotted at 2095, the *magenta bar* is the range of model projections and the *red bar* is the extended range to allow for the potential but poorly quantified additional contribution from a dynamic response of the Greenland and Antarctic ice sheets to global warming. Note that the IPCC AR4 states that "larger values cannot be excluded, but understanding of these effects is too limited to assess their likelihood or provide a best estimate or an upper bound for sea-level rise." The *inset* shows the 2001 projection compared with the observed rate estimated from tide gauges (*blue*) and satellite altimeters (*orange*) (based on Church et al. 2001; Meehl et al. 2007; Rahmstorf et al. 2007)

Figure 1. At left is Figure 6, reproduced from Church and others (2008)

Figure 2. At right is Figure 3, reproduced from Jevejeva, Moore, Grinsted and Woodworth (2008).

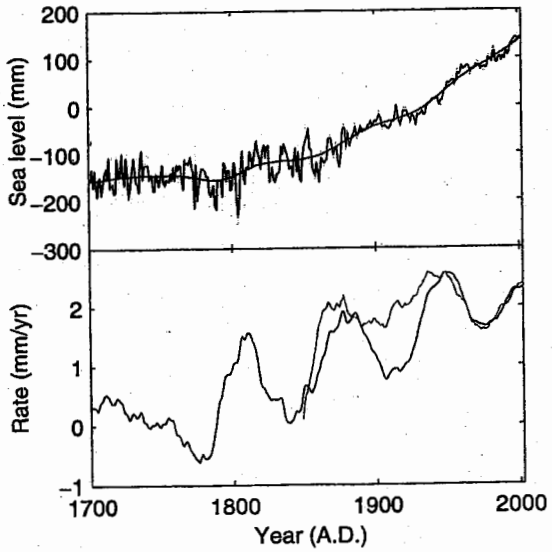

Figure 3. (top) Time series of yearly global sea level and time variable trend detected by method based on MC-SSA with 30year windows, grey shading represents (top) the standard errors. (bottom) The evolution of the rate of the trend (black line) since 1700. Blue line corresponds to the rate of North East Atlantic regional sea level rise since 1850.

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December 15, 2009

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Re: Appeal Numbers A-3SCO-09-001, - 002, - 003 (Frank)

Dear Ms Craig:

I have been asked by the applicant in the above-referenced appeals, Donald Neil Frank, to submit this analysis of the rate of coastal bluff retreat at Hidden Beach which is the site of his proposed project. This letter responds in part to certain issues raised by Dr. Mark Johnsson's Geotechnical Review Memorandum dated June 18, 2009. The analysis and conclusions in this letter apply as well to the site of the proposed project of Mr. and Mrs. Trousdale.

In particular, this letter addresses the geologic setting at the subject site, the process of erosion modification on coastal bluffs, and the site-specific erosional history at the project site. My analysis and conclusions are based on my professional qualifications and 39 years professional and personal studies of coastal processes and observations of coastal bluff erosion along the Santa Cruz, San Mateo, and Monterey County coastlines. A resume of my professional qualifications, education and experience is attached for your reference. I have lived and worked in Santa Cruz County for the past 39 years, and among my professional positions I have served as the County Geologist for the Santa Cruz County Planning and Environmental Health Departments, and served on an occasional basis in the same manner for San Benito and San Luis Obispo Counties. In addition I have been on the faculty of the Earth Sciences Department at the University of California, Santa Cruz for over 20 years as a lecturer teaching field geology, geomorphology and engineering geology.

The attached PowerPoint presents photographic evidence of the erosional history of the sea cliff at Hidden Beach, which fronts the subject property. The photos clearly show that there has been no wave erosion at the base of the sea cliff over the last 30 – 39 years. They also show that over the past 39 years there have been only two clear episodes of exceedingly minor bluff retreat. One of these episodes is referred to by Dr. Johnsson on page 7 in his Memorandum. If one closely examines the photographs in the Power Point it is clear that the referenced failure consisted of 2 or 3 blocks of soil, vegetation and terrace sands that fell out of the face of the cliff. These types of failures are typical of

what occurs on abandoned sea cliffs (refer to Figures 1 & 2 in the Power Point). The triggering mechanism of failures of this sort are typically related to the growth of vegetation (root wedging, added weight, wind pressure on plants), seismic shaking, shrink-swell of clays in the soil and localized over-saturation by water. These sorts of failures are not "slides" as typically defined by geologists and engineers. They should not be used as criteria for determining the parameters used in quantitative slope stability analyses for the site. To do so would be inappropriate.

The photos also show that the estimates of rates of cliff retreat published in U.S.G.S. Open-File Report 2007-1133, (by Hapke and Reid, 2007) are erroneous for this specific site, as are the estimated rates of retreat in Living With the Changing California Coast (Griggs, Patsch and Savoy, 2005). Both of these publications are broad regional surveys and should not be used for the determination of coastal bluff retreat rates at a specific site.

Historic photos – the past 29 years:

The photos in the Power Point Presentation are from my relatively large personal collection of geologic and coastal photographs of the central California coastline taken over the past 39 years. In the early 1970's when I began studying the coastal geology of this area it became obvious that "time series of photographs" would be a valuable tool for studying coastal erosion. Fortuitously, during the past 39 years I have taken photographs of the sea cliff at Hidden Beach. These photos, including several taken following the large oceanic storms of the early 1980's, are the basis of the PowerPoint presentation.

To avoid confusing the reader it is important to clearly define the terms that I will use in this discussion. Please refer to Figure 1.

1. In "Stage 1" the *base of the erosional sea cliff* is at the intersection of the sea cliff formed by wave erosion and the "wave cut" ocean floor. Between New Brighton Beach and Pajaro Dunes this base of the cliff is covered by a colluvial wedge (aka talus pile) as shown in "Stage 2." When the base of the erosional sea cliff is buried by a colluvial wedge it becomes an *"abandoned sea cliff"* because active wave erosion has ceased.

2. *Sea cliff.* This is a generic term for a cliff at the edge of the ocean that was created by wave erosion. However, the term by itself does not imply present day activity, and the original cliff may have been modified by any of a variety of geologic processes. The geologic processes that operate on an abandoned sea cliff are known as **sub–aerial erosional processes**, because they occur in the air, not in the ocean. These include soil and rock falls, landslides, erosion by running water, root wedging, etc.

Figure 2 presents the three stages that typically occur as a sea cliff is abandoned by the ocean. Note two aspects of the geologic processes: 1. During a "relative drop" in sea level wave erosion ceases. 2. Once the sea cliff has been abandoned (not subjected to

wave attack) sub-aerial erosion continues to modify the cliff face. The retreat of the top of the cliff is originally rapid but then decreases through time. As the slope angle of the sea cliff decrease through time the **rate of retreat of the top of the sea cliff slows**. Consequently, the rate of cliff retreat at the top of the cliff **is not constant**, but continually decreasing.

When wave erosion no longer cuts into the base of the cliff, sub-aerial weathering and erosion become the dominant geologic processes operating on the cliff face. The upper portion of the cliff slowly fails and falls down slope to the base of the cliff. The top of the cliff slowly "lays back" while at the same time the base of the cliff becomes progressively buried by the material that has eroded and sloughed from the top of the cliff. This reduces the steepness of the slope as the material eroding from the upper half of the cliff buries the lower half.

In the presentation of sequential photographs (Figures 3 – 9) the colored arrows point to identical locations on the face of the sea cliff. The most informative comparisons are those in which the photographs taken in 1980 are compared with photos taken in 2007 and 2009 (Figures 4 & 5). The photo comparisons clearly confirm the following interpretations:

1. The outermost edge of the colluvial wedge (talus) at the base of the sea cliff has experienced only very minor wave erosion over the past 29 years (refer to comparative photos – Figures 10 & 11). The bulk of the colluvial wedge (greater than 95%) has not been eroded during this time period. The base of the old "abandoned" sea-cliff remains buried under the colluvial wedge and has never been touched by wave erosion during the past 39 years.

2. The exposed portion of the cliff face above the colluvial wedge (talus) has experienced only minor sloughing and earth falls. These typically occur during large storm events and/or earthquakes but can occur randomly. This process of minor sloughing (earth falls and small rock falls) creating a colluvial wedge that is burying the lower sea cliff is consistent with the erosional modification that occurs along all "abandoned" sea cliffs as indicated in Figure 2.

3. The sea cliff at Hidden Beach is "abandoned" (and indeed the coastline from New Brighton Beach to about Sunset Beach) is characterized by an abandoned sea cliff, the base of which has not been touched by wave erosion for the past 39 years based on my personal observations. There is strong evidence that the cliff has probably not been touched by wave erosion for a much longer time period.

Aerial Photographs – the past 80 years, & historic maps – the past 150 years:

Interpretation of vertical aerial photographs, beginning with the 1928 and the 1930s photographs and ending with photos taken in the past 10 years, reveal no evidence that the base of the abandoned sea cliff at the subject property has been touched by wave erosion over the past 81 years. In addition a comparison of aerial photographs and

modern maps with the 1860s shoreline maps prepared by the U.S. Coastal Survey suggests very strongly that there has been little if any erosion in the past 160 years. However, the 1860s maps are difficult to register with modern maps and aerial photographs; which makes it difficult to draw firm conclusions as to what actually happened between the 1860s and about 1930. However, the relatively low slope of the face of the cliff and the colluvial wedge themselves are strong evidence that these cliffs have not been subjected to wave attack for a very long period of time.

The storms of January 1983

During 39 years of walking Santa Cruz County beaches there is only one year in which I witnessed almost complete removal of the beach between New Brighton Beach and Sunset Beach (which encompasses the subject property) by wave erosion during major storms. During late January and early February of 1983 a series of large oceanic storms pounded the coastline. Large storm waves superimposed on high tides and a storm surge temporarily stripped sand off the beaches and eroded small scarps into the "toes" of the colluvial wedges at the base of the sea cliffs. It is probable that the storm surge associated with several of these large storms during an El Nino year raised relative sea-level several feet, suggesting very strongly that the base of the coastal bluff along this stretch of coastline is generally above the level of wave attack. This in turn suggests that erosion at the base of the cliff will not occur on a regular basis until sea-level rises several feet.

Figure 10 presents two photos of the extent of the erosion immediately south of Via Gaviota. Note that the waves have only eroded into the toe of the colluvial wedge, and have not eroded the base of the abandoned sea cliff. Figure 11 is taken north of Via Gaviota showing the beach in front of the subject property. The colluvial wedge is barely eroded. This is the thinnest beach that I have personally observed in this area over the past 39 years. Figure 12 shows the beach fronting the subject property in November 2000.

The same storms severely damaged homes along Via Gaviota and at Pajaro Dunes (Figure13) and elsewhere along the northern Monterey Bay shoreline. The homes at Pajaro Dunes which are built at the upwind edge of an active dune field on the active beach were severely damaged. Yet a short distance north at Sunset Beach (Figure 13) the waves created only a small scarp in the colluvial wedge at the base of the sea cliff. At Hidden Beach which fronts the subject property, the same storms stripped sand off of the beach exposing the risers for the sewer line, but only slightly eroded into the toe of the colluvial wedge at the base of the cliff (Figure 11).

The storms of 1983 provide an excellent illustration of the difference in exposure to wave attack that is present on the active beach versus the toe of the sea cliff. They also clearly demonstrated that the beach between New Brighton and Pajaro Dunes lies at the base of an abandoned sea cliff.

Summation:

To summarize, there is no evidence of erosion at the base of the sea cliff in the past 29 years based on my photographs, and 39 years based on my personal observations. In addition, vertical aerial photographs taken between 1928 and 2006 indicate that it is highly probable that there has been no erosion at the base of the cliff for the past 80 years. The toe of the colluvial wedge has been nicked by wave erosion on at least one occasion but the old erosional sea cliff has not been touched by erosion. Even though there is no wave erosion occurring at the base of the cliff the sea cliff continues to slowly erode through a variety of natural "slope processes" which consist of a slow retreat of the top of cliff and burial of the base of the cliff by colluvium.

I recognize that Dr. Johnsson did not have this site-specific information at his disposal when forming his initial conclusions, but rather was relying on the general surveys referenced above. It is a well-accepted scientific practice, however, that site-specific data and conditions are the superior and preferred means of assessing coastal erosion. In this instance the site specific information is comprehensive and was sampled over a lengthy time interval with a significant number of episodes.

These site-specific observations and the photos constitute a direct contradiction to the analysis and conclusions drawn by Dr. Johnsson. On page 8 of his Memorandum he states:

> *The USGS National Assessment of Shoreline Change (2007) reports long-term erosion rates of 0.2-0.3 meters (0.66 – 0.98 ft)/yr for this stretch of coastline. ...this would predict 98 feet of bluff top recession over the course of the next 100 years."*

However, this analysis is clearly incorrect. This can be demonstrated by using the erosion rates presented in the USGS OFR to calculate the amount of erosion that should have occurred at the subject property between 1970 and 2009. Using the published rates of 0.2-0.3 m/yr (0.66 – 0.99 ft/yr) it is clear that between 1970 and 2009 the **coastal bluff at Hidden Beach should have retreated between 26 and 38 feet**. However, there has been no measurable retreat. A simple look at the photographs tells the story - there has been no erosion. Thus Dr. Johnsson's analysis and use of the rates published in OFR 2007 - 1133 are not applicable to this site. In addition, if Dr. Johnsson is correct, then the entire coastline, from the subject property south to Sunset Beach, should have retreated a similar amount: 26-38 feet. There is no evidence that this has happened. Thus, Dr. Johnsson's analysis is clearly incorrect.

Based on both photographic evidence and my personal observations over the past 39 years it is clear that the sea cliff in front of the subject property is truly "abandoned." It has not been attacked by wave action during my 39 years of observation and aerial photos indicate that it has not experienced erosion for approximately 80 years. In addition the presence of a large colluvial wedge at the base of the coastal bluff indicates that the bluff

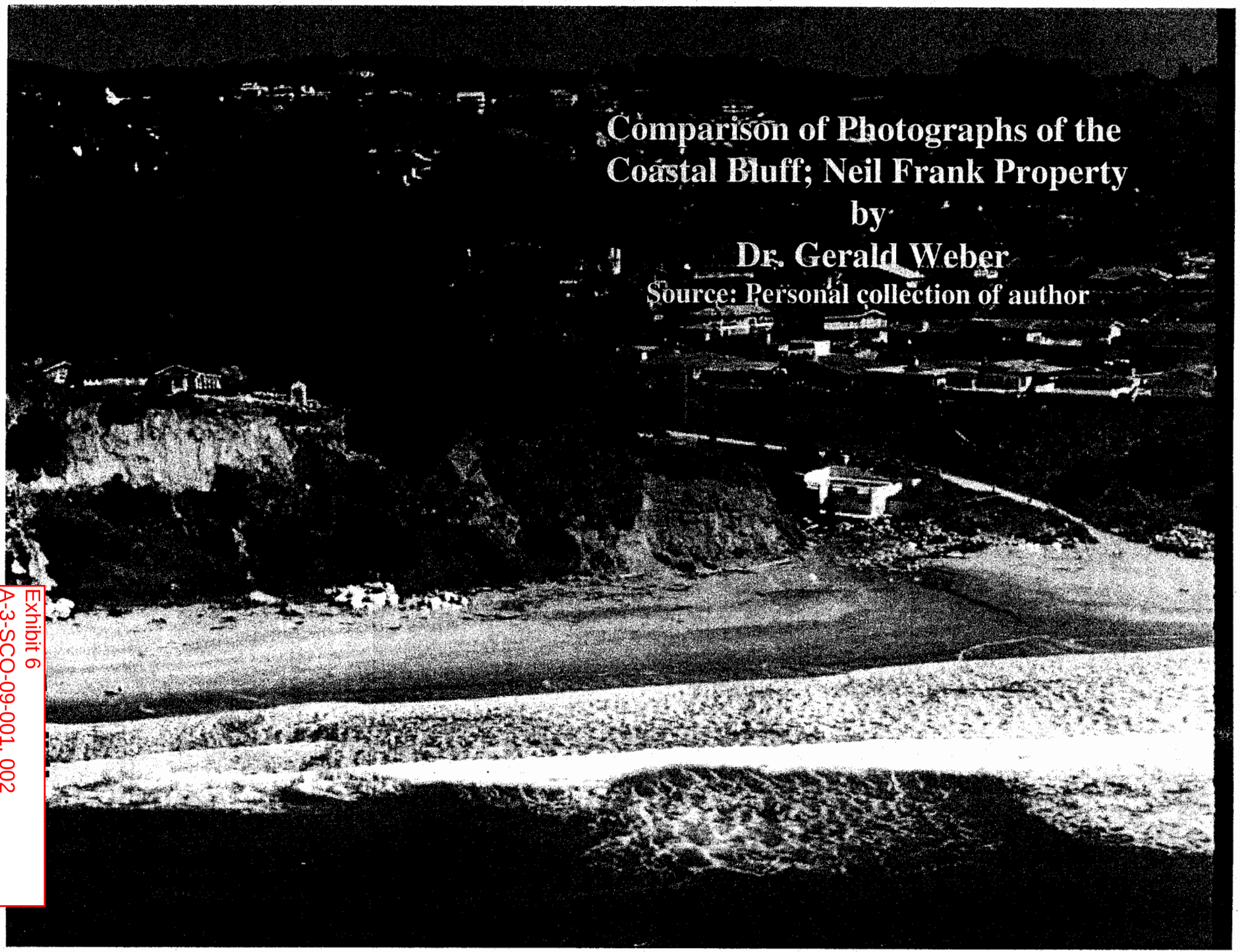


Figure 1. Abandonment of the Erosional Sea Cliff

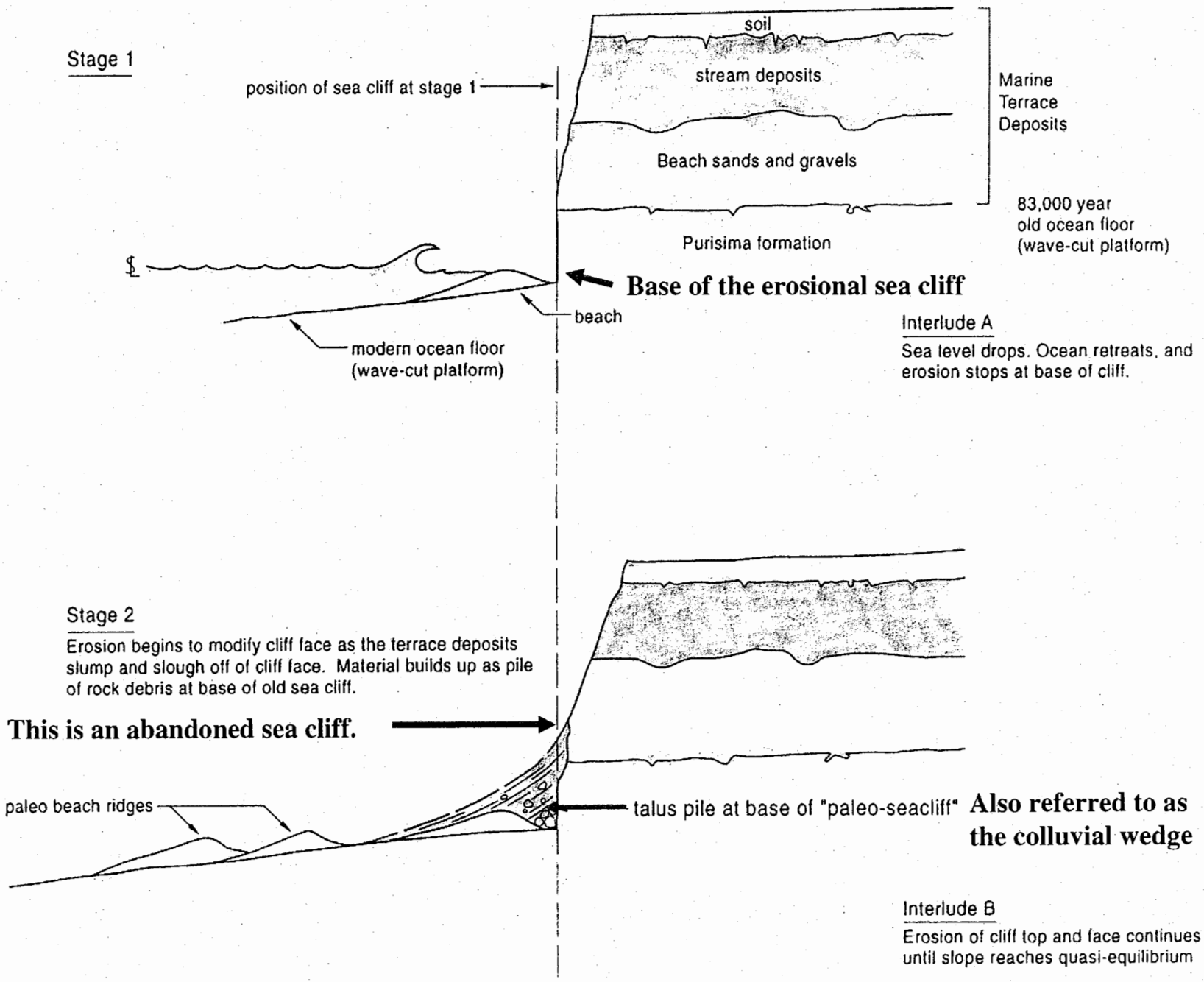
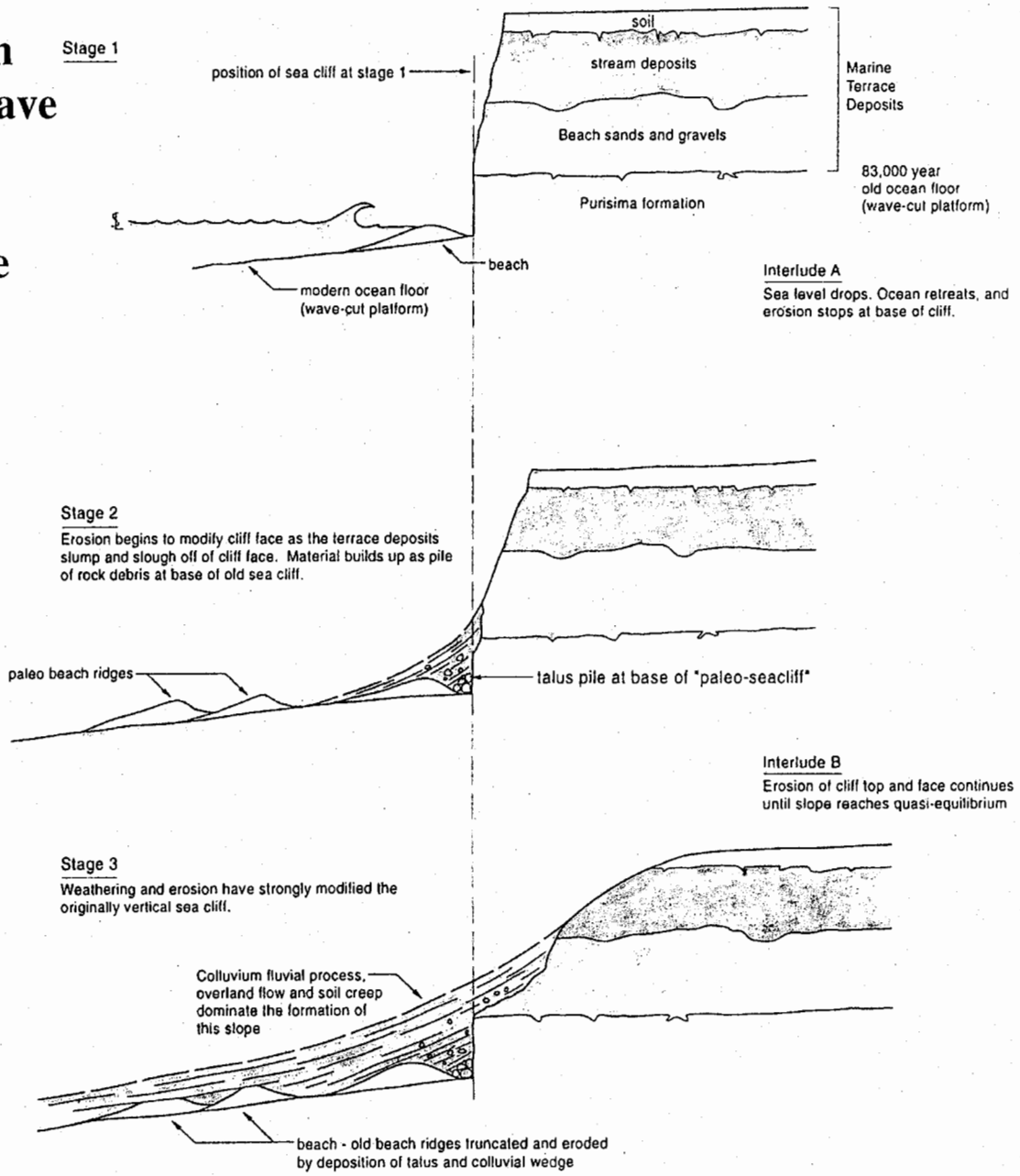
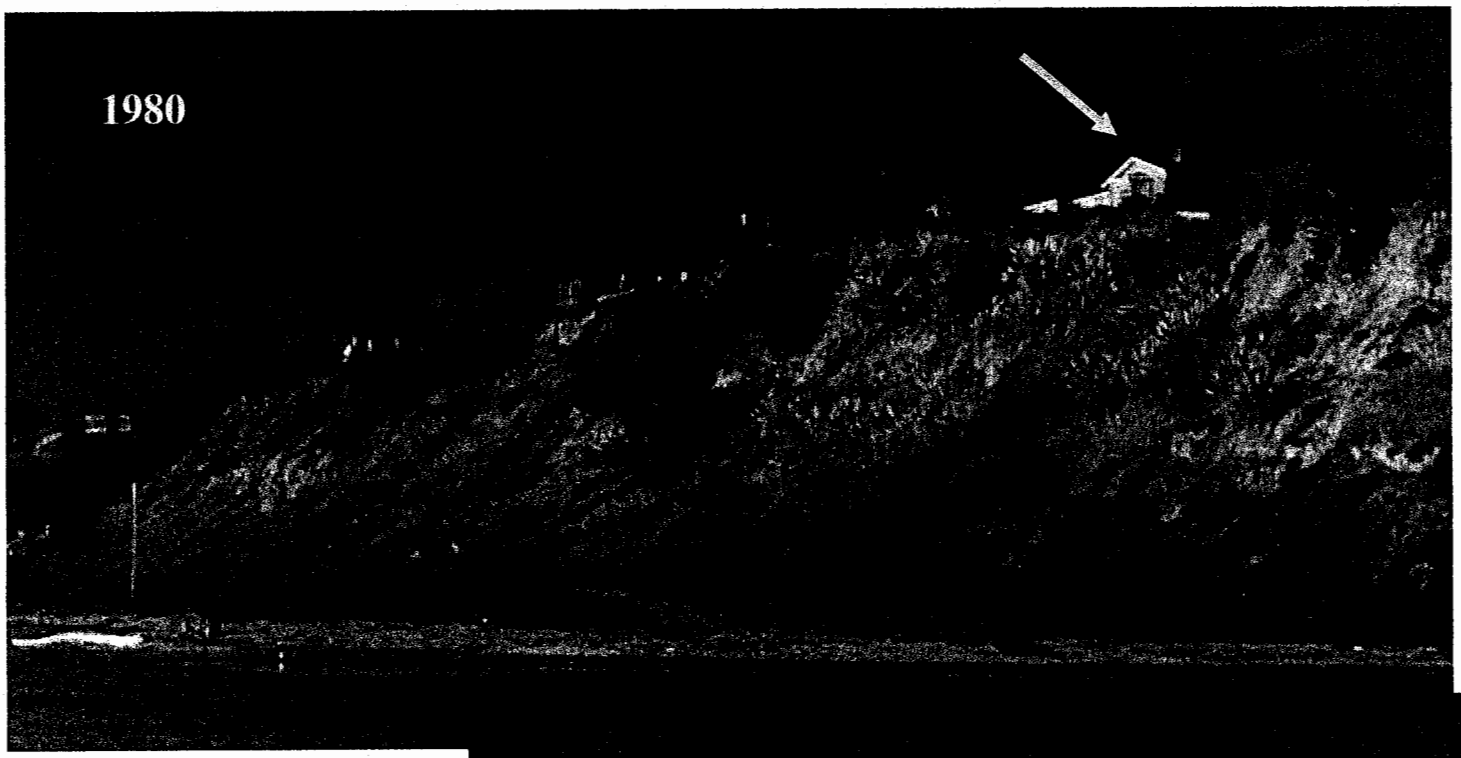


Figure 2. Erosional modification of an abandoned sea cliff. No wave erosion at base, accompanied by a slow build up of colluvium which has been derived from the top of the sea cliff.





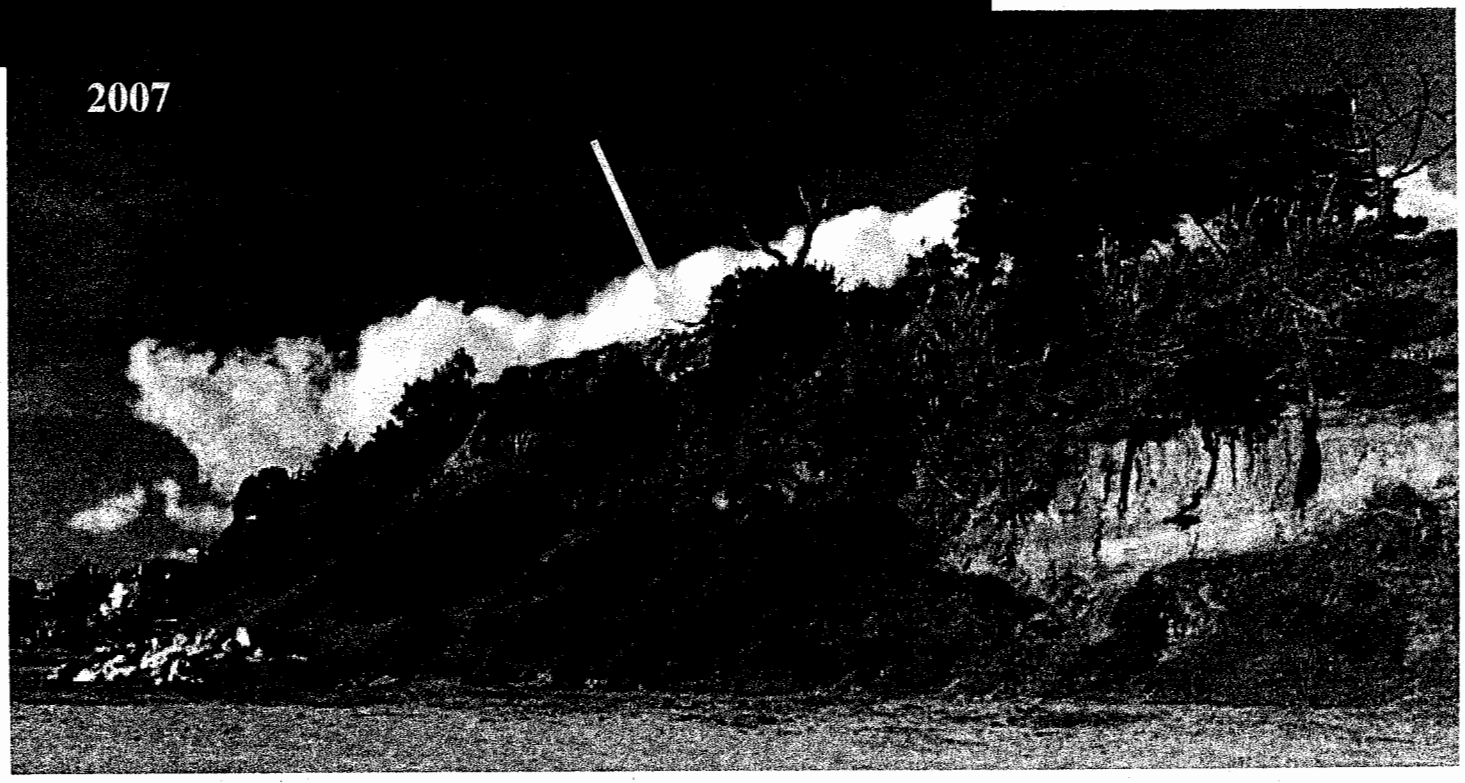


Figure 3. The yellow Arrow points to the house. No erosion of the base of the sea cliff in 27 years. Only some minor changes in vegetative cover.

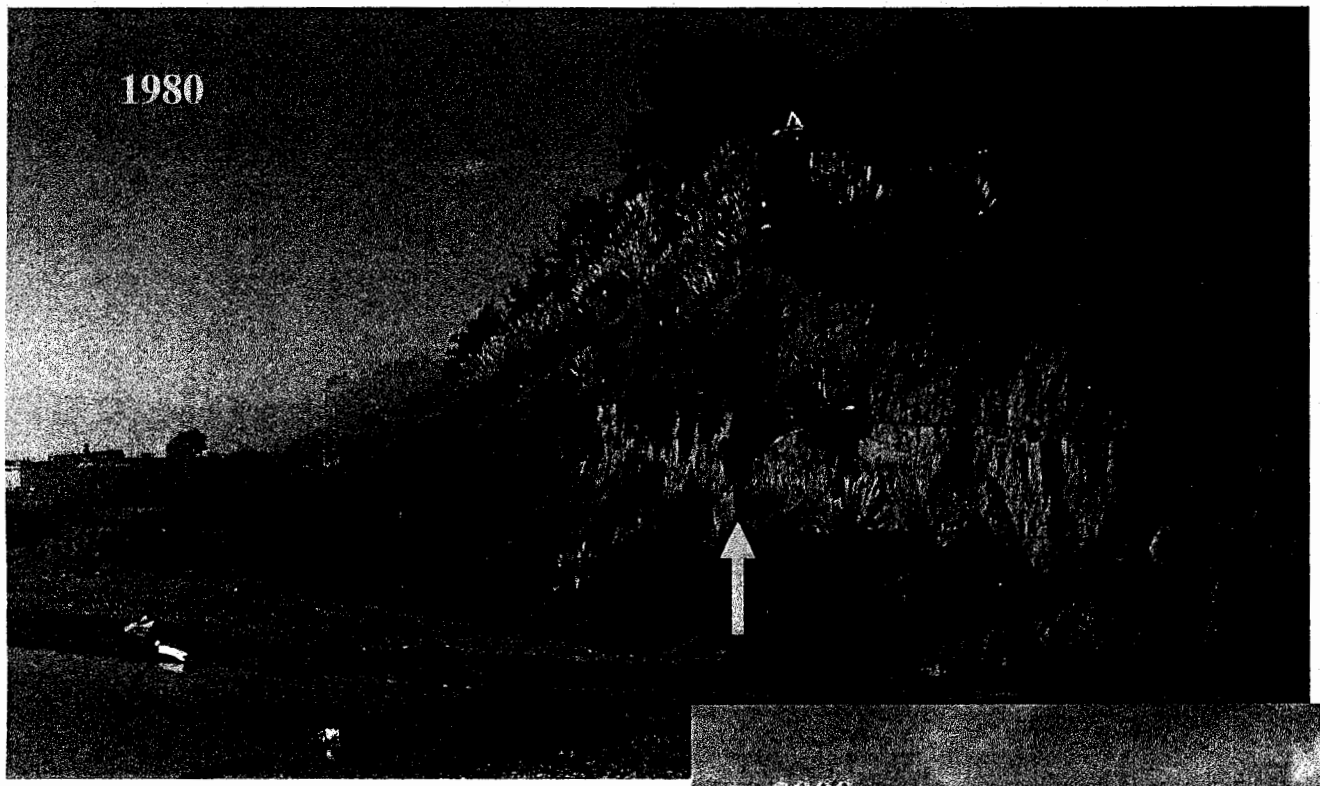
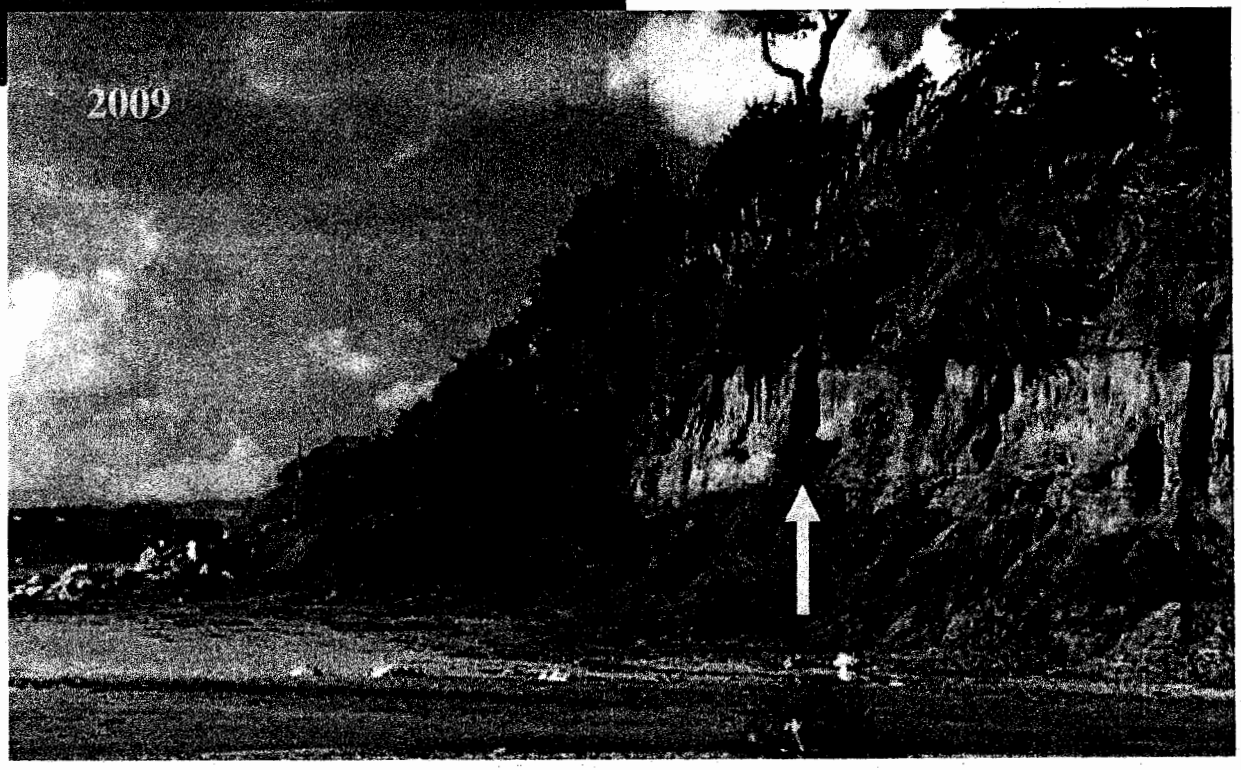


Figure 4. Nearly 30 years and no significant erosional change. Possibly a foot or two of soil and terrace deposits have sloughed off of the top of the sea cliff.



The arrows indicate the same points on the cliff face.

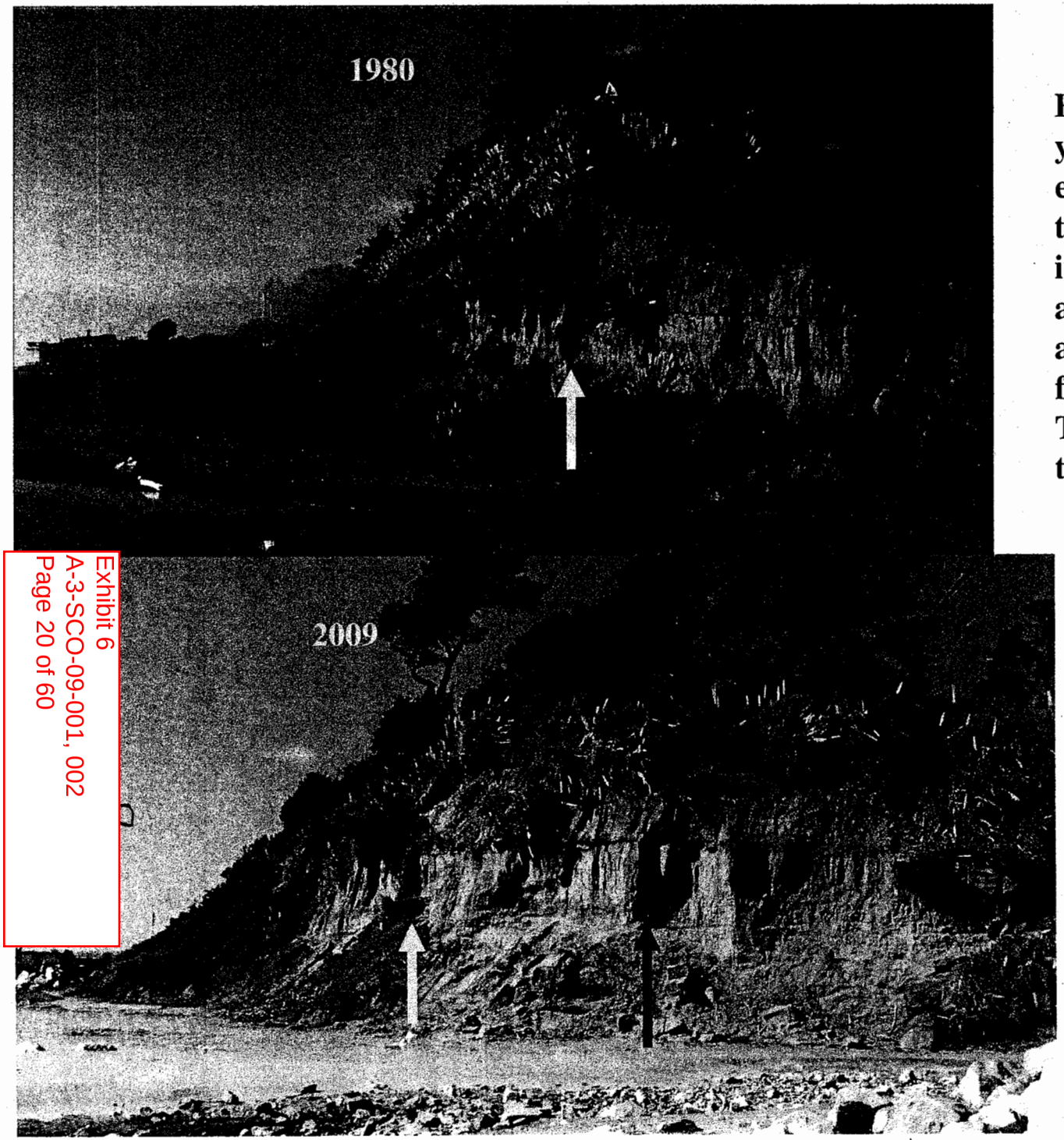
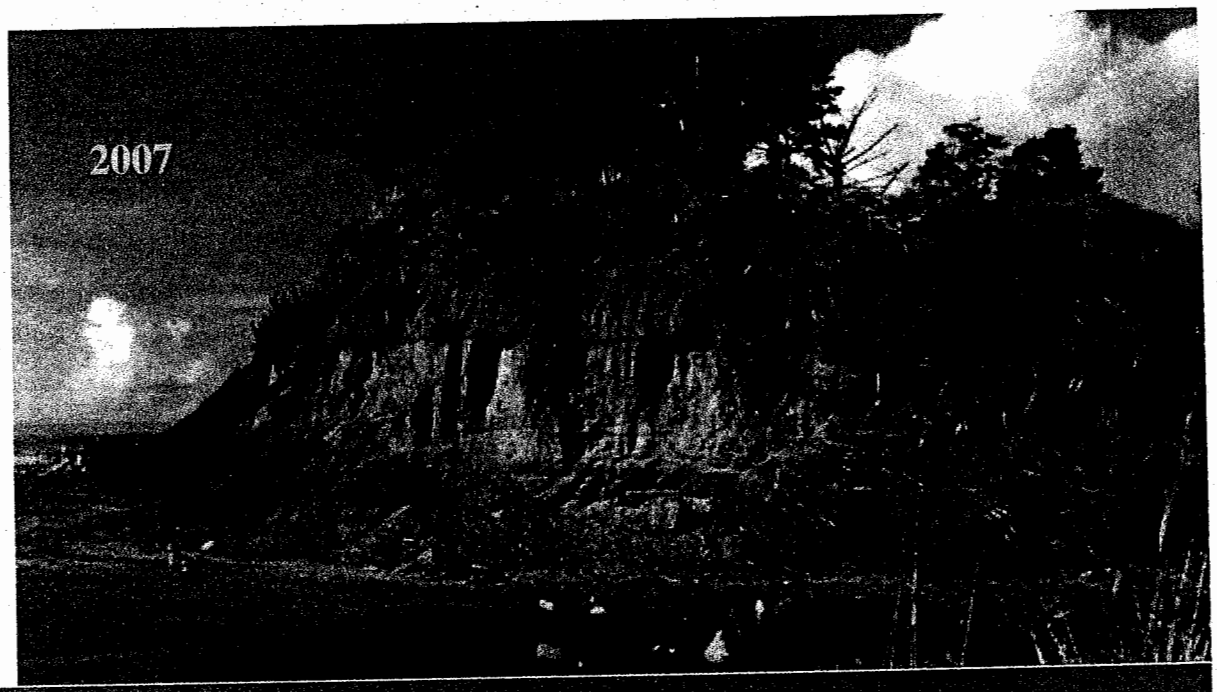


Figure 5. Again, nearly 30 years and no significant erosional change. The bare talus slope has slightly increased in size and the bare area (red stars – 2009 photo) are sites of small recent soil failures off of the cliff face. There has been no erosion at the base of the sea cliff.

Figure 6. Very little change in 2 years. It appears 2 small soil blocks have fallen (red stars). These apparently are the erosional changes alluded to by Mark Johnsson in his memorandum.

The blue arrows point the same spot in both photos.



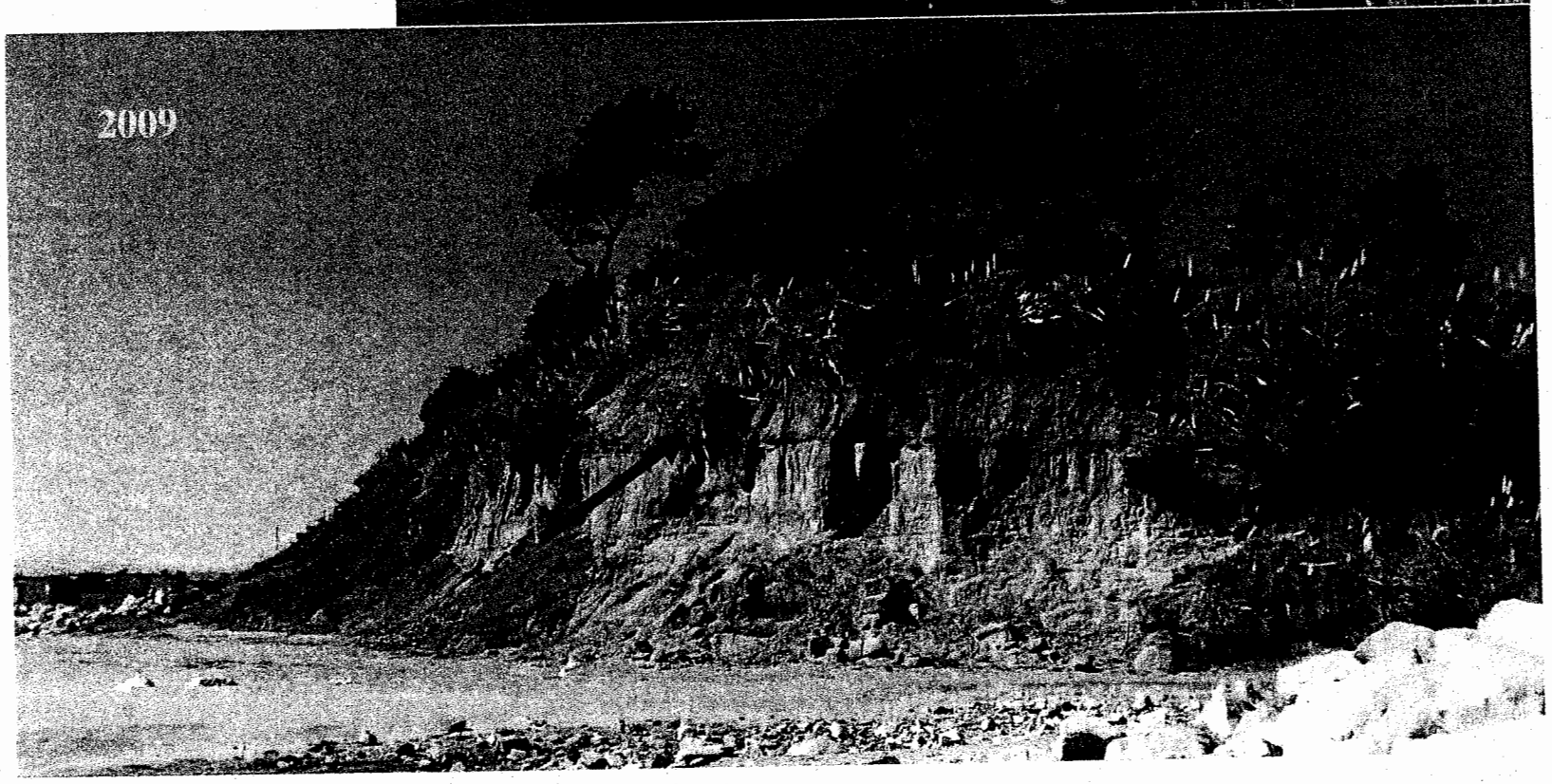


Figure 7: Aerial obliques of the subject property.

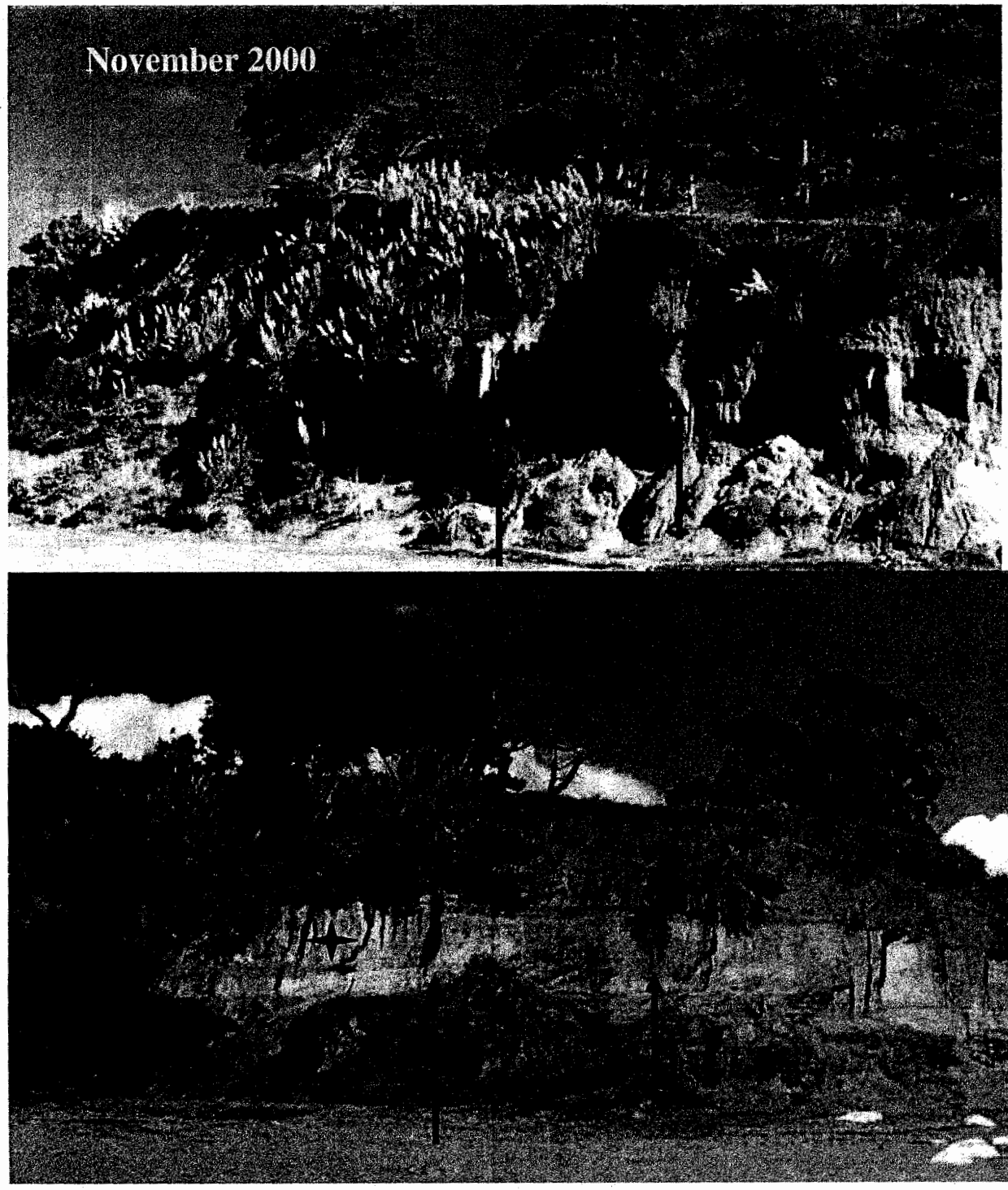
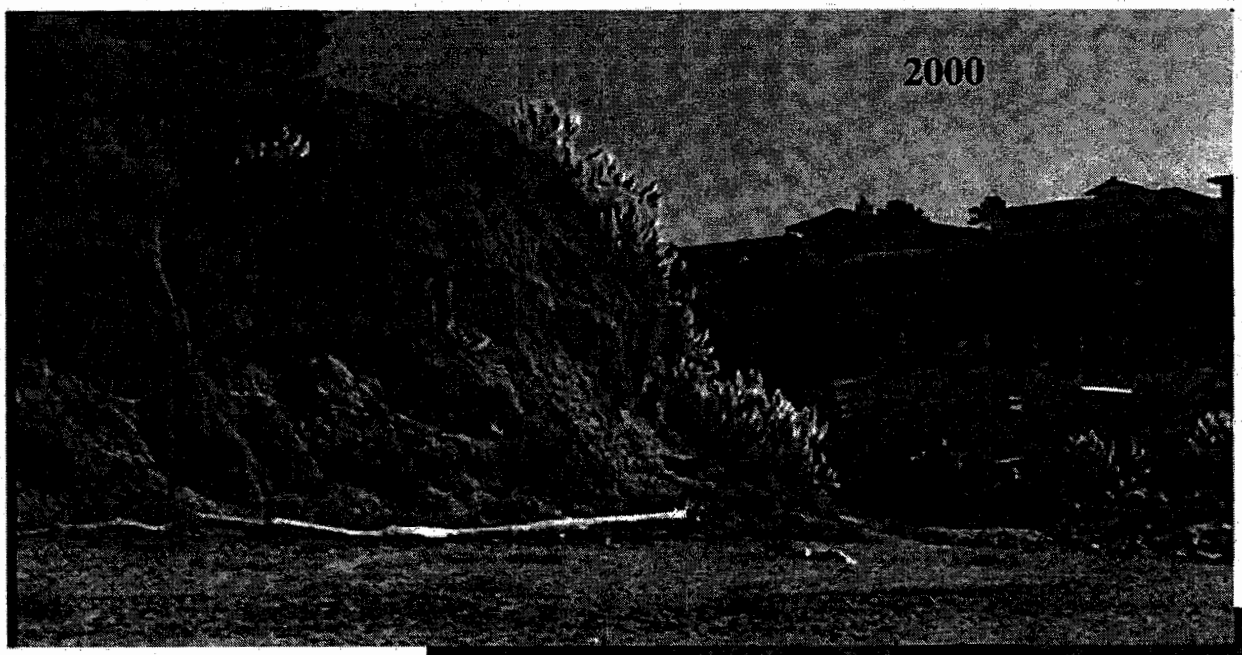


Figure 8. Seven years of change. The only change is The formation of minor failures off the upper cliff face (red stars). No erosion at the base of the cliff.



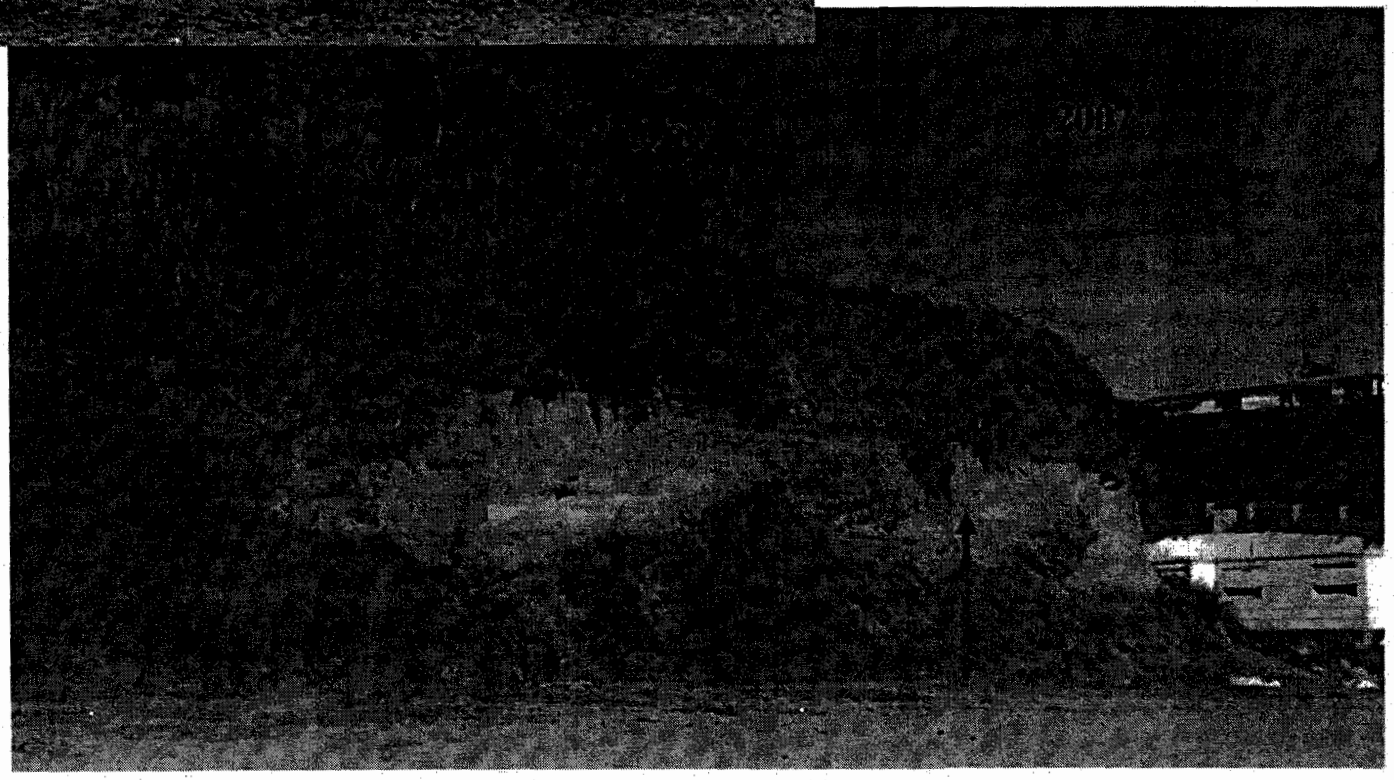


Figure 9. These photos were taken at the same time as in Figure 8. No evidence of wave erosion at the base of cliff.

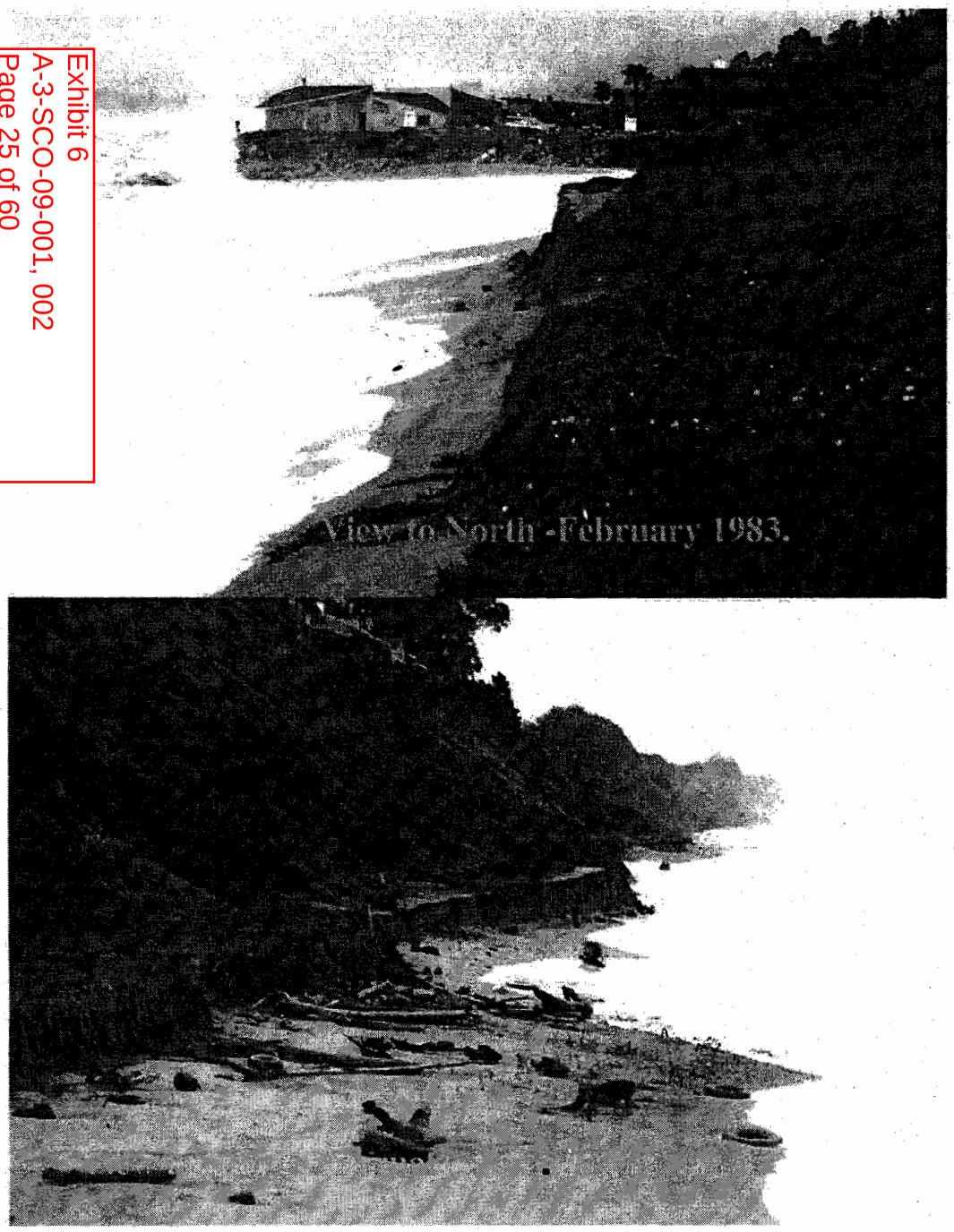


Figure 10. Two photos taken of the same area south of Via Gaviota. There has been only slight erosion of toe of colluvial wedge at base of the sea cliff. Note that the storm has stripped The beach and nipped into the toe of the colluvial wedge. This is the maximum amount of erosion I have observed in this area over the past 39 years. Note the base of the erosional sea cliff, which is buried, has not been touched by erosion. This lack of erosion during the largest storm in 40 + years supports my contention that the base of the sea cliff is above the reach of normal wave attack.

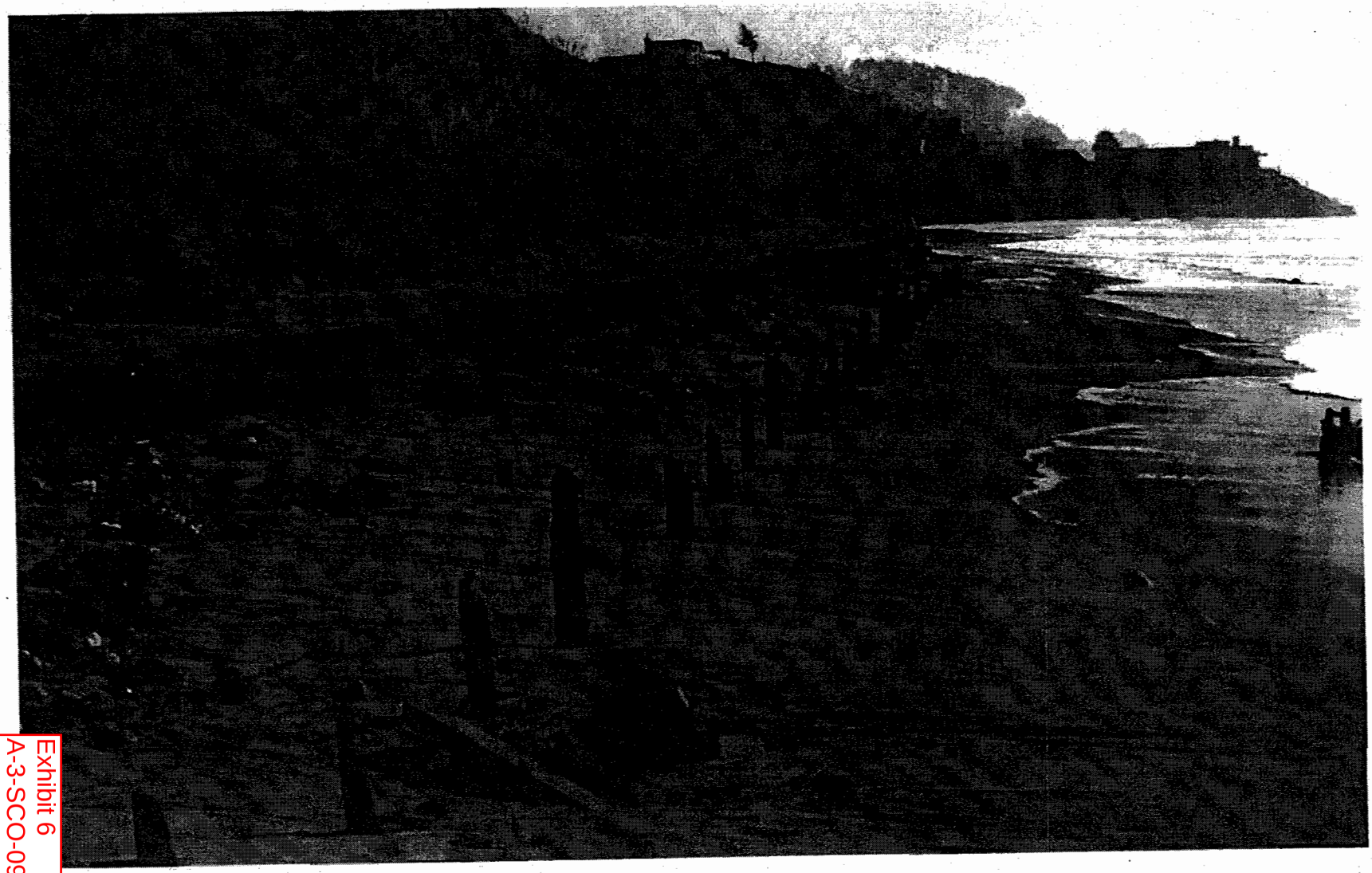


Figure 11. Wave erosion at subject properties – January 23, 1983. The only time the beach has been stripped in the past 39 years. Evidence that the base of the erosional sea cliff is above the level of wave attack.

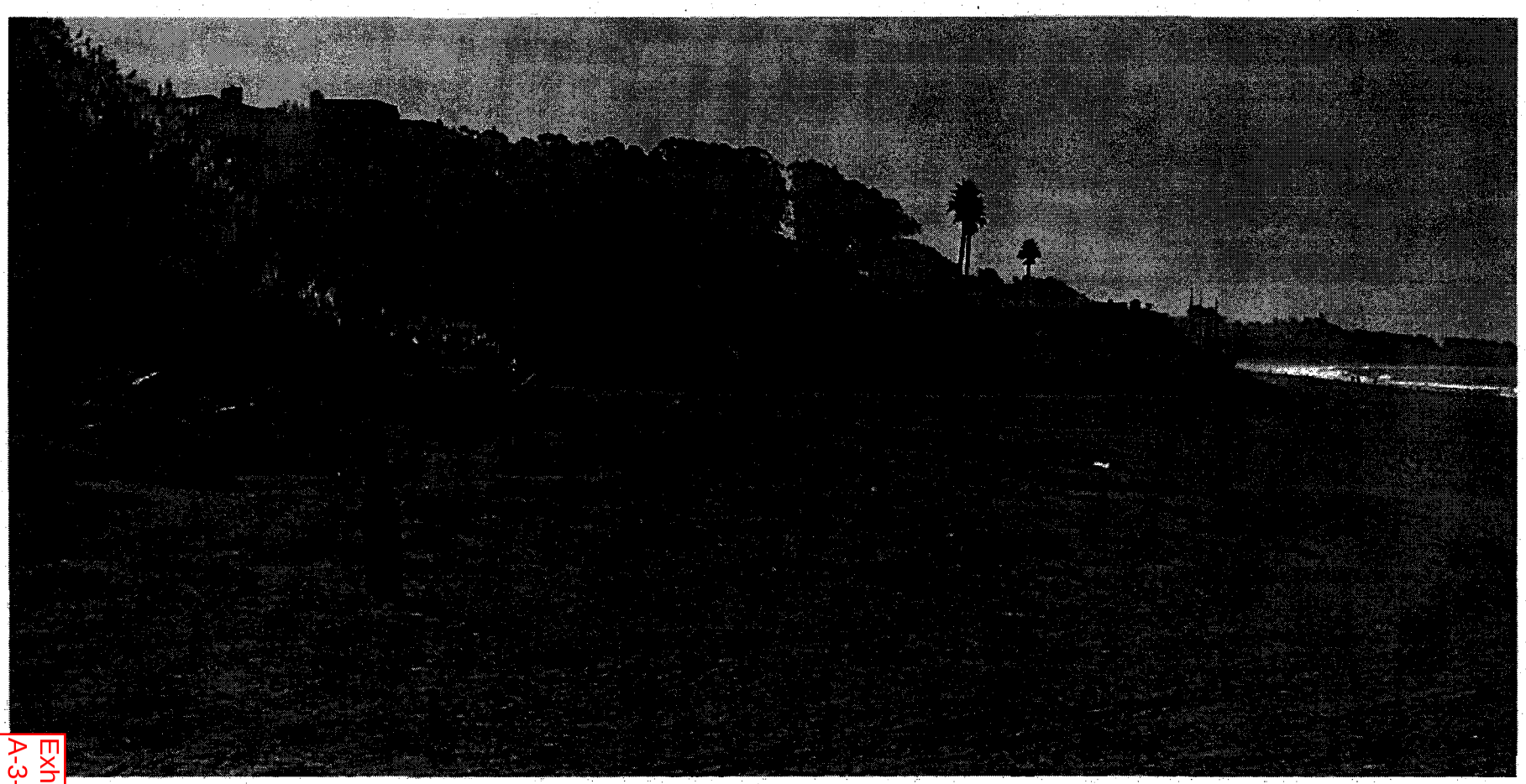


Figure 12. Beach in front of the subject properties, November 2000. Same location as in figure 11. Note the growth of vegetation out onto the upper beach, a sign that this area is generally not within the reach of the waves.

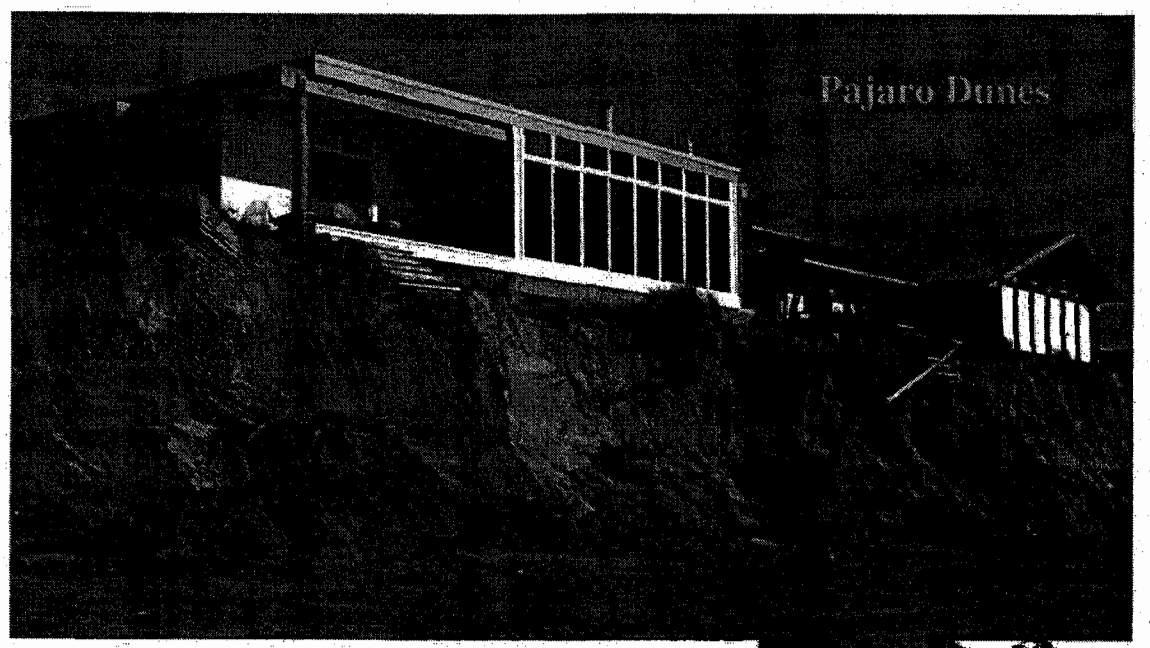
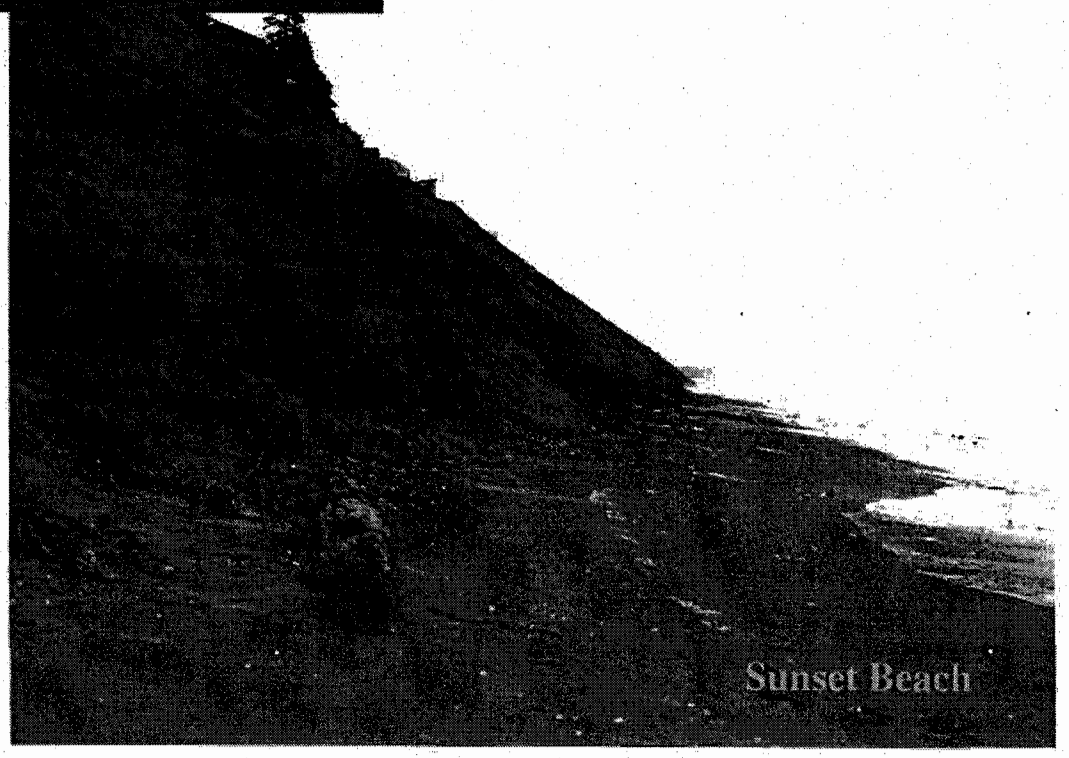


Figure 13. Two examples of erosion associated with the 1983 storm.

At Sunset Beach (north of Pajaro Dunes) the colluvial wedge was eroded, but the waves did not erode base of the abandoned erosional sea cliff.

At Pajaro Dunes the storm eroded *active dune sands (very soft and easily eroded*) that were recently deposited on the beach face. These homes were built on the active beach as opposed to the top of the sea cliff. This is the result.



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February 2, 2010

Ms. Susan Craig, Coastal Planner
California Coastal Commission
725 Front Street, Suite 300
Santa Cruz, CA 95060

Re: Appeal Numbers A-3SCO-09-001, - 002, - 003 (Frank)

Subject: Projections of Sea-level Rise in the 21st century:

Dear Ms. Craig:

Introduction

In my letter to you of December 15, 2009, I explained the site-specific erosion and bluff top retreat rates at the site of the Frank projects at Hidden Beach which are the subject of the above appeals. In that letter it was explained that the specific conditions prevailing at this site, based on observations and data that are comprehensive, differed considerably from the data that Dr. Mark Johnsson utilized in his Geotechnical Review Memorandum dated June 18, 2009. Dr. Johnsson did not have the benefit of all of this comprehensive data in forming his initial recommendations. However, two things are clear from his Memorandum as well as his article and the other papers he cites on bluff top retreat. First, erosion conditions and rates can vary significantly by site location, so it is always site-specific data that is both preferred and the most reliable in evaluating erosion/bluff top retreat at any given site. Second, the data that we have on erosion and bluff top retreat at Hidden Beach is comprehensive, and that data as well as our use of it is consistent with the protocol set forth by Dr. Johnsson himself in his paper on coastal bluff setbacks; principally, it extends over a lengthy period of time (well over the 50 years recommended by Dr. Johnsson), and includes several episodic events. Indeed, it was the intent to follow that protocol, to the extent it comports with accepted professional geological standards, in evaluating the Frank site.

This letter report now addresses certain issues related to future sea level rise raised in Dr. Johnsson's Geotechnical Review Memorandum. In his Memorandum Dr. Johnsson presents the view of the California Coastal Commission that sea level will rise 3 feet (one meter) in the next century. This number is stated as a minimum; and he suggests that sea level could rise in excess of 4 feet. It appears that this number is to be taken into account in determining erosion rates and the "setback distance" for construction on the subject properties.

In assessing the possible effects of an assumed value for sea level rise, as pointed out above, one must first put it into context with the **site-specific conditions** on the properties. Consequently, the effect of sea level rise on these properties must be evaluated in the light of the specific geologic conditions of these properties.

The following analysis of the effects of sea-level rise is based on the site-specific conditions and not upon regional or generic studies. Of particular significance is the elevation of the toe of the colluvial wedge in respect to sea level and the height at which coastal erosion may be initiated.

Site-Specific Geologic Conditions

Historic Coastal Erosion

Photographic Evidence: As indicated in my letter of December 15, 2009, both the photographic evidence and my personal observations over the past 40 years indicate that the cliff in front of the subject property is an "abandoned sea cliff." It has not been attacked by wave action during my 40 years of observation.

Analysis of historic vertical aerial photographs (beginning with the 1928 flight) extends this period of "non erosion" to 80 years. There is no indication of erosion of the sea cliff at the subject properties between 1928 and the present. The large colluvial wedge at the base of the abandoned sea cliff is present in both the 1928 and the 1931 photographs. This period of "non erosion" can be extended even further. Comparison of the aerial photographs with the maps produced by the first coastal surveys performed in the mid 1800's also show no indication of cliff erosion. I want to make it clear that because of the large time gaps between sequential aerial photographs; and the difficulty of comparing them with the mid 1880's maps; it is impossible to be 100% certain that minor amounts of erosion of the toe of the colluvial wedge did not occur in the 1800's. Regardless, one can use these sources to conclude that there has been little, if any, erosion of the toe of the colluvial wedge during the past 80 years, and probable that no significant erosion has occurred for the past 150 years.

The Colluvial Wedge: The conclusion stated above is supported by a second line of reasoning – the presence of the colluvial wedge itself at the base of the sea cliff. The large colluvial wedge at the base of the cliff is present on all aerial photographs, and appears to be present on the mid 1800's maps. This colluvial wedge presently has a slope angle of about 30 – 40 degrees, and there is no discernable difference in slope between the 1980 and the 2009 photographs. The shape and size of the wedge is essentially unchanged by 40 years of sub-aerial erosion and deposition on the wedge. This clearly indicates that sub-aerial erosion is degrading the sea cliff very slowly, and that the top of sea cliff is retreating at an extremely slow rate. The presence of a well developed colluvial wedge on the 1928 and 1931 aerial photographs is clear evidence that this is the same colluvial wedge that is present today. We know this has to be true because of the limitations of the deposition rates on the formation of these wedges. This obviates any other conclusion.

Hypothetically, if one assumes that the colluvial wedge which is present on the 1928-31 aerial photographs was completely eroded away by a series of large storms in the late 1930's, then the wedge we see today would have to have been deposited between the late 1930's and 1970 – a little over 35 years - and then experienced no noticeable change for the next 40 years. This is not possible. The colluvial wedge has to have been there for well over 80 years. This in turn indicates that the colluvial wedge had to begin forming many years before 1928. This supports the conclusion that it is highly probable that the coastline has not experienced significant erosion since the mid 1800's.

On January 23, 2010 I visited the Hidden Beach area to assess the condition of the sea cliff following the recent series of storms. These storms were associated with the present El Nino, had occurred during a period of neap tides when the daily high tide was between 5.1 and 5.5 feet, and had significant wave height of approximately 15 ± feet. The toe of the colluvial wedge had not been eroded.

Tectonic Uplift: the 1989 Loma Prieta Earthquake

During the Loma Prieta earthquake along the San Andreas Fault Zone the area west of the fault moved northwest and up, while the area east of the fault moved southward and down (Plafker and Galloway, eds. 1989; and Anderson, R. S., 1990). In both papers the maps showing uplift are based on data obtained from laser geodometer (geodolite) and GPS measurements made within days of the earthquake. The Plafker and Galloway article shows between 8 – 9 inches of uplift, while Anderson shows about 35 centimeters (10.2 inches) of uplift during the earthquake. More recently (Burgmann, and others 1994, Figure 12) a model of recent Santa Cruz Mountains deformation was created using fission track ages and geodetic data. The model suggests that uplift at the subject properties was about 200 millimeters (approximately 8 inches). Although these studies all show uplift in the range of 7-10 inches, other studies suggest it may be less. For example, Arnadottir and Segal (1994) using a variety of geodetic data indicate an uplift of about 10 centimeters (about 4 inches) at the subject properties.

The effect of the uplift of the mainland relative to sea level during the 1989 earthquake places the toe of the colluvial wedge higher above sea level than the colluvial wedge was in 1989. This provides an even greater margin of safety in regard to wave erosion than was present in 1983 – the only year in the last 39 years during which wave action eroded the beach back to the toe of the colluvial wedge.

The above referenced data can be used to project the effect of this uplift on the potential for future erosion at the subject properties. Here are four possible interpretations, using two different sea level curves. These are the IPPC 2007 projections which range from 18 cm to 90 cm (7 inches – 35 inches); and the Rahmstorf 2007 projections which range from 60 cm to 145 cm (2 feet to 4 ¾ feet).

Using the **IPCC 2007** model of projected global sea level we can assess the effect of the tectonic uplift resulting from this single event as follows:

1. Assume that uplift at the site was 9 inches (229 mm), and use the middle of the range of "model projections" - 380 mm by 2100: Then the properties in question will have the same relationship to sea level in the year 2065 as they had in 1989. This suggests that the toe of the colluvial wedge will not be subjected to erosion until well after the middle of the 21st century.

2. Assume that uplift at the site was 9 inches (229 mm), and use the maximum projected sea level rise – 900 mm by 2100: Then the properties in question will have the same relationship to sea level in the year 2040 ± as they had in 1989. This suggests that the toe of the colluvial wedge will not be subjected to erosion until about the middle of the 21st century.

3. Assume that uplift at the site was 4 inches (102 mm), and use the middle of the range of "model projections" – 380 mm by 2100: Then the properties in question will have the same relationship to sea level in the year 2033 ± as they had in 1989.

4. Assume that uplift at the site was 4 inches (102 mm), and use the maximum projected sea level rise – 900 mm by 2100: Then the properties in question will have the same relationship to sea level in the year 2016 ± as they had in 1989.

Using the **Rahmstorf 2007** model of projected sea level (p. 31 of Cayan et al, 2009):

1. Assume that uplift at the site was 9 inches (229 mm); and use the middle of the range of projections – 1000 mm by 2100: Then the properties in question will have the same relationship to sea level in the year 2037± as they had in 1989. This suggests that the toe of the colluvial wedge will not be subjected to erosion until 25 – 30 years in the future.

2. Assume that uplift at the site was 9 inches (229 mm), and use the maximum projected sea level rise – 1400 mm by 2100: Then the properties in question will have the same relationship to sea level in the year 2030 ± as they had in 1989.

3. Assume that uplift at the site was 4 inches (102 mm), and use the middle of the range of projections – 1000 mm by 2100: Then the properties in question will have the same relationship to sea level in the year 2022 ± as they had in 1989.

4. Assume that uplift at the site was 4 inches (102 mm), and use the maximum projected sea level rise – 1400 mm by 2100: Then the properties in question will have the same relationship to sea level in the year 2014 ± as they had in 1989.

Discussion: I want to emphasize that these projections reflect **only the effect of the uplift of the coastline during the Loma Prieta earthquake.** It projects when the properties will have the same relationship to sea level as they had in 1989. Although there is some uncertainty regarding the exact amount of uplift that occurred, it is clear

that the toe of the colluvial wedge will be higher above sea level than it was in 1989 for a minimum of 4 years and a maximum of 55 years.

El Nino Caused Elevations in Sea Level

During the 1980's and 90's the central California coastline was subjected to two major El Ninos in which sea level was raised well above average. The colluvial wedge at the site was not subjected to erosion during these El Ninos. This provides information as to the height sea level must rise in order to initiate erosion of the colluvial wedge. I emphasize that this methodology has been recommended previously by other researchers. A paper in the *Proceedings of the Coastal Zone 07* (Ewing, L., 2007) suggests the following (italics are mine):

> "Some steps toward examination of the coastal responses to a rapid rise in sea level are *(1) using current or historic surrogate conditions, such as El Ninos, floods, tsunamis, or subsidence, as qualitative models of future shoreline change*; (2) assessing sea level adaptability of various natural and constructed coastal features; *(3) determining the sea conditions which would exceed the adaptive capacity of various coastal features*; and (4) examining the implications for current coastal management efforts."

The 1982-83 El Nino: The Fort Point tide gauge shows that during the 1982-83 El Nino sea level was temporally elevated **9 inches above** the "present day sea level." This elevation of 9 inches is related to the El Nino oscillation and does not include the wind induced storm surge. Beach erosion during this El Nino occurred during several exceedingly large storms associated with high tides and a storm surge of several feet. Despite this the toe of the colluvial wedge at the subject site was barely nipped by wave erosion.

The 1997-98 El Nino: The Fort Point tide gauge shows that during the 1997-98 El Nino sea level was temporarily elevated **11.5 inches above** the "present day sea level." Again this does not include the wind induced storm surge. The total effect of all factors associated with a major storm system (high tides, high waves, El Nino, storm surge) can elevate sea level a large amount. Cayan et al (2009, p. 13) state that during one of the storms in February 1998 all of the factors that affect sea level coincided to raise sea level by up to 5 feet (1.5 meters) above normal in San Francisco Bay. I am of the opinion that it would be inappropriate to transfer this number directly to the outer coast; but it is reasonable to infer that during this El Nino sea level was probably raised several feet (3 feet at a minimum) at Hidden Beach. During this storm there was no erosion at the toe of the colluvial wedge at the subject properties.

Discussion – Tectonics and El Ninos

The only historic stripping of the beach in front of the subject properties during the past 40 years (personal observation) occurred in the 1982-83 El Nino year during large storms associated with a storm surge of at least several feet added on top of a high tide and a sea

level that was already elevated 9 inches (by the El Nino) in respect to today's mean sea level. If one adds to this 9 inch elevation to the 2 -7 inches of relative uplift associated with the Loma Prieta earthquake, and add the fact that the erosion occurred at the highest tides of the year on top of a storm surge; it is clear that the beach was barely eroded by storm waves at a relative sea level that was more than 3 feet above the present level.

How Much Must Sea Level Rise to Initiate Erosion of the Colluvial Wedge?

Site Specific Erosion: The sea cliff fronting the subject property is clearly above the level of wave attack. The same appears to be true for the entire length of coastline between New Brighton Beach and Sunset Beach. I have personally observed that there has been no erosion of the sea cliff over the past 40 years. Historic vertical aerial photos indicate there has been no erosion over the past 80 years, and comparison of these photos with the mid 1800's coastal surveys suggests that there has been little if any erosion over the past 150 years. The reason for this is not known. There are a minimum of three hypotheses that could explain this anomalous condition. None can be either proven or rejected.

What is clear is that even under conditions where sea level was 3 feet higher than at present, during large storms with significant wave heights of 7 meters (23 feet) and during periods of high tide, there was no erosion of the toe of the colluvial wedge. Clearly, sea level must rise 3 feet (or more) before it will be high enough to begin to erode the toe of the colluvial wedge on more than an occasional basis. Using the two sea level curves used earlier we can approximate when this will happen for sea level elevations of 2 ft (609 mm), 2 ½ feet (762 mm) and 3 feet (914 mm).

Using the most radical projection (highest) of **Rahmstorf 2007,** those levels would be reached on about 2061, 2070 and 2077 respectively.

Using the highest projection of the **IPCC 2007,** those levels would be reached on about 2078, 2090 and 2100 respectively

Consequently, using the highest projections of sea level from both sets of projections, I anticipate that we will not see the initiation of erosion of the toe of the colluvial wedge at the subject properties until well after mid century. Considering all of the uncertainties and assumptions involved in the construction of the computer models used to predict both global warming and sea level rise, and the exceedingly short time period on which these projections have been based, it is likely that there will be no erosion of the toe of the colluvial wedge until around 2090.

In summation, it is clear that a close examination of the site specific geologic conditions reveals a geologic setting for the coastal bluff that is quite different than that portrayed in USGS Open-File Report 2007-1133 (Hapke, and Reid, 2007). It is important to point out that the Hapke and Reid paper is a generalized approach to evaluating trends in erosion

for the entire California coastline. It was not intended to be used in site-specific evaluations. As is clearly stated in Hapke and Reid (2007, p. 2) under **Use of Data**:

> *"The results and products prepared by the USGS **are not intended for comprehensive detailed site specific analysis of cliff retreat,** nor are they intended to replace any official sources of cliff erosion information identified by local or state government agencies, or other federal entities that are used for regulatory purposes."*
>
> ***"The results are not intended for predicting future cliff edge positions** or future rates of cliff retreat."*

The toe of the colluvial wedge has barely been touched by erosion in the past 40 years. It is highly probable that the toe has not been eroded by waves over the past 80 years; and indeed may not have been touched by erosion for 150 years. It is also clear that the toe of the colluvial wedge is elevated a minimum of 2 ½ feet above the level of wave attack; and that a sea level rise of over 3 feet will be needed to place the subject properties in a position where the toe of the colluvial wedge will be subject to routine wave erosion. This will most likely occur late in the 21st century.

Planning Issues

Projections of Sea Level Rise

As stated in my earlier response (March, 2009) regarding projections of sea level rise, there is a great deal of uncertainty in these projections. The projections are typically calculated from computer generated global coupled ocean-atmosphere general circulation models (GCMs). These models are driven by scenarios of future greenhouse gas concentrations that are in turn determined by such variables as future population, the level of economic activity and wealth along with other variables. In addition, computer projections on the total amount of sea-level rise during the next century will be based in part on interpretations and/or assumptions of how rates of global warming, thermal expansion of the oceans, and mass increase of the oceans from melting glaciers will change over time.

One of the great uncertainties lies in the rate of change of sea level rise. At present scientists do not have an adequate understanding of the rate of change in the warming of the atmosphere and the oceans, and their relationship to the rate of change in the volume of CO_2 in the atmosphere. Examples of recent studies that reflect the uncertainty include:

1) Jevrejeva, Moore and Grinsted, 2008: ***Relative importance of mass and volume changes to glacial sea level rise.*** Journal of Geophysical Research

In this study the authors examine the relationship between global sea level rise, thermal expansion of sea water due to warming, and increased mass related to melting of glacial ice and ice sheets. The authors found that despite their efforts they could not explain

where 27 % of the water added to the ocean came from. Glacial melt water and thermal expansion of the oceans could only account for 77% of the additional water. This clearly indicates it is impossible at present to fully explain the existing sea-level rise in light of what we know about ocean heat content, ocean volume changes due to mass increases, and the amount of glacial meltwater. If it is not possible to determine what the relative components are that contribute to observed sea level rise over the past decades and century, it raises serious doubts about the validity of projections of sea level rise in the future.

2) Jevrejeva, Moore, Grinsted and Woodworth, 2008: *Recent global sea level acceleration started over 200 years ago?* Geophysical Research Letters

The authors present a reconstruction of global sea-level since 1700 in an attempt to determine when the acceleration started and to understand how it changed through the past 300 years. They conclude that *"...global sea level acceleration up to the present has been about 0.01 mm/yr² and appears to have started at the end of the 18th century."* However, they note that there are periods of slow and fast sea level rise including a 60-year variability that appears to be global. The causative mechanism for this cycle is not understood. They also point out the importance of random events such as large volcanic eruptions that cool the earth. They conclude that an extrapolation of the data between 1700 - 2000 indicates there will be a 34 cm (13 inches) sea-level rise between 1990 and 2090. However, the authors note that this projection (34 cm) is probably too low and that sea-level will probably rise faster, once again reflecting uncertainty in what might or will happen.

3) Flick, R. E., and Ewing, L. C., 2009: *Sand volume needs of Southern California beaches as a function of future sea-level rise rates.* Shore & Beach, Vol. 77, No. 4, pp. 36-45

The authors deal primarily with a deficiency in sand in the littoral drift systems along the Southern California coastline. However, they discuss both Past Sea-Level Rise and Possible Future Sea-Level Rise near the end of the article. In respect to past sea-level rise they point out that while west coast tide gauges typically show about 20 centimeters of rise over the past 100 years , the *"...tide gauge data from La Jolla suggest that local sea-level off southern California rose much more slowly or may actually have dropped slightly, since about 1980. The reason for this is not known; it may relate to influences from the Pacific Decadal Oscillation."*

In regard to future sea-level rise, they state, page 40: *"Few geophysical phenomena can be accurately predicted, including sea level rise."* They continue by stating that projections can be made and scenarios created using a general understanding of principles and processes and projecting these into the future. These scenarios can then be modified over time. They also point out: *"Each approach requires certain assumptions, which can only be refined as time goes on and observations become available."* And yet again, the authors clearly state that great uncertainties exist in the prediction of sea level rise in the next century.

Discussion: Sea-level has been rising slowly since the end of the "Little Ice Age." The Fort Point tide level gauge shows approximately 8 inches (203 mm) of sea level rise over the past century. In addition a slow acceleration in the rate of sea level rise has been identified from global studies. However, neither the amount of sea level rise nor the acceleration of sea level rise has been constant throughout the oceans of the world (Fletcher, 2009; Jevrejeva, et al 2008). In particular, the causes of the changes in the rate of sea level rise are not understood. Although some processes (i.e. large volcanic eruptions, as ice-calving - ice-sheet dynamic processes) that can affect sea level have been identified, there are others which have not been neither identified nor adequately quantified. Consequently, any projection of sea level rise over the coming 90-100 years must be regarded as highly speculative.

Regardless, the projected rise of sea level for the period ending 2100 (based on a review of articles listed in the Bibliography) can be summarized as follows:

1. The majority of the projections lie between about 40 cm (16 inches) and 60-80 cm (24 – 32 inches).

2. The highest projections are from Pfeffer, Harper & O'Neel (2008), who project a rise of between 0.8 meters (32 inches) and 2.0 meters (79 inches – 6.6 feet).. They include a component for ice-sheet calving.

3. The IPCC (2007) predicts a rise between about 20 cm (8 inches) and 70 cm (27 inches); but include a projection including ice sheet dynamic processes the indicates a sea level rise of about 90 cm (36 inches).

Many of the projections contain the caveat that larger values cannot be excluded.

This leaves us with projections that range from a low of 20 centimeters to a high of 200 centimeters – a ten fold difference. This by itself demonstrates the tremendous amount of uncertainty incorporated in any projections of sea level rise. The requirement for the use of a 3-4 foot rise in sea level in estimating erosion at the site is clearly at the high end of an extremely wide spread of predicted values.

Conclusions

Historic Erosion: Historic photographs clearly show that the subject properties lie at the top of an abandoned sea cliff fronted by a broad beach; and that it has not been subjected to wave erosion for the past 40 years. They also show that the top of the sea cliff has retreated a very small amount over this time period. In addition, the large colluvial wedge that forms the face of the abandoned sea cliff has been untouched by wave erosion over this time period. In the winter of 1982-83 large storms with 15-20 foot waves, on top of a storm surge, on top of high tides, occurring during an El Nino year when sea-level was raised about 9 inches, stripped the beach back to the toe of the colluvial wedge. During the El Nino year of 1997-98 with a sea level elevation or 11 ½ inches (due to El Nino) there was no erosion of the toe of the colluvial wedge.

Vertical aerial photographs from 1928 and the early 1930's of the subject area show that the sea cliff has a broad, well developed colluvial wedge at its base, very much like today. There is no evidence of erosion of the colluvial wedge on the historic aerial photographs. From this we can conclude that there has been no erosion of the colluvial wedge for the past 80 years. The absence of erosion can be extrapolated back to about the mid 1800's when the first coastal maps were prepared by the United States Coastal Survey. It appears that the coastline is unchanged in this area and that a colluvial wedge is present at the base of the cliff. Consequently this section of coastline has probably not been subjected to significant amounts of erosion (if any) for the past 150 years or so. The exact reason for this is not known, but these facts are known and documented.

El Ninos and Storms: During the past 40 years the coastline has been subjected to several El Ninos (1982-83 & 1997-98) during which relative sea level was raised between 9 – 11 inches in respect to what mean sea level is today. During the 1982-83 El Nino (9 inch rise in relative sea level) the coast was subjected to series of very large storms during the months of January and February. These storms rode into the coastline on top of high tides and a storm surge with 20-25 foot waves. During these storms the beach at the subject property was stripped out to the toe of the colluvial wedge, but the wedge was not cut back by the storm waves. I estimate that sea level during these storms was a minimum of 3 feet higher than the present day mean sea level – and may have been considerably more.

The 1997-98 El Nino raised sea level about 11 inches in respect to today's mean sea level and did not erode the toe of the colluvial wedge, and there was less overall impact to the coastline in general than in 1982-83. This may be because the storms were not as severe as in 1982-83.

Loma Prieta Earthquake: The 1989 Loma Prieta earthquake raised the southwestern side of the Santa Cruz Mountains in respect to the northeast side. The coastline at the subject properties was raised between 2 and 7 inches in respect to today's mean sea level.

Predicted Sea Level Rise and Cliff Erosion: Using this information it is reasonable to conclude that even a rise in sea level of 2 ½ to 3 feet will not result in erosion of the colluvial wedge at the subject property. Since storms surges such as occurred in 1982-83 are relatively rare events, it is highly probable that it will take over 3 feet of sea level rise to initiate erosion at the base of the sea cliff. This will most likely occur some time between sometime between 2070 and 2090. That erosion, when and if it occurs, will be intermittent. It will not occur on a yearly basis until well after 2100.

This analysis of the site specific geologic and oceanographic conditions at the subject properties suggests that the pending rise in sea level will probably not initiate erosion at the toe of the colluvial wedge for at least 60 years. Consequently, I suggest that any analysis of sea cliff erosion should use as a starting point for "sea cliff" erosion the year 2075 as the worst possible scenario.

Projections of Sea Level Rise: Review of the scientific literature on climate change and sea level rise reveals that there is a great amount of uncertainty in the prediction of these processes. The computer models are approximations at best, at this time. Climate has been slowly warming and sea level has slowly risen over the last century, but there is great uncertainty as to what will occur in the future. Computer models used to project climate change and sea level rise all suffer from a lack of certainty because of the complexities of the systems and the relationship between these two systems. Over the next 10 – 20 years, as the data base expands, these models will be improved and the predictions will become more reliable. As Neils Bohr once said; "Prediction is very difficult, especially if it's about the future."

Summation: The subject properties lie at the top of an abandoned sea cliff that has not experienced active wave erosion for a long time – perhaps 100-150 years. When one considers the absence of erosion on these properties, the occurrence of tectonic uplift, the absence of erosion during El Nino elevated sea levels, and the absence of erosion during exceedingly large storms associated with storm surges, it is clear that the area is elevated above the level of present day wave erosion by at least 3 feet, and probably more. When this information is plotted on the IPCC and Rahmstorf projected sea level curves it is clear that wave erosion will not be routinely occurring at the base of the colluvial wedge until after 2070 and perhaps not until after 2100.

If you have any questions regarding these materials, my observations and conclusions please contact me.

Sincerely,

Gerald E. Weber

Gerald E. Weber, Ph.D.
R.G. #714
C.E.G. #1495

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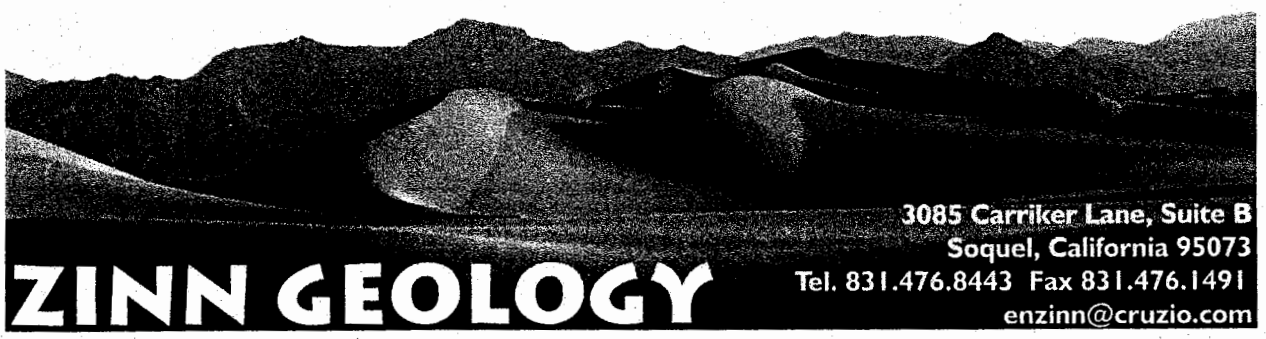

26 February 2009 Job #2006009-G-SC

Neil Frank
c/o Cove Britton
Matson - Britton Architects
728 North Branciforte Avenue
Santa Cruz, California 95062

Re: Supplemental analysis in response to California Coastal Commission comments
Parcels southeast of Bayview Drive
Aptos, California
County of Santa Cruz APN's 043-161-51, -40, & -39

Dear Mr. Frank:

Our firm is pleased to respond to your request for supplemental analysis of the long term bluff retreat for the above-listed parcels. The work summarized in this letter is in direct response to comments issued by the California Coastal Commission [CCC] Geologist, Dr. Mark Johnsson. Dr. Johnsson has requested that we revisit our analysis completed in August 2006, in light of recently published papers on projected sea-level rise over the next century. Dr. Johnsson has asked us to substantiate our 100-year long term coastal bluff retreat setback for your project in light of the CCC"s concern that sea level will continue to rise at an accelerated rate within the next 100 years. The following sections summarize our analysis.

OVERVIEW OF PREDICTING FUTURE UPPER COASTAL BLUFF RETREAT

The primary process that drives the retreat of the sea cliff in the Monterey Bay is hydraulic impact and scour from wave action. The sea cliff fronting the subject property appears to have been largely untouched by wave action since at least 1939. Ironically the top of the coastal bluff has continued to lay back through the process of erosion and shallow landsliding, resulting in the build up of a wedge of sediments in front of the bluff, herein referred to as a "colluvial wedge". The toe of the bluff, which includes the colluvial wedge, actually appears to be aggrading (moving seaward) overall through time. We are aware of only one coastal storm event in the last 70 years that has touched the colluvial wedge, a large oceanic storm piled upon a very high tide in early January 1983, which resulted in a small scarplet being cut into the toe of the colluvial

wedge, where the colluvial wedge contacts the beach sand. The wedge has since refreshed itself and continues to grow seaward as the top of the bluff continues to lay back.

In order to calculate a future shoreline angle (where the coastal bluff intersects the wave cut platform abraded by the ocean) location for rising sea levels for this project, a geologist will need to consider the following parameters: sea-level rise and position, the rate at which the specific rising sea level will remove or drown the broad beach that fronts the bluff at a given sea-level rise rate, the rate at which the colluvial wedge will erode and retreat for a given sea-level rise rate, and finally the rate at which the sandstone bedrock that underlies the site and forms the sea cliff will erode and retreat for a given sea-level rise rate. The answer for this four variable equation would be the ultimate position of the coastal bluff for whatever time period is stipulated. The following subsections discuss each of these parameters and what might be a reasonable assumption for each parameter.

It is important to note that there are other parameters that could potentially be inserted into the bluff retreat equation, such as frequency and intensity of future storms. Even if we could accurately predict the future changes in such parameters, they are less likely to affect the long term retreat rate of the bluff then the aforementioned four primary parameters.

Sea Level Rise

Dr. Gerald E. Weber has written an entire letter on this topic for this project, available under separate cover. His synthesis of this topic and how it applies to this project is far more exhaustive than what we have presented below. The reader should refer to Dr. Weber's letter, which will be submitted under separate cover with this letter, for a much more detailed discussion of this topic.

The study of climate and sea level changes has become a hot scientific topic in the last 5 years, as evidenced by the number of peer-reviewed journal papers issued on the topic. We specifically reviewed the following papers for our supplemental analysis: Ekstrom et al., 2006; Domingues et al., 2008; Church and White, 2006; Church et al., 2008; Cayan et al., 2006; Cabanes et al., 2001; Vaughan et al., 2007; Rahmstorf, 2007; Pfeffer et al., 2008; Overpeck et al., 2006; Joughin et al., 2008; Jevrejeva et al., 2008a; Jevrejeva et al., 2008b; Collins and Sitar, in press..

All of the papers assume that the sea level will continue to rise because: 1. geological evidence clearly indicates that the earth has overall been slowly warming since the last sea-level low stand approximately 18,000 years, including the emergence from the Little Ice Age in the late 1700's-early 1800's.; 2. recorded historic sea levels clearly reflect a continuing rising sea level; 3. the processes driving global warming will continue into the foreseeable future; 4. the current warming trend is thought to be directly related to anthropogenic contributions to CO_2 concentrations. Hence, since sea level has been slowly rising as the earth slowly warms, this will continue in response to rising CO_2 levels. This continuing slow increase in temperature results in

two processes that contribute to the rise of sea-level: 1. thermal expansion (heating) of the ocean and 2. increase in mass due the addition of water from the melting of glacial ice and polar ice sheets.

The unifying theme in these peer reviewed articles is that there is a direct relationship between rates of atmospheric warming, oceanic warming, and atmospheric CO_2 concentration, even though this connection is poorly understood. Consequently, researchers have had to make tacit assumptions as to how these variables interact in order to calculate projected sea levels and the rates at which the sea level will rise. It is important to note how profoundly important these assumptions are to the outcome of the researchers sea level predictions. If any of these unproven assumptions are incorrect, the predicted sea-level rise will be incorrect.

The papers listed at the beginning of this section, as well as the results published by the International Panel on Climate Change (IPCC) indicated that projected sea level rise is somewhere between 7 inches to 2 feet by 2100. An added uncertainty sea level rise factor between 4 inches and 34 inches has been added to account for their poor understanding of the volume of ice that currently exists on the continents.

In our opinion, the most reasonable approach for dealing with something as uncertain as projected sea-level rise should mirror the approach used in characterizing the hazard and risk for a given project with respect to the uncertainties present in calculating seismic shaking forces for a structure. The presumptive criteria utilized for assessing the acceptable risk is directly tied to occupancy and use of the structure being constructed. In that example, facilities such as hospitals are designed for higher seismic shaking values than single-family residences, since the hospitals have greater exposure to potential injuries and deaths and therefore a lower acceptable risk threshold than residences.

Based on the aforementioned information, and the excellent summary presented by Dr. Gerald E. Weber in his letter, it is my opinion that a reasonable assumption for sea-level rise in the next century to be applied to analyses for single-family residences should be equal to or greater than the total sea level rise in the 20th century and consistent with the rate of rise over the past 20-30 years. This number would lie someplace between approximately 11 to 13 inches. Hence, we have utilized an assumed sea-level rise of about one foot for the next 100 years for this supplemental analysis.

Removal and/or Drowning of the Broad Beach Fronting the Subject Property

The width of the broad beach fronting the subject property is defined as the distance from the toe of the colluvial wedge to the high tide line at any given time.. This distance has been and will continue to be highly variable. The single instance in which the beach was almost completely removed by storm waves was in early January 1983. Typically the beach ranges in widths up to well over 300 feet. The average value (based on interpretation of historic aerial photographs)

over the last 70 years is approximately 300 feet. Although minor differences in width are common, we were unable to discern a clear trend toward either a thinner or wider beach . The minor variations noted in beach width are clearly the result of seasonal changes (summer berm versus winter berm) in beach mass and width and the intensity and frequency of oceanic storms prior to the date of the photographs.

The back beach in front of the subject property is currently 10 feet above mean sea level (see the attached cross section – Plate 1). This area has only been eroded by waves once within the last 70 years (January 1983), during a large storm combined with a storm surge piled upon a very high tide. Since then the beach has built back out to its' average width. It is difficult to predict how many tens of years it will take to **permanently** remove the beach so that wave action can routinely impinge on the base of the colluvial wedge. Additionally, it appears there is no standard of care, no published statute, no ordinance or published peer-reviewed paper that presents a clear formula for the direct relationship between the rate of sea level rise and the rate at which the shoreline on a broad beach will advance landward.

Because of the lack of information in respect to this parameter, we must assume a value. Consequently, for this analysis we have assumed that it will take approximately 50 years,(corresponding to a sea level rise of 6-inches) for the permanent removal of the existing broad beach during the winter season.. This value is within the estimates for the IPCC (2001) assessment and AR4 updated projections (refer to Church et al., 2008, Figure 6). When one considers that this beach has only been removed once over the past 70 + years it is difficult to rationalize that a 6-inch rise in sea level would lead to a complete and permanent removal of the winter beach. However, in order to deal with a hypothetical process we need to assume a number that is far in excess of what we feel is probably valid. Therefore this is an ultra conservative analysis that would place the shoreline at the toe of the colluvial wedge 50 years from today.

Colluvial Wedge Retreat Rate

The same dilemma of lack of published data and formulas relates to the rate at which the colluvial wedge will retreat, if it is routinely attacked by wave erosion on a yearly or bi-yearly basis. We presume that the rate would be fairly high, considering the fact that the colluvial wedge is composed of unconsolidated sediments, roughly similar in composition to the underlying beach sand.

If one assumes a future shoreline angle elevation of one foot below mean sea level, the aggregate thickness of colluvium that needs to be removed before the bedrock is reached is approximately 10 feet.

Considering the lack of information for this parameter, we once again will have to assume a rate, so for this analysis we have assumed it would take approximately 3 years for the sea level to rise

to the point high enough to advance the shoreline to the contact between the bedrock and the colluvial wedge.

Sea Cliff Retreat Rate

Published and unpublished average long term bluff retreat rates for the sea cliff up shore (northwest) of the subject site range from nil to upwards of 2 feet, depending upon the stratigraphy and structure of the bedrock and the orientation of the coastline. There are no published long term rates for sea cliff retreat by wave erosion anywhere near the site because the coastal bluff in this area has been protected by a broad beach (from New Brighton Beach State Park - up coast and northwest of the site - to Sunset Beach – down coast and southeast of the site) for 70+ years. Any bluff retreat rates for this stretch of sea cliff are basically rates that record the retreat of the top of the bluff due to rainfall erosion, drainage erosion, rock falls and shallow landslides - all terrestrial processes. Considering the geological setting, we have conservatively assumed that if the ocean ever forms a shoreline angle within the underlying Purisima Formation sandstone bedrock, it will do so at about one foot below mean sea level and will erode the shoreline angle back at an average annual rate of about one to two feet per year.

We have no reason to believe that the above listed assumed annual average bluff retreat rate values are too low or too high. Collins and Sitar (in press) attempted to quantify another way to deal with quantifying coastal bluff erosion, but their paper addresses a stretch of coastline along the Pacifica, California area that is underlain by entirely different earth materials. Additionally, it is important to note that if the sea level rise rate significantly exceeds the rate at which the shoreline angle can be abraded into the bedrock and advanced landward, there is every chance that the retreat rate might stabilize or slow down due to deeper water conditions in front of the shoreline angle (i.e. a drowned shore line angle). In any event, it is best to use predictable and reproducible rates for comparable geological conditions, where available, instead of creating fictitiously assumed rates.

WHAT DO WE DO WITH THESE PARAMETERS?

If the retreat rate for each component was rigid and simplified, the calculation would be easy to do. Unfortunately, as noted, we are very unsure of how quickly the broad beach will disappear and then how rapidly the colluvial wedge will be removed if sea level rises about one foot within the next 100 years. Hence, we feel it is reasonable to work backwards from the imminent failure of the residence, and deal with the envelope of uncertainty from the contact between the colluvial wedge and bedrock seaward toward the modern day shoreline.

In order to do this, we need to set the stage for imminent failure of the proposed residence. Assuming a vertical bluff that has just exposed the piers for the residence, which is presumptively built right upon the edge of our envelope, with a shoreline angle at about one foot below mean sea level, we note from our cross section that there is approximately 108 ½ feet of

bedrock seaward of this point. If we assume a bedrock/bluff retreat rate of 1 foot per year, then it would take 108 ½ years for the proposed residence to become endangered after the bedrock is breeched by the rising sea. If we assume a bedrock/bluff retreat rate of 2 feet per year, then it would about 54 years for the proposed residence to become endangered after the bedrock is breeched by the rising sea.

If the bedrock retreat rate is one foot per year, then the proposed residence is obviously set back far enough to fulfill the intent of the Local Coastal Plan of a stipulated 100-year design life. Nonetheless, to carry out the calculation, we would then add 3 years for the removal of the colluvial wedge and 50 years for the removal of the beach resulting in a hypothetical lifetime of 161 ½ years.

Using a similar tally for a bedrock retreat rate of 2 feet per year (i.e. bedrock+colluvial wedge+beach = 54 years + 3 years + 50 years) results in a lower value of 107 years for the hypothetical lifetime.

CONCLUSIONS

The above analysis clearly shows that the proposed residences continue to be geologically feasible and that they conform to the intent of the Local Coastal Plan. The calculated life of the residences with respect to hypothetical bluff retreat lies between 107 and 161 ½ years, even after assuming a reasonable sea-level rise of one foot or more for the next 100-years and assigning conservative assumptions for loss of the broad beach, loss of the colluvial wedge and abrasion of the sandstone bedrock. We stand behind our original conclusions and recommendations issued in 2006 - the residences constructed within our stipulated envelope are geologically feasible.

It is important to note that we have performed this research at the behest of the California Coastal Commission Geologist, Dr. Mark Johnsson. To our knowledge, none of the work outlined in this letter adheres to standard of care for coastal geology investigations in Santa Cruz County or in any approved ordinances, prescriptive codes or statutes. We have assembled a plausible geological model for what we consider to be a reasonable assumption for a future sea level rise rate. There is no end of possibilities and ways to model this situation, if the geologist is almost completely unconstrained by data or calculations, as is the case here. As noted in the above sections, the only rate that appears to be even remotely constrained by data is the retreat of the Purisima Formation bedrock, located well up coast of the subject property. Considering the inherent uncertainty in all of the work done to date by the researchers, there is no reason to pursue this matter any further for this project and continue to debate the merits of all the different

assumptions that one could conceivably make. To continue this pursuit any further would only unnecessarily forestall the issuance of the permit for the project, without furthering our understanding of the geology of the site, which has been determined to be suitable for the proposed development.

Sincerely

Zinn Geology

PROFESSIONAL GEOLOGIST
ERIK N. ZINN
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CERTIFIED
ENGINEERING
GEOLOGIST
STATE OF CALIFORNIA

By Erik N. Zinn
Principal Geologist
CEG No. 2139

Attachment: Plate 1 - Cross Section Used For Bluff Retreat Calculation

Exhibit 6
A-3-SCO-09-001, 002
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February 26, 2009 Project No. 0630-SZ70-D63

Mr. Neil Frank
c/o Matson-Britton Architects
728 N. Branciforte Drive
Santa Cruz, CA 95062

Subject: **Response To California Coastal Commission Comments**
Lands of Frank
Bayview Drive
A.P.N. 043-161-51, -40 and -39
Rio Del Mar, Santa Cruz County, CA

Reference: **Review of Geotechnical and Geologic Investigation Reports**
Dr. Mark Johnsson, California Coastal Commission, dated November 10, 2008

Dear Mr. Frank,

As requested, we have reviewed the comments expressed by Dr. Mark Johnsson of the California Coastal Commission. Our response is based upon those comments, as well as discussions with Dr. Johnsson and Susan Craig during a meeting at their office on January 6, 2009. We offer the following response:

Comment #1
The minimum factor of safety of all potential failure modes was not determined. Instead, an assumed failure surface was specified and its factor of safety calculated. This is not standard practice and does not assure that the specified surface is, indeed the most likely failure surface."

As outlined in our geotechnical report, long-term bluff retreat rates were calculated on the basis of the project geologist's understanding and experience with bluff failures along this area of coastline. Such failures inherently included all the geological processes (erosion, landsliding, co-seismic failures, etc.) which could conceivably contribute to retreat of the bluff over the next 100 years. The purpose of our slope stability analysis was to quantify a worse-case failure surface using this analytical process and demonstrate consistency with observed slope failures, particularly those triggered by seismic shaking. In our opinion the most likely failure surface was adequately demonstrated using this approach and was consistent with numerous observations along the coastal bluffs.

Nevertheless, Dr. Johnsson asked us to perform additional slope stability analysis in accordance with the procedures outlined in the 16 January 2003 memorandum, titled "Establishing Setbacks from Coastal Bluffs". In general, the procedures outlined in this document require demonstrating a static safety factor of 1.5 or greater assuming circular failure surfaces through generally homogeneous materials.

The recommended setback is then determined on the basis of this failure plane, or a failure plane demonstrating a 1.1 safety factor with a horizontal seismic coefficient of 0.15g, whichever lies furthest landward. The results of our analysis are enclosed with this letter and demonstrate that, although the approach is not in our opinion a realistic model for coastal bluff landslide analysis, the recommended setback as outlined in the geologic and geotechnical reports lies landward of these postulated failure planes and remains appropriate from a geotechnical standpoint.

The results of our analysis suggest that retreat of the terrace deposit materials may encounter portions of the foundation piers for the seaward edge of the residence near the end of the structure's design life. The portion of the pier extending into bedrock will not be exposed however, suggesting continued support or mitigation measures that would not require the need for a coastal protection structure.

Comment #2
"No data are presented in support of the assumed shear strength parameters used in the analysis. Indeed the friction angle assumed for the Purisima Formation is unusually high"

As discussed with Dr. Johnsson, the following is a tabulated summary of shear strength values that have been obtained from laboratory testing of samples from this and adjacent properties (starting with the property furthest to the northwest and proceeding down coast):

Property Location	Reported By	Sample Depth	Cohesion	Phi Angle
Terrace Deposit Materials:				
A.P.N. 043-161-52 (650 Bayview Drive)	Steven Raas & Associates	5'	1420 psf	35°
		10'	790 psf	40°
		15	1230 psf	30°
		20	710 psf	45°
A.P.N. 043-161-08 (656 Bayview Drive)	Steven Raas & Associates	5'	2150 psf	36°
		16'	985 psf	42°
A.P.N. 043-161-57 (660 Bayview Drive)	Pacific Crest Engineering	6'	0 psf	39°
		16'	0 psf	38°
A.P.N. 043-161-58	Pacific Crest Engineering	2'	0 psf	31°
A.P.N. 043-161-39	Pacific Crest Engineering	12'	700 psf	45°
	Haro, Kasunich & Associates	5'	880 psf	45°
		13'	100 psf	50°
		21'	300 psf	40°
A.P.N. 043-161-40	Pacific Crest Engineering	23'	175 psf	43°
A.P.N. 043-161-51	Haro, Kasunich & Associates	17'	0 psf	38°
Average Strength Values:			***630 psf***	***40°***

Purisima Formation Bedrock:

A.P.N. 043-161-52 (650 Bayview Drive)	Steven Raas & Associates	35'	1670 psf	37°
A.P.N. 043-161-08 (656 Bayview Drive)	Steven Raas & Associates	26'	1115 psf	33°
A.P.N. 043-161-58	Pacific Crest Engineering	27'	275 psf	45°
A.P.N. 043-161-51	Haro, Kasunich & Associates	29'	410 psf	34°
	Pacific Crest Engineering	22'	1150 psf	61°
		27	500 psf	48°
Average Strength Values:			***850 psf***	***43°***

As can be seen from the laboratory test results presented above, the soil stratigraphy is highly variable within the marine and fluvial terrace deposit materials, with resulting variations in laboratory-derived soil strength parameters. Our review of laboratory test results from this site and the adjacent properties up and down-coast confirm a wide variation in shear strength properties within the soils that overlie bedrock contact.

The slope profile was modeled using three predominant soil/rock types. Direct shear testing of soil samples within the wedge of marine and fluvial terrace deposits overlying the bedrock at this site indicate that cohesion appears to be the dominating strength component within the upper ten feet, with a more frictional component dominating the underlying sand strata to the bedrock contact. The strength values were conservatively selected and fall within the range of test results outlined above.

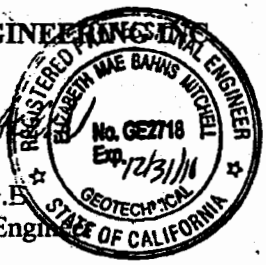
Comment #3
"The statement that "we do not expect failure geometries to encroach beyond the boundary [as specified by Zinn] and onto the building envelopes within the next 100 years" is not supported by facts or calculations."

Our 2006 analysis presented our interpretation of worse-case failure geometries and demonstrated that they would occur within the recommended structural setback outlined by the project geologist. Observed and calculated failure planes along these coastal bluffs suggest failures occurring at angles of about 35 degrees from horizontal, both statically and seismically. The increase in calculated safety factors therefore does not support failure geometries flatter than 35 degrees that could encroach beyond the recommended setback.

We appreciate the opportunity to be of service. If you have any questions, please contact our office. We can be reached at (831) 722-9446.

Sincerely,

PACIFIC CREST ENGINEERING INC



Elizabeth M. Mitchell, G.E.
Associate Geotechnical Engineer
GE 2718
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Copies: 1 to Client
5 to Matson-Britton Architects
1 to Zinn Geology
1 to Dr. Gerald Weber

Enclosure: Quantitative Slope Stability Analysis

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VIA EMAIL AND REGULAR MAIL

Susan Craig
Dan Carl
California Coastal Commission
725 Front Street, Suite 300
Santa Cruz, CA 95060

Re: Appeal Numbers A-3-SCO-09-001, -002, -003 (Frank)

Dear Susan and Dan:

I wanted to summarize in this letter my understanding of the salient points of geologic information and standards that have been disseminated in the various reports, counterreports, critiques, etc. for Neil Frank's project. In summarizing this information, this is in part my own attempt at trying to comprehend the information and grasp its significance from a practical standpoint. I am not a geologist so I am sure I may miss something, but it seems worth the effort to try to make some sense out of the points from a lay standpoint and try to understand how three professional geologists could reach such a dramatically different conclusion on the bluff setback.

Initially, as to the standard utilized by the Coastal Commission in measuring coastal erosion and establishing setbacks based thereon, I have read twice now in recent Coastal Commission reports[1] that the standard for gauging future coastal erosion is the historical coastal erosion rate; accelerating sea level rise is not a factor that is calculated into the future rate because of the numerous uncertainties and indeed considerable disagreement over what that amount might be. This Commission policy is made clear in the Monterey Bay Shores Appeal Staff Report dated April 24, 2009, in which it is stated at page 47:

> "There is no single, widely-accepted methodology for explicitly including sea level rise into projections of future bluff retreat. Rather, the Commission's practice in the past has been to base the recommended setback on the highest historic bluff retreat rate for [sic] in order to minimize the risk of coastal erosion hazards, and not to assume a specific amount

[1] Monterey Bay Shores Appeal Staff Report dated April 24, 2009, and the Staff Report for the Crescent City LCP Amendment cited in Dr. Johnsson's June 18, 2009 Geotechnical Review Memorandum on the Frank project.

of retreat to the effects from sea level rise. This approach is particularly compelling given the uncertainty in sea level rise projections, including that associated with the potential melting of ice sheets and glaciers."[2]

Reviewing the geologic information submitted on the Frank project, we have Erik Zinn, the project geologist from Santa Cruz County, and Dr. Gerald Weber, a consulting geologist who was formerly the Santa Cruz County Geologist and is presently Lecturer Emeritus, Earth and Planetary Sciences Department, at the University of California, Santa Cruz. Mr. Zinn reviewed stereopair aerial photographs dating back to 1928 which were site-specific to the project location at Hidden Beach, and determined that the historic erosion rate at the site over almost 80 years varied from 0.27 to 0.30 feet per year on the beach bluffs and 0.05 feet per year on the along the arroyo bluff. Bluff top recession setbacks for the structures over a 100 year period were established accordingly at a minimum of 25 feet (as required by the Santa Cruz County LCP) up to 30 feet.

Dr. Weber was given the assignment of independently reviewing Mr. Zinn's report to critique its accuracy and conclusions in light of his own knowledge and experience. Dr. Weber concurred with Mr. Zinn's conclusions; in fact Dr. Weber concluded that Mr. Zinn's projected future rate was a very conservative estimate of the future bluff top recession at this location.

A couple of important conditions at this site were discussed in Mr. Zinn's report. One factor noted was that the base of the bluff of the Frank site has experienced no erosion at all since 1939. Another factor is that Hidden Beach is extremely wide, such that it is rare and only during the severest of coastal storms that wave run up ever reaches the base of the bluff. With no erosion occurring at the base of the bluff, the bluff top erosion will occur only as the angle of the bluff "lays back" to reach what I would call an angle of repose. This angle of repose was calculated and the erosion/setback rate was based upon it. Dr. Weber concurred in these conclusions and observations based on his own experience, and in fact explained that he believed that future bluff top retreat could well be less than in the past because (as I understand it) the base of the bluff was not eroding and the bluff angle had already "laid back" to some degree.

Mr. Zinn also noted that among the circumstances of which he could not take account were any future accelerated increases in ongoing sea level rise and any increasing intensity of

[2] In the recent Geotechnical Review Memorandum (June 18, 2009) provided by Dr. Johnsson on the Frank project, Dr. Johnsson states "Staff has always recommended consideration of sea level rise when evaluating future erosion rates. Until recently, this has been done only qualitatively and was based on historic trends in sea level rise. Given our evolving understanding of the mechanisms of sea level rise, staff is now recommending an upward revision of the rate of sea level rise, to a minimum of 3 ft/century." Yet this is only a recommendation of staff, and to our knowledge it has not yet been adopted as a policy or rule by the Commission, particularly on the order of 3 feet which is extremely high given the "uncertainty concerning sea level rise" repeatedly cited by Dr. Johnsson. And it is entirely inappropriate to apply this new "staff recommendation", if indeed it is one, to a small residential project such as the Frank project, which would effectively prohibit the project in a location where similarly-situated bluff top owners have been allowed to build for years.

coastal storms, because they were simply subject to too many variables and too uncertain to predict. As I understand it, however, a sea level rise of at least 8 inches is already imputed into the future erosion rate (because the historic rate includes 8 inches of sea level rise that occurred over the past 100 years), as well as the effects of intense coastal storms which are documented to have occurred over the past 80 years. So the future erosion rate, being based on the historic erosion rate, already includes some amount of sea level rise and the effects of a certain amount of intense coastal storms.

On the other hand, Dr. Mark Johnsson in his Geotechnical Review Memorandum of June 18, 2009 reaches a dramatically different conclusion on the appropriate bluff top recession setback. But prior to reaching the point in his memorandum (as well as the Monterey Bay Shores report) where Dr. Johnsson states what he is adopting as his recommended setback based on "observed historic long-term bluff retreat rates", he recites that he has requested the applicants in each case to go through what I believe he refers to as a "sensitivity" analysis of sea level rise. This involves requiring the geologists to extrapolate and fold into the projections of future coastal erosion various scenarios of accelerated sea level rise. This produces a series of increasingly severe projections of coastal erosion and therefore presumed setback requirements, without explicitly ever stating that these are being relied on or required. Why this exercise is insisted upon escapes me, because in the end all that is required in terms of a setback is the highest historical coastal erosion rate, which Dr. Johnsson picks, more or less as a "safety factor" to account for an accelerated rise in sea level which may (or may not) occur.

For the Frank project, in the end Dr. Johnsson selects the USGS National Assessment of Shoreline Change (2007) long-term erosion rates, which he reports as 0.2 – 0.3 meters (0.66 – 0.98 feet) per year "for this stretch of coastline". He then chooses the highest value, which is three times higher than Mr. Zinn's site-specific rate. What " this stretch of coastline" refers to is not the defined or described, nor is the support for Dr. Johnsson's quoted rate apparent from the USGS Study[3]. Dr. Johnsson then establishes the setback at the bluff top recession over the course of the next 100 hundred years (which is correct under the Santa Cruz County LCP), but

[3] I have reviewed the 2007 USGS Study and I cannot find that the erosion rates reported by Dr. Johnsson are cited in the Study. The Study reports an average erosion rate for all of the Monterey Bay shoreline at 0.4 meters per year, but this includes the very high erosion rates in southern Monterey Bay at Sand City and Marina. No specific erosion rates are cited in the text for Hidden Beach or indeed even the Santa Cruz/northern Monterey Bay shoreline. Figure 23 is a graph chart showing erosion rates at various locations from Davenport to Sand City, which is somewhat crude and imprecise. From it one could easily conclude that the erosion rate at Hidden Beach is – 0 –. The problem is compounded by Dr. Johnsson's lack of definition of "this stretch of coastline;" the results from location to location vary dramatically, indicating (I believe) that there is no substitute for a site-specific evaluation.

Further on this point, I cannot find anywhere in his Review Memorandum that Dr. Johnsson actually critiques or disagrees with Mr. Zinn's established site-specific erosion rates. All he critiques is Mr. Zinn's analysis of accelerated sea level rise. Mr. Zinn calculated the site-specific erosion rate from stereopair aerial photographs dating back to 1928, which are readily available for Dr. Johnsson's own review. Nor does Dr. Johnsson comment on or account for the particular unusual circumstances at Hidden Beach, discussed by Mr. Zinn, that militate against a higher erosion rate.

having taken the highest value of the erosion rate for "this stretch of coastline" and then adding a safety factor for stability (which I frankly do not comprehend) and then "following the method outlined in Johnsson (2005)", which method is not described, Dr. Johnsson comes up with a recommended set back of 116 feet for the beach bluff top lots, which of course is considerably greater than the depth of any of the lots and would preclude any development at all.

To me this is perplexing and surprising, because Santa Cruz County and the cities within Santa Cruz County and the Coastal Commission itself have for years approved development on the bluff top (and even on the beach) with far less of a setback, with findings that such development is consistent with the policies of the Coastal Act and the Santa Cruz County LCP. Mr. Zinn tells me that Dr. Johnsson's approach has never been taken before in analyzing Santa Cruz bluff top projects for single family residences. Indeed, as recently as 2008 and 2009, two bluff top developments were approved which had far lesser setbacks than that designated by Dr. Johnsson.[4] With Dr. Johnsson's conclusions, however, it appears that in no less than 100 hundred years (and likely much sooner, perhaps 25 years) the amount of "this stretch of coastline" will have the line of houses along the beach inundated, and many of the houses on the bluff top having collapsed on top them or onto the beach.

Some of the maps and data cited by Dr. Johnsson predict a disaster of gargantuan proportions, yet those maps apparently do not even trust themselves. The Pacific Institute maps on which Dr. Johnsson relies indicate on the maps themselves that they are not to be relied upon to assess actual coastal hazards.[5] But, in any event, even if they were, the conclusions would have tremendous implications for the public health and safety, not to speak of precluding any further development on the Santa Cruz County coast. The implications would be such that all houses presently along the bluff line on "this stretch of coastline" will shortly be a public hazard to the persons who inhabit them, and prudence would indicate that evacuation plans should be developed soon.

Distilling the essence of these reports, and to summarize my understanding.

1. The Coastal Commission does not impute an accelerated increase in sea level rise in its calculations of future erosion rates to establish development setbacks, but only historic erosion rates.

2. In establishing the historic erosion rate for the Frank project, Dr. Johnsson did not use a site-specific historic erosion rate but an erosion rate with varying values for a stretch of coastline that is not defined and is not site-specific, and took the highest erosion rate.

[4] These were A-3-SCO-06-006 (Willmot) approved by the Commission in 2008, and Appeal A-3-SCO-09-019, for which the Commission found No Substantial Issue on June 10, 2009.
[5] The maps state: "This work shall not be used to assess actual coastal hazards...." A similar caution is found on page 2 of the 2007 USGS Study which states in pertinent part that "The results...are not intended for comprehensive detailed site specific analysis of cliff retreat..."

3. Mr. Zinn calculated a site-specific historic erosion rate based on stereopair aerial photographs specifically applicable to this beach and site, which was concurred in by Dr. Weber based upon his independent review and evaluation and his experience with the Santa Cruz County coastline in a position of responsibility.

4. Mr. Zinn cited specific factors that explained the historic erosion rate and minimized the risk of future higher erosion rates, including the breadth of the beach and the fact that the base of the bluff has shown no erosion over the past 75 years.

5. Permits approved regularly along the Santa Cruz County bluff tops over the years under the Coastal Act have not assumed a position or calculated an erosion rate or setback line anywhere approaching what Dr. Johnsson has come up with for the Frank project.

6. As a consequence, Dr. Johnsson's review and recommendations are not an appropriate basis for analyzing this project or for applying to this project.

I look forward to communicating with you further on this topic so we can, hopefully, dispense with this as an issue in the appeal.

Very truly yours,

FENTON & KELLER
A Professional Corporation

Thomas H. Jamison

Thomas H. Jamison

THJ:tob

cc: Neil Frank
Cove Britton
Susan McCabe
Erik Zinn
Dr. Gerald Weber