



COTTON, SHIRES AND ASSOCIATES, INC.

CONSULTING ENGINEERS AND GEOLOGISTS

May 23, 2025

E6175

By Email (bfroelich@ci.capitola.ca.us)

TO: Mr. Brian Froelich, AICP
Senior Planner
CITY OF CAPITOLA
420 Capitola Avenue
Capitola, CA 95010

SUBJECT: **Geologic and Geotechnical Peer Review**
RE: 4820 Opal Cliff Drive Bluff Retreat Mitigation
Capitola, California

At your request, we have completed a geologic and geotechnical peer review of the subject permit application using:

- Pacific Crest Engineering, Inc., Update to Geotechnical and Geologic Study, Emergency Repair Plan (letter), 4820 Opal Cliff Drive, Capitola, California, dated April 28, 2025;
- R.I. Engineering, Inc., Pin Pier Wall and Drainage Plan, For Opal Cliff Homeowners Association (three sheets), most recent revision dated March 31, 2025;
- Pacific Crest Engineering, Inc., Geotechnical Plan Review (letter), 4820 Opal Cliff Drive, Capitola, California, dated March 5, 2025;
- R.I. Engineering, Inc., Structural Calculations, Emergency Pin Pier Wall 4820 Opal Cliff Drive, Capitola, CA, dated February 13, 2025;
- Pacific Crest Engineering, Inc., Geotechnical and Geologic Study (report), 4820 Opal Cliff Drive, Capitola, California, dated November 20, 2024; and
- Haro, Kasunich and Associates, Inc., Summary Letter of Geotechnical Evaluation of Coastal Bluff Failure Occurring in January 2023 on Neighboring Swenson Property at 4840 Cliff Drive, dated May 25, 2023.

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In addition, we have reviewed pertinent technical documents and maps from our office files and completed a recent site reconnaissance.

DISCUSSION

We understand that a portion of the coastal bluff located on the property at 4840 Cliff Dr failed in early May 2020. The bluff failure was located just east of the eastern property boundary of 4820 Opal Cliff Drive and left approximately 35.5 feet of horizontal distance from the eastern edge of the existing condominium building to the edge of the top of coastal bluff, at its closest point. Currently, the coastal bluff has continued to erode/retreat and the current horizontal distance from the eastern edge of the existing condominium building to the edge of the coastal bluff is approximately 28 feet, at its closest point. Based on our review of the referenced documents, we understand that the applicant proposes to construct mitigation measures to arrest bluff erosion/retreat at 4820 Opal Cliff Drive. The proposed mitigation includes constructing a new 158-foot-long buried pin pier and grade beam wall reinforced with lateral tiebacks located on the eastern side of the condominium building, along the eastern edge of the property boundary. The referenced plans indicate that the wall will consist of 40, 2-foot diameter by 43 feet deep piers spaced at 4-foot on-center. The plans also indicate that the tops of the piers will be tied together with a 16-inch-wide by 48-inch-deep grade beam, and 93.58 kip (design load) tiebacks spaced at 8-foot on-center along the grade beam. Estimated earthwork quantities include approximately 160 cubic yards of cut.

SITE CONDITIONS

The site is generally characterized by a mostly level marine terrace that fronts the Pacific Ocean seaward of Opal Cliff Drive. The topography between Opal Cliff Drive and the top of the coastal bluff slopes gently seaward, before reaching a near vertical approximately 69-foot-high sea cliff that borders the eastern and southern edges of the property. The coastal bluff is protected by a shared seawall along the southern edge of the property and is unprotected along the eastern edge of the property. The condition of the existing seawall along the southern edge of the property was not evaluated. Drainage is generally characterized by sheet flow directed toward the south-southeast. Regional geologic mapping of the area indicates that the subject property is underlain, at depth, by bedrock of the Purisima Formation (Johnson et al., 2016). Purisima Formation sandstone is exposed along the lower portion of the coastal bluff and locally overlain by terrace deposits. The terrace deposits have been reported to be 21.6 to 24 feet thick. The closest active trace of the San Andreas Fault is mapped approximately 9.5 miles northeast of the site. The site is currently improved with a multi-unit condominium building accessed from Opal Cliff Drive.

In 1998, Haro, Kasunich and Associates (HKA) investigated the subsurface conditions at the adjacent property at 4840 Cliff Dr site by means of one small diameter boring drilled to a depth of 31.5 feet and a hand auger excavated to a depth of 10.5 feet located in the vicinity of the existing residence. In Boring B-1, HK observed 23.5 feet of loose to dense terrace deposits consisting of sand, silt, and gravel underlain by bedrock materials (sand) of the Purisima Formation which extended to the bottom of the boring at 31.5 feet. In Boring B-2, HK observed 10.5 feet of terrace deposits consisting of sand and silt. Groundwater was encountered during the 1998 investigation in Boring EB-1 at a depth of 22 feet. No subsurface investigation was performed at the 4820 Opal Cliff Drive site by the current Geotechnical Consultant, Pacific Crest Engineering (PCE), or the previous Geotechnical Consultant, HKA. Boring B-1 (1998) is located approximately 12 feet east of the proposed pin pier wall alignment based on the Geologic Site Map included in the referenced 2024 PCE report. Typically, the standard of practice for geotechnical investigations is to perform a site-specific subsurface investigation within the footprint of the proposed improvements. However, given the exposed coast bluff and proximity of the borings, it is reasonable to assume the subsurface conditions at 4820 Opal Cliff Drive will be similar to those encountered in Boring B-1 for the 4840 Opal Cliff Drive investigation.

GEOLOGIC AND GEOTECHNICAL EVALUATIONS

As a part of their investigation, the current Project Geotechnical Consultant (PCE) evaluated the coastal bluff by reviewing previous report, mapping the face of the coastal bluff on the property, and performing an engineering and geologic analysis and evaluation. PCE concluded:

“The current position and geometry of the portion of the bluff composed of marine terrace deposits is clearly over steepened. The marine terrace deposits exposed in the bluff will fail incrementally via raveling and erosion triggered by increased moisture content from terrestrial processes such as rainfall and perched groundwater seepage (at the contact between the marine terrace deposits and underlying Purisima Formation bedrock) out of the bluff face. A medium to large magnitude earthquake on one of the nearby faults may also trigger failure of both the bedrock and the soil out of the bluff.”

“If the bedrock at the base of the bluff doesn’t fail, the marine terrace deposits are very likely to lay back to a more stable slope angle of 34 degrees in the next few storm seasons, which would then result in the top of the bluff coming to within approximately 4 feet of the footing of the condominium complex (see Figure 3). If the bedrock exposed in the bluff fronting the property fails again in a similar fashion as it did in 2023, up to 5 feet of bedrock failure can result in another 5 feet of retreat of the top of the bluff, which in turn could result in the daylighting of the top of the bluff intersecting the foundation of the condominium complex after the marine terrace deposits lay

*back to 34 degrees (see Figure 3). It is possible that this can occur in one to two storm cycles in the future. This would result in the undermining or damaging settlement of the structure. **Therefore, in our opinion, the process of bluff retreat on the property constitutes an imminent threat to the condominium complex. The risk of future settlement or undermining of the structure should be mitigated immediately in our opinion.***

In order to reduce the imminent threat to the condominium building, PCE recommends: *"Based on the results of our investigation, it is our opinion that construction of a buried, pin-pile retention system is an acceptable interim, emergency step to reduce the imminent threat to the building until a more permanent solution can be developed and approved."* PCE also states and recommends *"It must be understood that the pin piles will **not** stabilize the bluff seaward of the piers. The marine terrace deposit soils will continue to retreat, and it will be necessary to place lagging between the piers to prevent erosion or raveling when bluff retreat exposes the section of the piers between the bottom of the grade beam and the bedrock contact. An additional row of tiebacks should be considered at the bedrock contact if the pin piles come within 8 feet of the bedrock bluff face. Pacific Crest Engineering Inc. should be consulted in order to provide supplemental measures as necessary, once the pin piles become exposed and/or the passive resistance becomes compromised due to bedrock failures."*

CONCLUSIONS AND RECOMMENDED ACTION

The proposed pin pier wall is constrained by on-going coastal bluff instability and anticipated very strong seismic ground shaking. The Project Geotechnical Consultant provided recommendations for a pin pier wall along the eastern side of the condominium building with *" . . . a minimum embedded of 35 feet below the top-of-slope or 10 feet into Purisima bedrock whichever is greater"* and in Table No.1, indicated that the *"Depth Retained (feet below top of bluff)"* is 19 feet. We also note that the Geotechnical Consultant estimated that the thickness of the Marine Terrace Deposits along the proposed wall alignment is *" . . . approximately 24 feet . . . "*. The Project Geotechnical Consultant also recommended extending the pin pier wall a minimum 12 feet beyond the northeast and southeast building corners. Based on the reference Civil Plans, the pin pier wall will be supported by 24-inch diameter by roughly 43 feet deep drilled piers, a 16-inch wide by 48-inch-deep grade beam, and 44-foot-long post tensioned tiebacks. The Geotechnical Consultant reviewed pages C-1 and C-2 of the project civil plans and indicated that they are in conformance with their design recommendations.

Based on the evaluation by the Geotechnical Consultant, it appears that the local bluff retreated a horizontal distance of approximately 7.5 feet along the eastern portion of the bluff between May 2020 and November 2024. Using publicly available LiDAR data, CSA estimates that the bluff retreated approximately 10 feet from 1998 to April 2020.

Based on our review of the existing published geologic maps, provided investigation reports and documents, aerial photographs and satellite imagery, our site reconnaissance, and our experience with similar projects we conclude the following:

- A least impactful bluff stabilization would be to construct a shotcrete and tieback or soils nail wall on the bluff face; however, this would require the following:
 - Constructing the seawall on the neighboring property (4840 Opal Cliff Drive);
 - Staging and accessing the beach to complete the construction; and
 - Working during low tides to complete the construction. Assuming that those three constraints are deal breakers, then we consider the proposed pin pier and tieback wall is the least impactful approach to provide " . . . *an interim, emergency step to reduce the imminent threat to the building until a more permanent solution can be developed and approved.*" It is our experience that a pin pier and tieback wall is a typical mitigation measure to protect habitable and non-habitable structures adjacent to steep slopes and bluffs.
- We anticipate that there will be significant impacts to the neighboring property and building to the east (4840 Opal Cliff Drive). These impacts will likely include the following:
 - Equipment encroaching on the 4840 Opal Cliff Drive property;
 - Grading, including excavating to drill and install the tiebacks and backfilling behind the grade beam;
 - Conflicts with drilling and installing the four northern most tiebacks and the existing house structure at 4840 Opal Cliff Drive; and
 - Vibration from the construction work on the house and the adjacent bluff.

We note that the proposed pin pier wall is not intended to address the bluff retreat within the bedrock, and the Geotechnical Consultant cautions that *"The marine terrace deposit soils will continue to retreat, and it will be necessary to place lagging between the piers to prevent erosion or raveling when bluff retreat exposes the section of the piers between the bottom of the grade beam and the bedrock contact. An additional row of tiebacks should be considered at the bedrock contact if the pin piles come within 8 feet of the bedrock bluff face."*

Prior to City permit approval, we recommend that the Geotechnical and Civil/Structural Consultants address the following items:

1. **Terrace Deposit Thickness** – The previous Geotechnical Consultant, HKA, drilled the adjacent property and encountered 23.5 feet of terrace deposits. The current Geotechnical Consultant, PCE, reported 24 feet of terrace deposit material at the site. However, they recommend a retained height of 19 feet for design. The Geotechnical Consultant should clarify their recommended retained height, and justification if less than 24 feet, and their recommended depth to embedment material (Purisima Formation).
2. **Purisima Formation** – We note that this repair does not appear to address an apparent weak bedrock plane that the previous failure(s) mobilized on. The recommended 10-foot embedment depth into the Purisima formation may not intersect this weak plane. The current and previous Geotechnical Consultants both indicated that the initial bedrock failure occurred along bedrock discontinuities. The Geotechnical Consultant should discuss and consider the benefits of extending the pin piers below their projection of this weak bedrock plane.
3. **Structural Design** – We have the following comments on the recommendations and structural design:
 - a. **Existing Foundations** – The Geotechnical and Civil/Structural Consultants should evaluate if the proposed tiebacks will intersect or convey stresses to the existing condominium building foundation.
 - b. **Property Line Constraints** – The Project Team should consider how the Contractor will access the site and build structure without impacting the adjacent property.
 - c. **Tieback Overburden and Passive Capacity** – The Geotechnical and Civil/Structural Consultants should evaluate if the limited overburden (roughly 4 to 5 feet) is sufficient to develop full tieback capacity given the 12-foot unbonded length and the 10 degree declination. The Geotechnical and Civil/Structural Consultants should also evaluate if tie beam will have adequate passive resistance to resist the tieback.

- d. **Drill Rig Surcharge** - The Geotechnical and Civil/Structural Consultants should also evaluate if the drill rig and tieback rig loads will trigger bluff failures during construction.

The Geotechnical and Civil/Structural Consultants should address the above comments in a letter/report submitted to the City for supplemental peer review prior to issuance of the City permits.

LIMITATIONS

This geologic and geotechnical peer review has been performed to provide technical advice to assist the City with its discretionary permit decisions. Our services have been limited to review of the documents previously identified, site reconnaissance and preparation of this letter. Our opinions and conclusions are made in accordance with generally accepted principles and practices of the geotechnical profession. This warranty is in lieu of all other warranties, either expressed or implied.

Respectfully submitted,
COTTON, SHIRES AND ASSOCIATES, INC.



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