

Detailed Review of FEMA CCAMP for City of Malibu



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1. INTRODUCTION

FEMA distributed Preliminary Flood Insurance Rate Maps (PFIRMs), Flood Insurance Study (FIS) reports, Summary of Map Actions (SOMA) and GIS database for Los Angeles County and Incorporated Areas, including the City of Malibu (the City), on October 28, 2016. This is a part of the Open Pacific Coast (OPC) Study of the California Coastal Analysis and Mapping Project (CCAMP). The PFIRMs are intended to supersede the current effective FIRMs. There are significant changes in Special Flood Hazard Area (SFHA) zone designations within the jurisdiction of the City.

Moffatt & Nichol (M&N) was contracted by the City to provide technical review of the PFIRMs and supporting FIS documents, including Intermediate Data Submittals (IDS). The technical review focused on basic assumptions, data, and methods used to characterize the 100-year coastal flood elevation (base flood elevation, BFE) along the City to determine if procedures and assumptions used in the study followed FEMA's Pacific Guidelines and if results are reasonable and mapped properly based on our understanding of the coastal processes and storm hazards along the City's coastline. A general review of all 43 transects in the City was performed and 22 transects were recommended for detailed review. Comments from the technical review memo prepared by M&N and dated October 31, 2017 were carried forward to this report. The technical review was submitted to FEMA on November 6, 2017 by the city of Malibu.

The detailed review examines runup methodology, profile features, wave parameters, and mapped results at each transect to determine if the correct methodology was applied and conditions are correctly represented. Data sources included in the technical review were analyzed in more detail and supplemented with additional data from FEMA, which was used in preparation of the IDS reports and PFIRMS. This detailed review report is intended to inform the community and aid in determining if there is a basis for a formal appeal for each transect in this detailed review.

2. WAVE RUNUP METHODOLOGY REVIEW

Total water levels (TWLs) is a summation of still water level (SWL), wave setup, and wave runup. The SWL was based on 50-year (1960-2009) hourly water level time series from the Santa Monica station (NOAA station ID 9410840). The wave setup, the increased elevation of the static water level due to the effects of momentum transfer from waves to the water column during breaking in the surf zone, includes both static and dynamic wave setup components. The wave runup is the theoretical elevation that water from a breaking wave could travel up an infinite shoreline slope. When wave runup exceeds the structure/bluff crest, wave overtopping occurs. Both wave setup and wave runup were calculated based on wave parameters at the 40-meter depth in the FEMA study.

Three wave runup methods were used in the FEMA study and are referred to as: Stockdon Method, Direct Integration Method (DIM), and TAW (Technical Advisory Committee for Water Retaining Structures) Method. The DIM and TAW methods are included in FEMA's Pacific Guidelines. The Stockdon method was published after development of the Pacific Guidelines, proposed by the study contractor, and approved by FEMA as described in IDS3 (FEMA 2015). The Stockdon method is an empirical relation developed based on shoreline water level time series collected during 10 dynamically diverse field experiments. Method selection for each transect was based on criteria comprising transect geometry parameters (slope, structure toe and crest elevation) and wave parameters, as described in IDS3.

Stockdon Method is used in the FEMA study for sandy beaches, natural shorelines, and shorelines where the structure toe is above the 2% dynamic water level (DWL2%), which satisfy the following slope and surf similarity parameter conditions:

- $m_f \leq 0.11$ [slope: 9.1H:1V], or
- $m_f > 0.11$ and $0.3 < \xi < 3.5$

in which

- m_f is the foreshore beach slope between mean sea level (MSL) to the highest observed tide (HOT) defined in Page 61 of IDS3
- ξ – surf similarity parameter

DIM is used in the FEMA study for sandy beaches, natural shorelines, and shorelines where the structure toe is above the DWL2%, and the Stockdon Method is not applicable due to steep slope.

TAW Method is used in the FEMA study for shorelines protected with structures (seawall, revetment, rubble, or riprap) or backed by bluff and the toe is below the DWL2%.

2.1 Study Contractor Comparison of DIM and Stockdon Method

The study contractor provided a comparison of the DIM and Stockdon methods in a memorandum dated December 5, 2012. Pertinent information from the memo is summarized below:

- For northern counties (Del Norte through Marin) the study contractor (Baker study team) applied the DIM method to calculate wave runup for beaches and natural shorelines with slopes less than 0.125 as described in the Pacific Guidelines.
- For central and southern counties (San Francisco to San Luis Obispo through San Diego) the study contractor (AECOM study team) applied the Stockdon and DIM methods as described above in Section 2.

- The biggest difference between these two equations is in their definition of beach slope, the method that calculates the steepest beach slope generally estimates the highest TWL.
 - DIM Method: the beach slope is calculated along the profile from 2 times the breaker depth (IDS3) to the DWL2%. (Note the memo indicates from 1.5 times the breaker depth to the DWL2%).
 - Stockdon Method: the slope is calculated along the profile from MSL to the HOT.
- The DIM Method is generally less sensitive to variations in peak spectral wave period (T_p) and more sensitive to variations in deep water equivalent significant wave height (H_o) compared to the Stockdon Method.
- On average, the Stockdon Method predicts higher TWLs compared to the DIM Method. The two methods were compared for 10 transects along the northern and central coast. The 1% annual chance TWL from the Stockdon Method was higher than that from the DIM Method for 7 out of 10 transects studied, and the TWL difference varies from 0.4 to 6.4 ft.

2.2 Comparison of Stockdon and DIM Method in Malibu

The IDS3 included TWL calculations using both the Stockdon and DIM Methods at some transects selected for detailed review. A comparison of average TWLs between using Stockdon and DIM Methods was made at these transects and are summarized in Table 2-1. The comparison indicates the TWLs calculated using the Stockdon Method are 2.1 to 4.5 ft higher than those using the DIM Method. These differences are much greater than the comparison made by the study contractor, which found the Stockdon Method to estimate a TWL that is on average approximately 1 ft higher than the DIM TWL.

Table 2-1: Comparison of Stockdon and DIM Average TWLs

PFIRM Transect # (Study #)	Avg TWLs of Stockdon (ft, NAVD88)	Avg TWLs of DIM (ft, NAVD88)	Difference (ft) (Stockdon - DIM)
Transect 8 (1116)	13.6	10.8	2.8
Transect 9 (1109)	15.6	11.1	4.5
Transect 23 (987)	13.6	10.7	2.9
Transect 24 (981)	14.7	10.4	4.3
Transect 25 (976)	12.7	9.3	3.4
Transect 27 (956)	14.9	10.5	4.5
Transect 28 (946)	13.0	10.9	2.1
Transect 34 (885)	14.4	11.2	3.2
Transect 36 (870)	14.2	10.5	3.6
Transect 40 (846)	14.8	10.9	3.9
Transect 42 (824)	13.7	10.2	3.5
Transect 43 (817)	13.6	10.4	3.3

The two methods use different slopes in the runup calculations, and the slope has a substantial impact in calculating TWLs and BFEs. Although both methods have been approved by FEMA, the inconsistent application of the Stockdon and DIM Methods resulted in unrealistic differences in BFEs between neighboring transects in Malibu.

3. SENSITIVITY OF TWL TO ROUGHNESS FACTOR AND OBLIQUE WAVES

The detailed review indicated that roughness factor of shore protection rocks were not considered in most transects and oblique wave approach impact was not considered in any transect. Among three wave runup methods used, only the TAW Method can include impacts of these two factors. Hence, seven transects in which the TAW Method was used were selected for limited analysis of wave runup elevations to understand how revised parameters would affect the TWL and whether BFE is likely over/under-estimated.

The effect of oblique wave approach cannot be included in Stockdon and DIM Methods, but should have been captured in the two-dimensional (2D) SHELF model performed for the FEMA study. Therefore, it would be more accurate if wave parameters used in wave runup analyses were extracted from the SHELF model at a shallower depth, such as 10 meters or even 5 meters instead of 40 meters. The wave approach angle varies from transect to transect and are more than 45 degree for the seven selected transects for analyses; hence, a 45 degree approach angle, which would result in a reduction factor of 0.8, was used in the limited analysis.

The roughness reduction factor is 0.6 for rubble mound revetment and 0.8 for rocky bluffs according to IDS3. A roughness factor of 0.8 was tested. The analysis indicates that the TWL can be reduced by 2 ft if a roughness factor of 0.8 is used and by additional 2 ft if an oblique wave impact is considered in addition to the roughness factor. Table 4-1 summarizes impacts of the roughness factor and oblique waves to the TWL. Therefore, the BFE can be lowered by a few feet if the roughness factor and/or the oblique wave were considered in wave runup analyses.

Note, the transects identified below are not the only locations where a reduction factor for oblique approach angle should be considered. Many transects were evaluated using the Stockdon or DIM Methods, which don't allow for such a reduction. The inability to account for wave height reductions due to sheltering from Point Dume and the influence of other nearshore bathymetric features (i.e., reefs, points, and headlands less than 40 meters of depth) results in an overestimate of wave heights for all events generated from a west-northwest direction. This represents the majority of extreme events that feed into the statistical analysis of 1% chance BFE.

Table 4-1: Impacts of Roughness Factor and Oblique Wave to TWL

Transect_Study #	TWL, ft NAVD (FEMA)	TWL, ft NAVD (M&N)	
		Roughness Factor	Oblique Wave Approach
	1	0.8	0.8
	1	1	0.8 (45 deg)
Tr23_987	21.8	19.5	17.7
Tr24_981	21.8	19.6	
Tr25_976	20.1	17.8	16.1
Tr28_946	31.5	27.1	
Tr36_870	19.9	17.9	16.5
Tr40_846	19	17	
Tr41_831	24.1	21	18.8

4. TECHNICAL COMMENTS

Overall, the OPC study benefited from new technologies and extensive high resolution coastal data; it was a very comprehensive study and is more accurate and detailed compared to the prior study. Based on review of the study for the City of Malibu, the following recommendations are provided for FEMA and its mapping contractor:

1. The general transect layout is acceptable. However, variations in coastal protection and structures throughout one transect zone could influence the BFE for specific parcels in the zone. At developed parcels, the BFE will vary based on how waves interact with specific structural details at each parcel. Additional transect(s) should be added to capture the shoreline variations and shoreline protection structure variations. Also, if the difference in BFEs between neighboring transects is more than 10 ft, a transitional zone shall be provided as the Pacific Guidelines (Section D.4.9.6) state: "Transition zones may be necessary between areas with high runup elevations to avoid large differences in BFEs and smooth the changes in flood boundaries."
 - a. The transect layout appears to be defined by wave parameters at the 40 meter depth contour. Our review indicates this is a poor differentiator for transect spacing as the nearshore wave heights can change significantly as waves refract around nearshore reefs, points and headlands inside of the 40 meter depth contour.
 - b. The transect layout and spacing should also be defined by shoreline type (i.e., beach, rocky bluff, coastal structures) because the shore type geometry and assumptions applied for coastal structures significantly influence BFEs.
2. The BFE is very sensitive to topography, especially to bluff/structure toe elevation. Toe elevation determines which of three wave runup methods (Stockdon, DIM or TAW) shall be used. However, the selection of toe elevation is not consistent throughout the Study area. When the DWL2% is below the toe of bluff/structure: 1) the Stockdon Method is used if the foreshore slope is mild; and 2) the DIM Method is used if the foreshore slope is steep. Physically, a steeper slope will result in a higher wave runup than that in a milder slope. However, the Stockdon Method for milder slopes results in higher wave runup than that of the DIM Method for steeper slopes. Hence, there is a clear sign that the Stockdon Method is more conservative than DIM Method for a similar shore type. When the DIM Method is used, the BFE is often a few feet or up to 10 ft lower than the neighboring transects. The additional analysis provided in Section 2.2 indicates the differences between Stockdon and DIM Methods are much greater than described in the Study Contractor memo dated December 5, 2012. The large differences call into question the validity of these runup methods when applied to the Malibu coast.
 - a. The use of different runup methods contributed to the significant alongshore BFE variations. Also, different runup methods were used for neighboring transects although they have similar shore/structure type. A more consistent application of runup methods would result in less variation in BFE.
3. Wave analysis transects begin at a depth of 40 meters except five transects (2, 10, 19, 25 and 41). Using wave parameters at the 40 meter depth from the nearshore wave model as input parameters for the wave runup analysis is a poor choice for reaches with oblique wave approach angles and wave refraction patterns, which occur around the many points, reefs and headlands along the Malibu coast. Some of the 2D wave phenomena captured in a 2D refraction model is

not adequately represented in the one-dimensional (1D) transect based analysis, potentially leading to overestimates of the BFE. A detailed review of shelf model results including nearshore wave height and refraction patterns should be performed by FEMA to demonstrate that using wave parameters from the SHELF model at the 40 meter depth for 1D transect based analysis does not over-estimate wave conditions nearshore. Limited wave runup analysis indicates that the BFE may be reduced by 10% if oblique wave approach impact is properly considered.

Additional potential issues related to wave input data are listed below:

- a. The record event jumps around between consecutive neighboring transects, as shown in Table 5-1. Transects 35, 37 and 39 have the same record event and time step, but Transect 36 in between has a different record event, and Transect 38 has a different time step, which is strange and does not make sense.

Table 5-1: Record Events between Consecutive Neighboring Transects

Transect# (Study#)	Storm Date/Time	SWL (ft, NAVD88)	Ho(ft)	Tp (s)
33 (LA894)	1/29/83 9:00	7.3	6.8	11.9
34 (LA885)	5/11/80 19:00	5.7	5.3	23.3
35 (LA873)	3/2/83 11:00	5.4	13.8	15.9
36 (LA870)	1/29/83 9:00	7.3	8.3	11.9
37 (LA865)	3/2/83 11:00	5.4	14.4	15.9
38 (LA859)	3/1/83 23:00	6.0	14.2	11.9
39 (LA854)	3/2/83 11:00	5.4	13.4	15.9
40 (LA846)	1/29/83 9:00	7.3	8.4	11.9

- b. Wave periods between neighboring transects were often different for the same storm event and time step, which does not make sense. Wave period is a key input parameter in wave runup calculations, and a wrong period could lead to a wrong TWL and BFE. Below are some examples:
 - i. Wave periods were different for the same storm event and time step between following pairs of consecutive neighboring transects: Transects 11 and 12, Transects 23 and 24, Transects 27 and 28, and Transects 41 and 42
 - ii. Table 5-2 illustrates wave period variations between consecutive neighboring transects during 1/27/1983 storm event. The time steps were within 3 hours, but three different periods were used, which does not make sense. Similarly, Table 5-3 illustrates wave period variations for 3/1/1983 storm. Three different periods were used from Transect 22 through 28 for the same time step, and again three different periods were used on three consecutive transects for the same time step.
- c. Note, there are two transects in the table below where the wave heights used in the analysis are much lower than adjacent transects. Based on our review of the profile data it appears that Transects 19 and 25 used wave parameters from the depth contours of 25 and 15 meters, respectively. These wave heights are 50% lower than wave heights used at the other transects (assumed to be from the 40-meter depth contour) and illustrate how much wave heights could be overestimated by applying wave parameters

that don't account for the dissipating and sheltering effects of nearshore points, reefs and headlands.

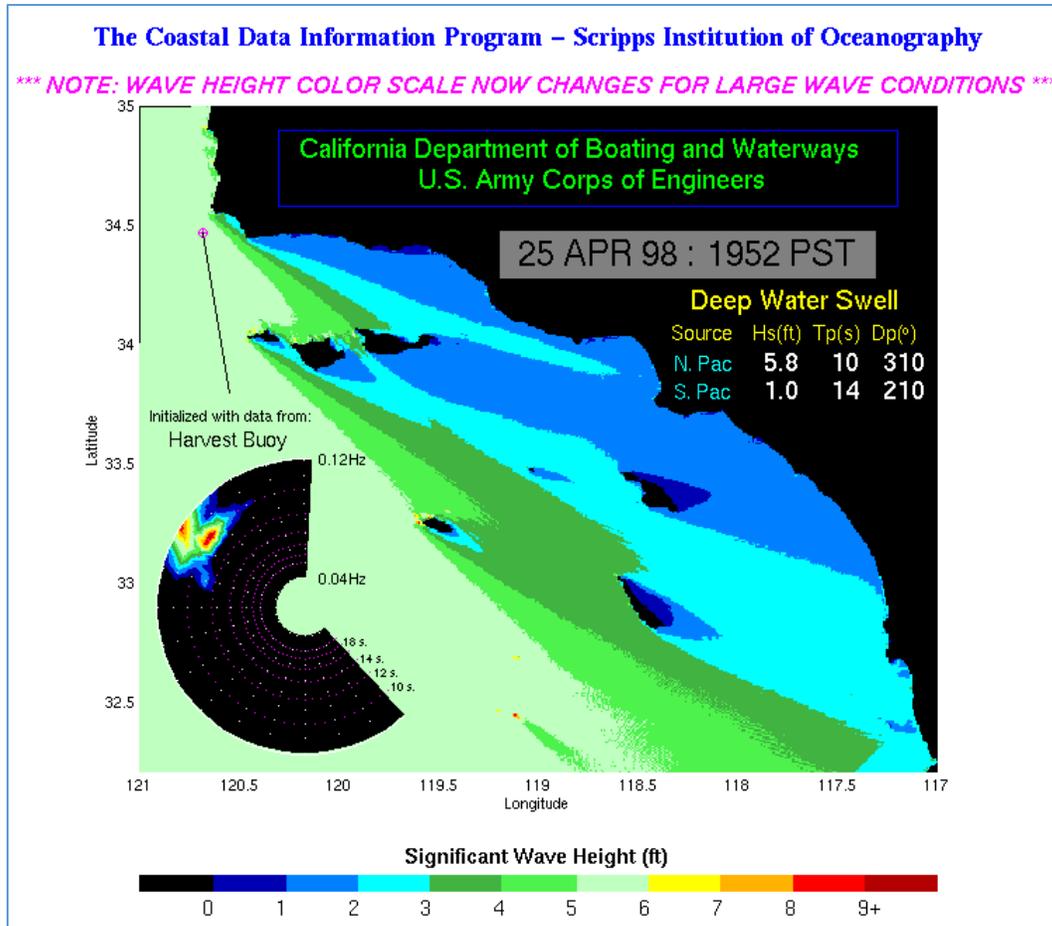
Table 5-2: Period Variations between Consecutive Neighboring Transects for 1/27/1983 Storm

Transect# (Study#)	Storm Date/Time	SWL (ft, NAVD88)	Ho(ft)	Tp (s)
15 (LA1053)	1/27/83 9:00	6.5	15.3	14.4
16 (LA1043)	1/27/83 7:00	7.4	13.0	11.9
17 (LA1039)	1/27/83 8:00	7.3	14.4	14.4
18 (LA1030)	1/27/83 7:00	7.4	12.3	11.9
19 (LA1017)	1/27/83 6:00	6.7	6.2	19.2

Table 5-3: Period Variations between Consecutive Neighboring Transects for 3/1/1983 Storm

Transect# (Study#)	Storm Date/Time	SWL (ft, NAVD88)	Ho(ft)	Tp (s)
22 (LA990)	3/1/1983 23:00	6.0	11.9	11.9
23 (LA987)	3/1/1983 23:00	6.0	12.3	11.9
24 (LA981)	3/1/1983 23:00	6.0	13.4	19.2
25 (LA976)	3/1/1983 23:00	6.0	8.7	19.2
26 (LA971)	3/1/1983 23:00	6.0	11.8	19.2
27 (LA956)	3/1/1983 23:00	6.0	16.1	19.2
28 (LA946)	3/1/1983 23:00	6.0	16.2	15.9
29 (LA934)	3/2/1983 11:00	5.4	14.8	14.4
30 (LA926)	3/2/1983 11:00	5.4	12.6	13.1
31 (LA914)	3/2/1983 11:00	5.4	14.2	15.9

- d. At Transects 30 to 37 there is an extreme event with a very long wave period (>25 seconds) that is outside of the typical range seen here on the west coast. Wave periods longer than 22 seconds are typically associated with forerunners from southern hemisphere swell events with small wave heights often less than 2 ft. The April 25, 1998 wave event listed in the IDS TWL has a wave height of 5 ft associated with the very long wave period. A closer review of measured data at nearby wave buoys indicates no sign of such an event. As the CDIP nearshore wave plot (below) shows, the wave periods reported on this day are much shorter than used in the analysis. Since this event ranks among the highest calculated TWL events at several transects, it does have an influence over the BFE in several locations. We recommend additional investigation by the Study Contractor to determine if this is a valid wave event to be included in the TWL and BFE analysis. If this wave event is not represented by actual buoy measurements and is an artifact of the hindcast methods, it should be discarded from the analysis.



4. Wave runup is very sensitive to the beach slope. Sandy beaches are highly dynamic and beach slopes can vary over time. The beach slope is based on a single data set, and long term beach profile data can help to identify a range of slopes to determine the most appropriate slope value to apply in runup calculations. Another issue with a single transect is the representation of the slope for the reach being represented.
5. Treatment of shore protection structures has a significant impact on BFEs. The revetment was assumed to be intact for Transects 11, 38 and 42. Shore protection structures at other transects were assumed to be removed (failed) in the analyses. For failed condition analyses, rubble/riprap were completely removed from the transect geometry and the roughness factor was replaced with that of sand (i.e., very smooth). The roughness treatment was not consistent with Section D.4.7.3.2 of the Pacific Guidelines, which states: "the Mapping Partner shall select an appropriate roughness factor when conducting runup and overtopping analyses on the failed structure." The additional analysis provided in Section 4 indicate a use of an intermediate roughness value for rocky bluffs or "partially failed" structures could result in a significant reduction in calculated TWL and BFE.
 - a. There are several reaches in Malibu where coastal structures line the back beach but were not included in the analysis. These reaches are represented by Transects 31, 32, 34, 35, 37 and 39. As the cover photo indicates, runup at the structures can reach high elevations, yet there is very little flooding landward of the structures. This is a case

where the runup method should have accounted for these structures and their effect on primary and secondary hazard zones.

6. The following errors were found:
 - a. For Transect 11, the secondary VE elevation in Table 1 of IDS4 is 1 ft higher than the primary VE elevation; and
 - b. For Transect 20, the BFE is 19 ft, while the TWL of the record event is only 11.7 ft according to the supporting FIS documents.
 - c. Transect 39: shoreline features (crest and toe) are incorrectly determined. If transect crest and toe were defined in a manner consistent with adjacent transects, a different runup method (probably TAW) would have been applied, resulting in a BFE similar to adjacent transects.
 - d. Transect 42: secondary VE BFE is higher than the primary VE BFE.
7. A 35-ft minimum distance criterion was applied in mapping a secondary VE or AO zone for transects with overtopping. If the resulting landward overtopping distance was less than 35 ft, the overtopping runup zones were integrated into the primary wave runup Zone VE or, where the VE and AO overtopping zones together were at least 35 ft, combined to create a secondary overtopping zone VE with a different (often lower) BFE. At 13 transects there was overtopping calculated, but the distance was less than 35 ft; therefore, the primary runup zone BFE was extended to cover this area. Since the primary runup zone BFE is often a few feet higher than the calculated overtopping zone BFE, the resulting mapped BFE is higher than the calculated BFE at these transects. This practice is inconsistent with Pacific Guidelines (Section D.4.9.4) as the community officials were not consulted about setting 35-ft as the minimum mappable distance criterion.

5. REFERENCES

- BakerAecom. 2012. Memo: Comparison of the DIM and Stockdon Wave Setup and Runup Methodologies for Application to the CCAMP/OPC Study. December 5, 2012
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- FEMA. 2016. California Coastal Analysis and Mapping Project / Open Pacific Coastal Study, Intermediate Data Submittal #4, Flood Hazard Mapping, Los Angeles County, California prepared by BakerAECOM. March 10, 2016.
- FEMA. 2016. Preliminary Flood Insurance Rate Maps for Los Angeles County, California. October 28, 2016.

6. DETAILED TRANSECT REVIEW

The detailed review included reach characteristics, profile features, wave parameters, runup methodology selection, and mapped results of the selected transects. Comparison between neighboring transects was also performed. Although coastal hazards can vary between adjacent transects due to changes in shoreline features (e.g., reefs, shoreline type, shoreline slope, and shore protections) and approaching wave conditions, significant differences in BFEs and shoreline parameters warrant additional scrutiny.

Items that are not representative of conditions or do not follow FEMA's Pacific Guidelines are flagged in the analysis section and the implications of revising any flagged item is discussed. Transects, where multiple factors influence BFEs and their overall effect needs to be determined through computation, were identified for further study in the event an appeal is filed.

6.1 Key of Detailed Review Sheets

Pertinent information for each transect has been summarized on the detailed review sheets. Terms and features of the detailed review sheets are summarized below:

Site Description: Describes general site conditions of the beach segment represented by the transect, shown as a black dash line in the PFIRM. The transect is intended to represent a shoreline section with similar shoreline and coastal flood characteristics.

Mapping: Details of effective and preliminary FIRMs at each transect were compared. The mapped features include BFE and secondary zones, if there are secondary zones. An excerpt of the PFIRM is provided next to the description.

Transect Parameters: The transect profile, together with important water levels, have been plotted for reference, and an oblique aerial image near the transect is provided.

- **Structure Treatment:** Coastal structures in Malibu include rubble/riprap, revetments, and seawalls. Treatment of shore protection structures has a significant impact on BFEs. According to the Pacific Guidelines, coastal structures, if not accredited by FEMA or Corps of Engineers, are assumed to be removed in the analyses. However, if coastal structures were engineered with multiple layers of rock sized to resist extreme wave forces and survived equivalent to and larger than the 1% annual chance storm event, these structures may be recognized on flood hazard maps per the Pacific Guidelines (Section D4.7.3). But as-built drawings, maintenance activities, and other documentation must be submitted to FEMA. To assist with this assessment, the TWL under the record event was compared to the BFE.
- **Runup Method:** Three wave runup methods were used in the OPC study. This review assessed whether an appropriate method was applied and the implication of the method selection for each transect.
- **Profile Features:** The key profile features (including structure toe/crest elevation, structure face slope, and foreshore slope) determine the wave runup method selection and runup elevation are summarized for analyses. Slopes used in different runup analyses are different and are described below:
 - DIM Method: the beach slope is calculated along the profile from two times the breaker depth (IDS3) to the DWL2%.

- Stockdon Method: the slope is calculated along the profile from MSL to the HOT.
- TAW Method: the slope is calculated iteratively as the average slope along the profile from a seaward slope endpoint at a depth equal to 1.5 H_{m0} (spectral significant wave height at the barrier toe) to the landward limit of runup. If this seaward slope endpoint is seaward of the barrier toe, the toe is instead selected as the seaward endpoint.
- **Event Record and Runup Parameters:** The table listed the following parameters of the record event:
 - Date/time of the storm peak,
 - SWL - still water level at the time of storm peak
 - H_o - deepwater equivalent wave height at the time of peak,
 - T_p - peak period of the deepwater equivalent spectrum,
 - DWL2% - calculated 2% dynamic water level,
 - TWL - total water level of the record event,
 - Slope – value used in PFIRM analysis,
 - Roughness Factor - For structure failed condition analyses, rubble/riprap were completely removed from the transect geometry and the roughness factor was replaced with that of sand (i.e., very smooth). The roughness treatment was not consistent with Section D.4.7.3.2 of the Pacific Guidelines, which states: "the Mapping Partner shall select an appropriate roughness factor when conducting runup and overtopping analyses on the failed structure." This review assessed whether an appropriate roughness coefficient was used.

Most Likely Winter Profile (MLWP): The MLWP is intended to represent average eroded conditions at a beach during winter months. According to the IDS3, the MLWP was only analyzed at dune-backed beaches for Los Angeles County. There are no dune-backed beaches along the Malibu coast, so no MLWP was analyzed in the FEMA study and assessed in this analysis.

6.2 Detailed Review Sheets

The detailed review sheets summarize the site description, mapping, transect parameters, analysis, and conclusions from the detailed transect reviews.

TRANSECT NO. 08 (1116) | El Matador State Beach

1. Site Description

Sandy beach backed by bluffs, transect intersects a residential parcel that appears to be pile-supported.

2. Mapping

Preliminary

- ▶ PFIRM BFE (Primary VE Zone): 17 ft.
- ▶ No overtopping.

Effective

- ▶ Effective BFE: 17 ft.
- ▶ Secondary Zone: VE zone is backed by zone AE with a BFE of 17 ft.



Excerpt from PFIRM Panel 1511G (FEMA 2016)

3. Transect Parameters

- ▶ Structure Treatment: n/a
- ▶ Runup method: TAW applied for 2 largest events, and Stockdon applied to remaining 174 events.

Profile Features

Toe El. ft	10.9
Crest El. ft	29.7
Foreshore Slope (H:V)	12.3 : 1
Face Slope (H:V)	1.5 : 1

Event of Record and Runup Parameters

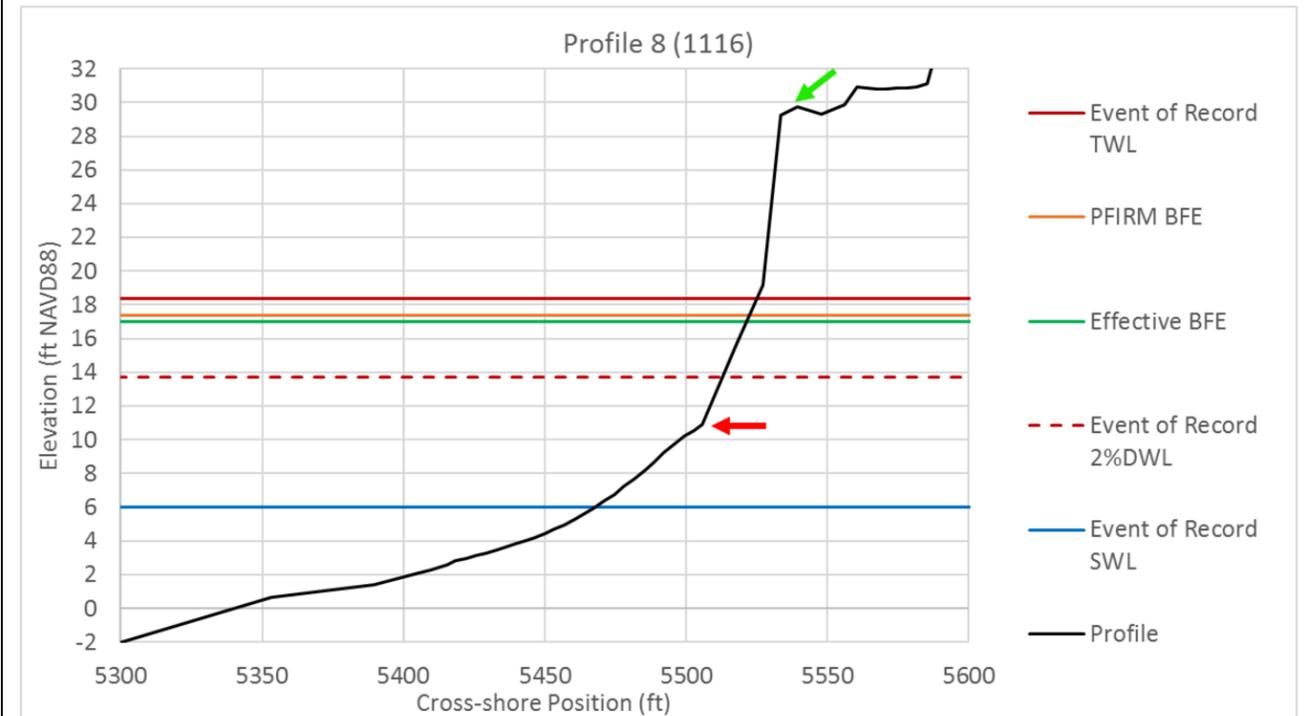
Date/Time	SWL ft	H _o ft	T _p seconds	H _o /Depth	DWL2% ft	TWL ft	Slope (H:V)	Roughness Factor
3/1/83 23:00	6.0	17.4	15.9	6.252	13.7	18.4	2.6 : 1	1.0

4. Analysis

- ▶ BFE is 1 ft less than the event of record TWL.
- ▶ Mild beach slope with DWL2% above toe and $TWL_{TAW} > TWL_s$, therefore, TAW runup method is appropriate for event of record.
- ▶ Event of record parameters vary slightly from upcoast and downcoast transects.
 - Transect 7: 3/2/83 0:00, SWL = 5.8 ft, H_o = 16.7 ft, T_p = 15.9 sec. Toe el. = 7.6 ft
 - Transect 9: 3/2/83 11:00, SWL = 5.4 ft, H_o = 16.2 ft, T_p = 15.9 sec, Toe el. = 11.8 ft
- ▶ BFEs are greater at upcoast and downcoast transects due to their steeper beach slopes and lower toe elevations. Transects 7 through 9 use the Stockdon Method for a majority of runup calculations, which is sensitive to increases in beach slope.
 - Transect 7: 20 ft | Runup method [Slope (H:V)] = 12 TAW [1 : 1], 167 Stockdon [9.1 : 1]
 - Transect 9: 20 ft | Runup method [Slope (H:V)] = All 149 Stockdon, [9.2 : 1]
- ▶ Sandy beaches are highly dynamic and beach slopes can vary over time. The beach slope is based on a single data set, and long-term beach profile data can help to identify a range of slopes to determine the most appropriate slope value to apply in runup calculations. If the Stockdon Method accounted for a range of beach slopes, the BFE may be similar to adjacent transects.
- ▶ Transects 7, 8, and 9 have similar wave exposure and shoreline features and should have similar BFEs.
- ▶ Coastal protection and structural design varies for each developed parcel.

5. Conclusion

The foreshore slope used in the Stockdon calculations is milder than the adjacent transects. If the foreshore slope becomes steeper, runup could increase to levels calculated at adjacent transects. At developed parcels the BFE will vary based on specific structural details. If the DIM Method were used, the BFE may be lowered by a few feet.



Transect 8 (1116) Profile and Runup Parameters



Oblique Aerial Image at Transect 8 (CCRP 2013)

TRANSECT NO. 09 (1109) | Lechuza Beach

1. Site Description

Sandy beach backed by bluffs. Transect intersects residential parcels on low bluff. Beachfront residential parcels exist at the eastern end of the mapping zone.

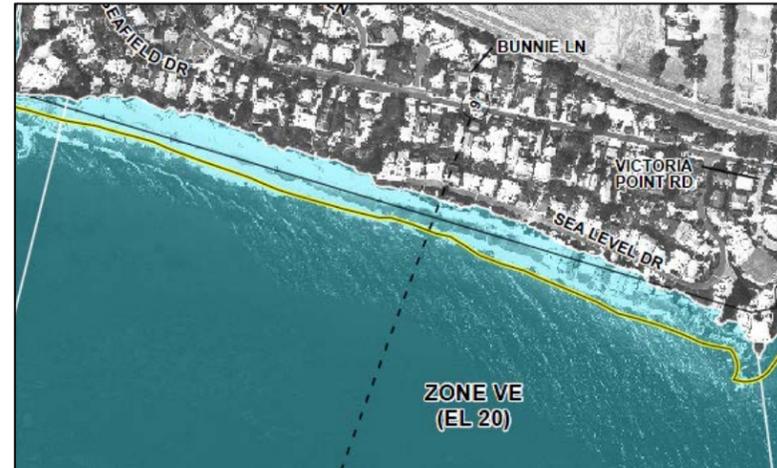
2. Mapping

Preliminary

- ▶ PFIRM BFE (Primary VE Zone): 20 ft
- ▶ Overtopping Treatment: Merge V and A to extend VE Zone 13.8 ft beyond crest.
- ▶ Landward Extent of Secondary VE Zone: 1.5 ft.
- ▶ BFE of Secondary VE Zone: 18.6 ft.

Effective

- ▶ Effective BFE: 13 ft.
- ▶ Secondary Zone: VE Zone is backed by AE Zone with BFE of 13ft.



Excerpt from PFIRM Panel 1511G (FEMA 2016)

3. Transect Parameters

- ▶ Structure Treatment: n/a
- ▶ Runup method: Stockdon for all 149 events.

Profile Features

Toe El. ft	11.8
Crest El. ft	18.5
Foreshore Slope (H:V)	9.2 : 1
Face Slope (H:V)	1.7 : 1

Event of Record and Runup Parameters

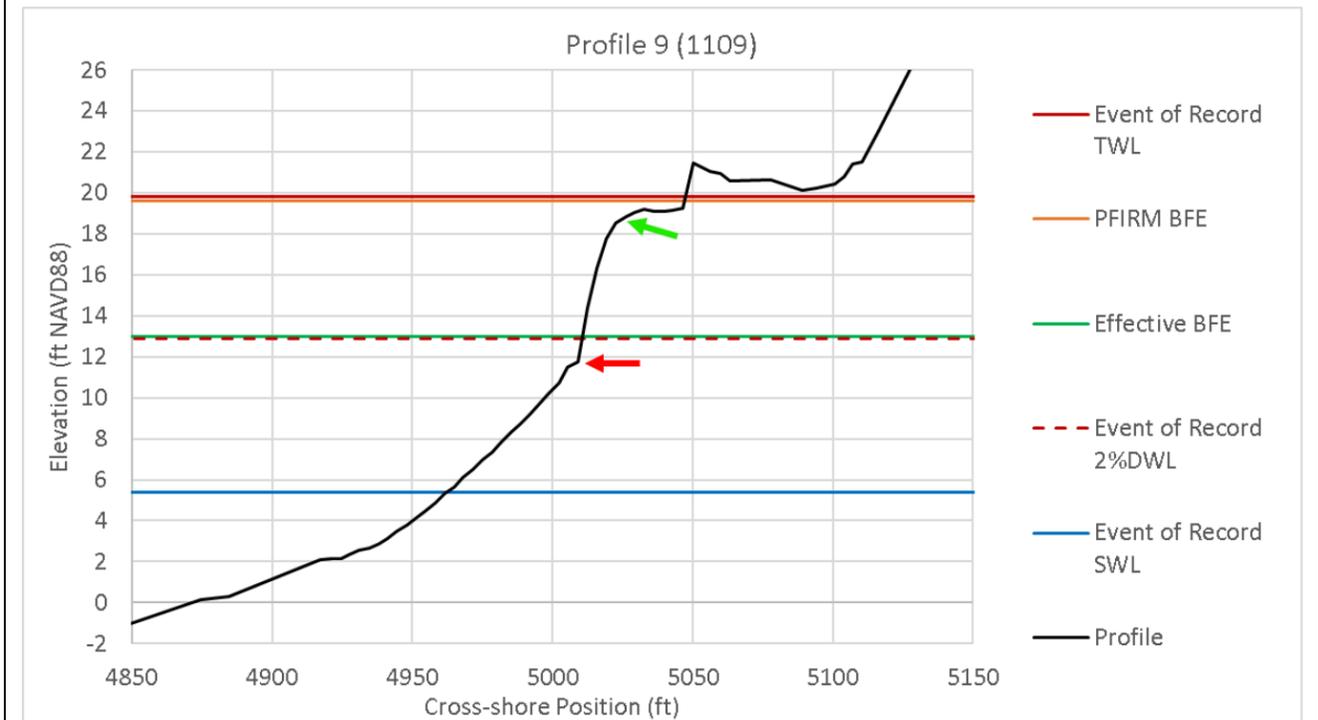
Date/Time	SWL ft	H _o ft	T _p seconds	H _o /Depth	DWL2% ft	TWL ft	Slope (H:V)	Roughness Factor
3/2/83 11:00	5.4	16.2	15.9	14.345	12.9	19.8	9.2 : 1	n/a

4. Analysis

- ▶ BFE is similar to the event of record TWL.
- ▶ Mild beach slope with DWL2% above toe, but $TWL_s > TWL_{taw}$ therefore, Stockdon runup method is appropriate for event of record.
- ▶ Event of record parameters vary slightly from the upcoast transect. The downcoast transect varies significantly due to sheltering from Lechuza point with a different shoreline orientation and wave exposure.
 - Transect 8: 3/1/83 23:00, SWL = 6.0 ft, H_o = 17.4 ft, T_p = 15.9 sec. Toe el. = 10.9 ft
 - Transect 10: 1/27/83 7:00, SWL = 7.4 ft, H_o = 9.2 ft, T_p = 11.9 sec, Toe el. = 9.9 ft
- ▶ BFEs for upcoast and downcoast transects:
 - Transect 8: 17 ft
 - Transect 10: 14 ft
- ▶ This transect uses the Stockdon method for all runup calculations similar to upcoast transects. The BFE is greater at this beach than Transect 8 because the slope used in the runup analysis is steeper.
- ▶ Coastal protection and structural design varies for each developed parcel located at the eastern end of the zone.

5. Conclusion

The BFE is based on a wave encountering a sandy beach backed by a bluff. Variations in coastal protection and structures throughout this zone could influence the BFE for specific parcels in this zone. At developed parcels, the BFE will vary based on how waves interact with specific structural details at each parcel. If the DIM Method were used, the BFE may be lowered by a few feet.



Transect 9 (1109) Profile and Runup Parameters



Oblique Aerial Image at Transect 9 (CCRP 2013)

TRANSECT NO. 11 (1091) | Broad Beach

1. Site Description

Wet sand beach backed by rock revetment fronting residential parcels.

2. Mapping

Preliminary

- ▶ PFIRM BFE (Primary VE Zone): 21 ft
- ▶ Overtopping Treatment: Merge V and A to extend VE Zone 25.9 ft beyond crest.
- ▶ Landward Extent of Secondary VE Zone: 8.7 ft.
- ▶ BFE of Secondary VE Zone: 22.2 ft, which is 1 ft higher than the primary VE BFE

Effective

- ▶ Effective BFE: 13 ft
- ▶ Secondary Zone: VE Zone backed by AE Zone with BFE of 13ft



Excerpt from PFIRM Panel 1511G (FEMA 2016)

3. Transect Parameters

- ▶ Structure Treatment: intact revetment in TWL calculations
- ▶ Runup method: TAW

Profile Features

Toe El. ft	5.9
Crest El. ft	16.6
Foreshore Slope (H:V)	19.6 : 1
Face Slope (H:V)	0.7 : 1

Event of Record and Runup Parameters *Intact Condition*

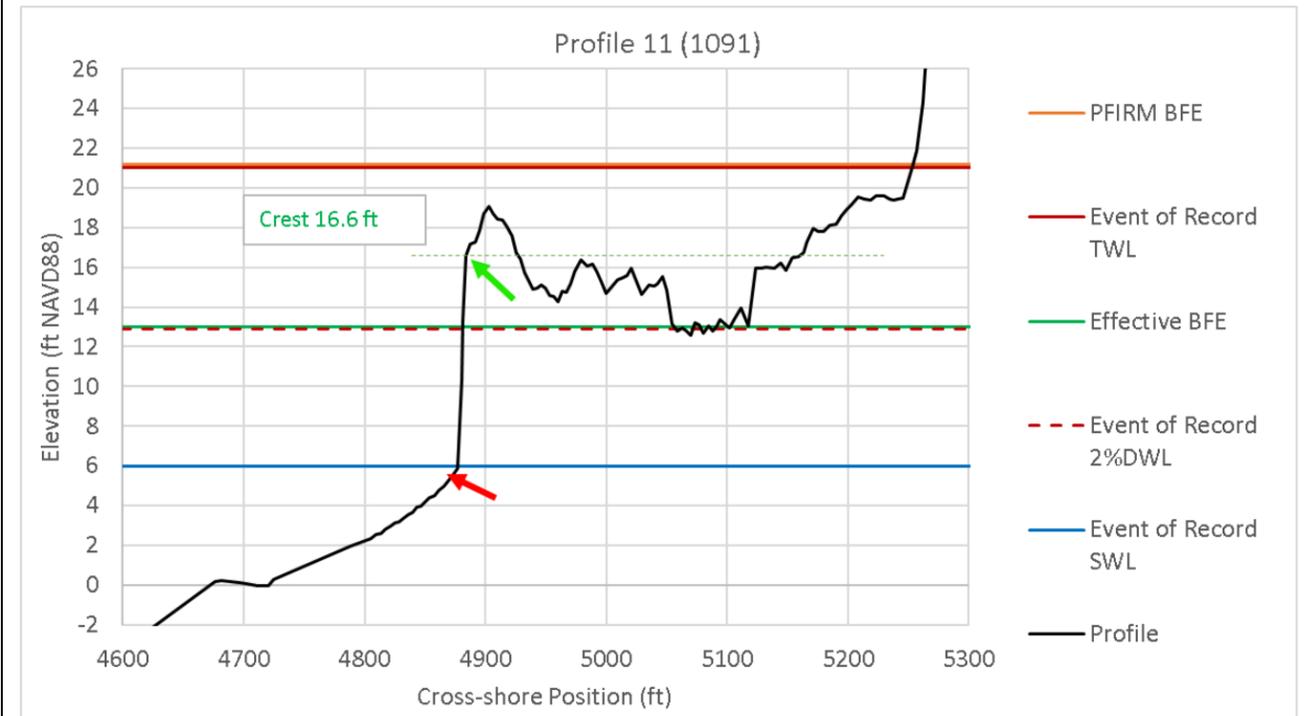
Date/Time	SWL ft	H _o ft	T _p seconds	H _o /Depth	DWL2% ft	TWL ft	Slope (H:V)	Roughness Factor
3/1/83 23:00	6.0	15.7	11.9	2.236	12.9	21.0	1 : 1	0.6

4. Analysis

- ▶ The low toe elevation contributed to high BFE.
- ▶ Same roughness factor of 0.6 is used in both intact and failed condition analyses.
- ▶ Event of record parameters vary significantly from the upcoast and downcoast transects.
 - Transect 10: 1/27/83 7:00, SWL = 7.4 ft, H_o = 9.2 ft, T_p = 11.9 sec. Toe el. = 9.9 ft
 - Transect 12: 3/1/83 23:00, SWL = 6.0 ft, H_o = 17.2 ft, T_p = 15.9 sec, Toe el. = n/a
- ▶ BFEs for upcoast transects are expected to be less than Transect 11 due to sheltering and orientation upcoast and a wider, gently sloping beach downcoast.
 - Transect 10: 14 ft
 - Transect 12: 16 ft

5. Conclusion

The revetment along this reach is uniform and well-engineered. The intact treatment in the BFE calculations is reasonable. There may be an error in the BFE of secondary VE zone, which is 1 ft higher than the primary VE BFE.



Transect 11 (1091) Profile and Runup Parameters *INTACT CONDITION*



Oblique Aerial Image at Transect 11 (CCRP 2013)

TRANSECT NO. 20 (1008) | Paradise Cove

1. Site Description

Sandy, bluff backed beach at the base of Ramirez Canyon. Transect intersects a parking lot in the canyon. A beachfront structure, pier, and additional parking lot are located in the eastern half of this zone.

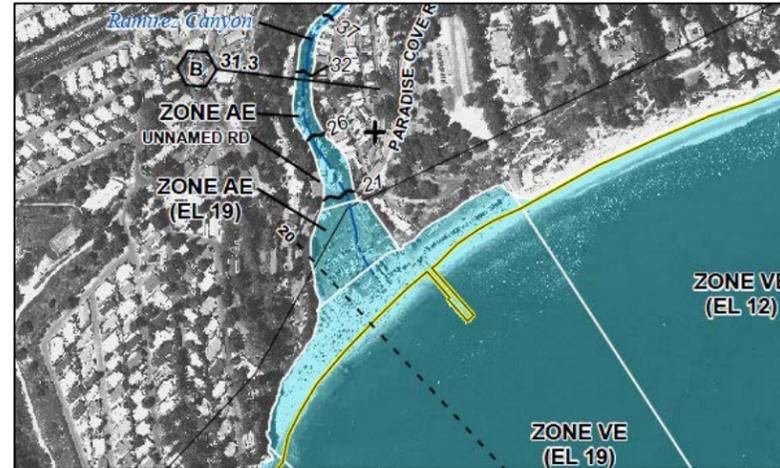
2. Mapping

Preliminary

- ▶ PFIRM BFE (Primary VE Zone): 19 ft
- ▶ Overtopping Treatment: none
- ▶ Backed by a riverine flood zone.

Effective

- ▶ Effective BFE: 14 ft
- ▶ Secondary Zone: VE Zone backed by AE Zone with BFE of 14ft, backed by Riverine flood AE Zone.



Excerpt from PFIRM Panel 1518G (FEMA 2016)

3. Transect Parameters

- ▶ Structure Treatment: n/a
- ▶ Runup method: DIM, all 138 events

Profile Features

Toe El. ft	n/a
Crest El. ft	15.7
Foreshore Slope (H:V)	7.4 : 1
Face Slope (H:V)	n/a

Event of Record and Runup Parameters

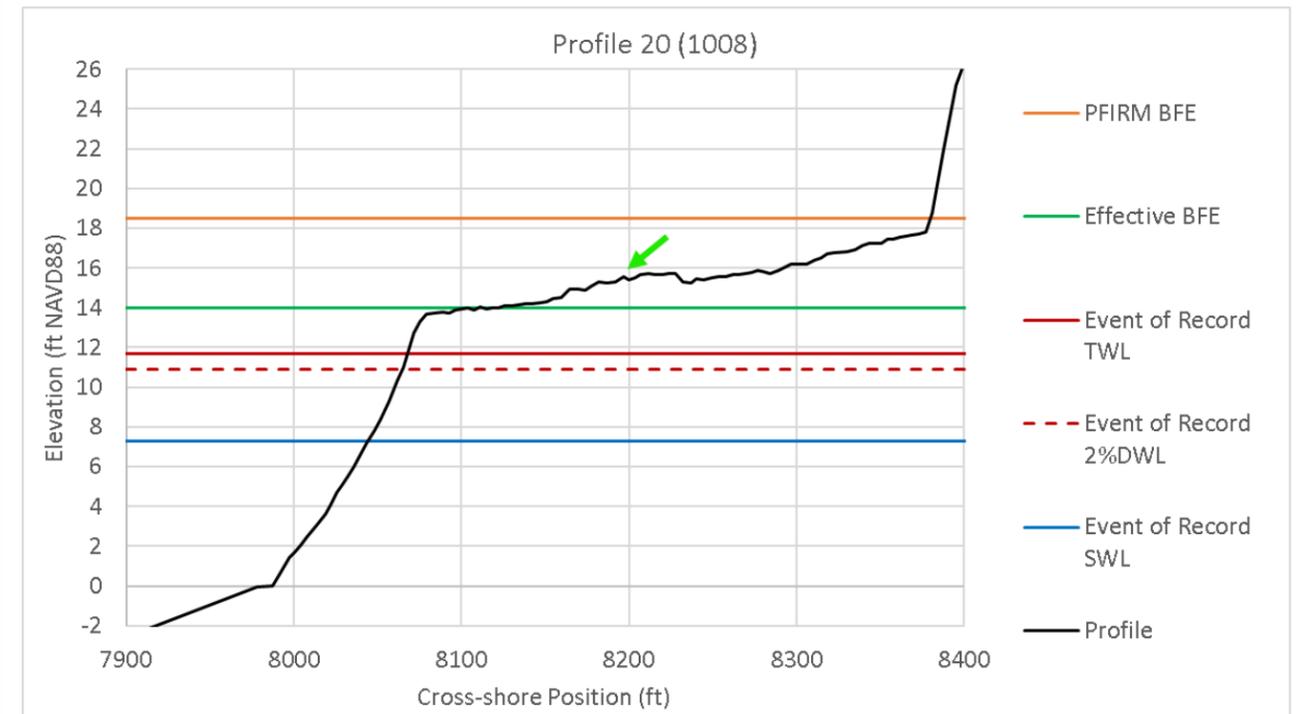
Date/Time	SWL ft	H _o ft	T _p seconds	H _o /Depth	DWL2% ft	TWL ft	Slope (H:V)	Roughness Factor
1/29/83 9:00	7.3	6.3	11.9	n/a	10.9	11.7	20 : 1	n/a

4. Analysis

- ▶ There may be an error at the tie-in of the riverine and coastal flood zones. It appears that the Ramirez Canyon riverine BFE dictates the coastal Zone VE BFE. Although IDS4 states: "the coastal Zone VE BFE of 19 ft superseded the effective riverine mapping beyond the BFE 15 ft and 16 ft features and was tied into the 21 ft BFE." IDS3 detailed TWL results show that the TWL for the event of record is only 11.7 ft, similar to downcoast Transect 21, which has an event of record TWL of 11.7 ft and a BFE of 12 ft.
- ▶ Event of record parameters vary from the upcoast and downcoast transects.
 - Transect 19: 1/27/83 6:00, SWL = 6.7 ft, H_o = 6.2 ft, T_p = 19.2 sec. Toe el. = 12.4 ft
 - Transect 21: 1/29/83 9:00, SWL = 7.3 ft, H_o = 7.2 ft, T_p = 11.9 sec, Toe el. = 22.4 ft
- ▶ BFEs for upcoast and downcoast transects:
 - Transect 19: 14 ft
 - Transect 21: 12 ft
- ▶ The coastal hazard Zone VE BFE should be similar to the downcoast transect as described above. However, the mapped BFE appears to be dictated by the riverine BFE.

5. Conclusion

The mapped coastal Zone VE BFE of 19 ft is not supported by the IDS3 detailed TWL results, which indicate the BFE in this zone may be closer to 12 ft. The Ramirez Canyon Riverine flood Zone BFE appears to dictate the coastal Zone VE BFE and the flood zone tie-in is unclear. An appeal may be warranted to determine if the coastal Zone VE BFE was mapped correctly.



Transect 20 (1008) Profile and Runup Parameters



Oblique Aerial Image at Transect 20 (CCRP 2013)

TRANSECT NO. 23 (987) | Escondido Creek Beach

1. Site Description

Narrow wet sand beach with pile-supported residential structures on the beachfront. The transect intersects an armored bluff that backs the first residential parcel in the zone. The western end of the zone is at the base of Escondido Canyon with a dry beach that extends to PCH in this area.



Excerpt from PFIRM Panel 1519G (FEMA 2016)

2. Mapping

Preliminary

- ▶ PFIRM BFE (Primary VE Zone): 23 ft
- ▶ Overtopping Treatment: Merge V and A to extend VE Zone 13.6 ft beyond crest;
- ▶ Western portion of zone backed by Zone A, Eastern portion of Zone backed by a 23 ft Zone AE.
- ▶ Secondary VE Zone BFE: 22.2 ft, width: 2.7 ft

Effective

- ▶ Effective BFE: 13 ft
- ▶ Secondary Zone: VE Zone is backed by an AE Zone with a BFE of 13 ft, backed by a riverine flood zone and Zone X.

3. Transect Parameters

- ▶ Structure Treatment: Failed (rubble/riprap removed)
- ▶ Runup method: 101 TAW, 38 Stockdon

Profile Features

Toe El. ft	6.7
Crest El. ft	22.2
Foreshore Slope (H:V)	9.9 : 1
Face Slope (H:V)	3.3 : 1

Event of Record and Runup Parameters

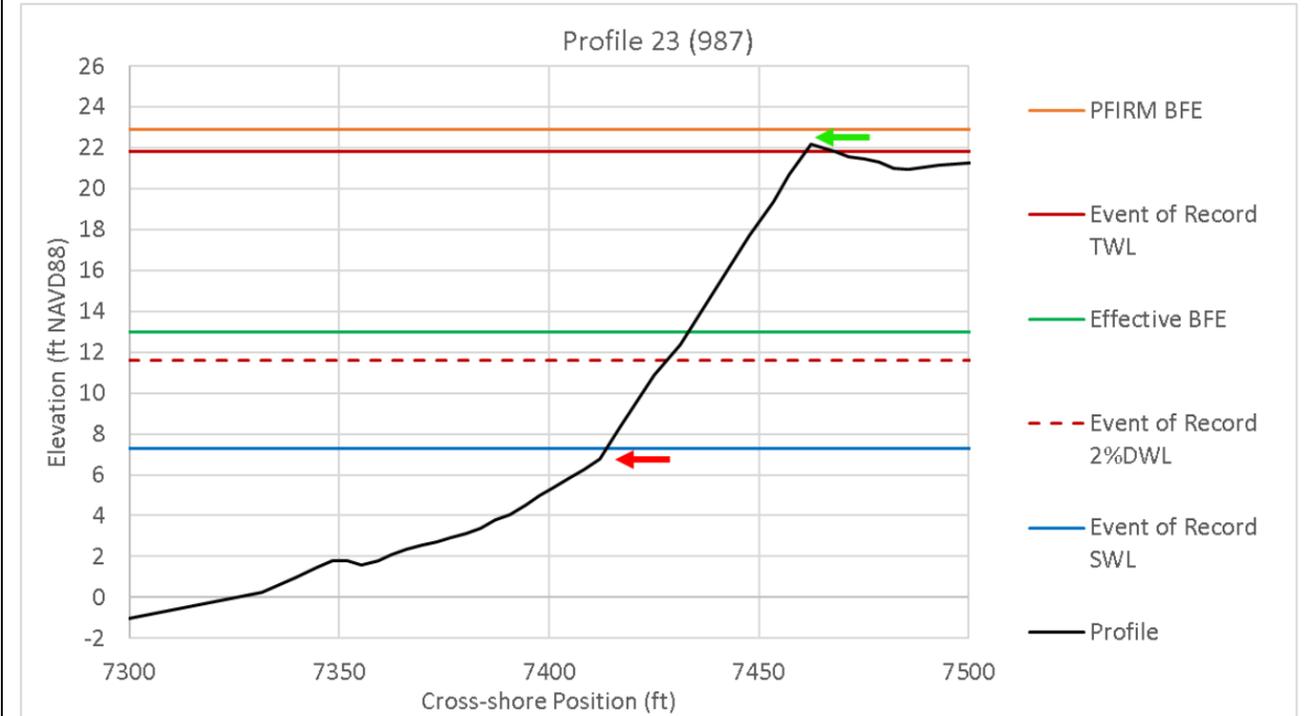
Date/Time	SWL ft	H _o ft	T _p seconds	H _o / Depth	DWL2% ft	TWL ft	Slope (H:V)	Roughness Factor
1/29/83 9:00	7.3	7.6	11.9	1.558	11.6	21.8	3.3 : 1	1.0

4. Analysis

- ▶ BFE is 1 ft higher than event of record TWL.
- ▶ Mild beach slope with DWL2% above toe; $TWL_{TAW} > TWL_s$ therefore, TAW Method is appropriate for event of record.
- ▶ BFE does not consider roughness coefficient for rock revetments.
- ▶ Wave input parameters may not adequately characterize reduced nearshore wave heights due to oblique approach angles from west-northwest and sheltering from Point Dume. A reduction factor applied to TAW calculation for oblique waves could reduce BFE by up to 2 ft, but Stockdon Method does not have a reduction factor for oblique waves.
- ▶ Event of record parameters differ from downcoast transect.
 - Transect 22: 1/29/83 9:00, SWL = 7.3 ft, H_o = 7.3 ft, T_p = 11.9 sec. Toe el. = 31.1 ft
 - Transect 24: 3/1/83 23:00, SWL = 6.0 ft, H_o = 13.4 ft, T_p = 19.2 sec, Toe el. = 8.4 ft
- ▶ BFE is lower at the upcoast transect due to a wider sandy beach and high bluff toe. The BFE is lower at the downcoast transect.
 - Transect 22: 12 ft | Runup method [Slope (H:V)] = All 145 DIM [8.8 : 1 – 30.1 : 1]
 - Transect 24: 19 ft | Runup method [Slope (H:V)] = 147 Stockdon, [9.3 : 1], 9 TAW [2.4 : 1 – 3.4:1]

5. Conclusion

The BFE can be reduced by 10% if the impact of oblique wave approach is considered in the analysis. The BFE will vary based on how waves interact with site specific structural and slope protection elements. The BFE can be reduced by 10% if a roughness reduction factor is considered. But the latter would require support documentations about shore protection structures.



Transect 23 (987) Profile and Runup Parameters



Oblique Aerial Image at Transect 23 (CCRP 2013)

TRANSECT NO. 24 (981) | Escondido Creek Beach

1. Site Description

Narrow wet sand beach backed by residential parcels that appear to be pile-supported. Transect intersects residential parcel, and the structure was not included in the profile data that assumed a bluff backed beach.

2. Mapping

Preliminary

- ▶ PFIRM BFE (Primary VE Zone): 19 ft
- ▶ Overtopping Treatment: none

Effective

- ▶ Effective BFE: 14 ft
- ▶ Secondary Zone: VE Zone backed by AE zone with BFE of 14 ft



Excerpt from PFIRM Panel 1519G (FEMA 2016)

3. Transect Parameters

- ▶ Structure Treatment: Failed (rubble/riprap removed)
- ▶ Runup method: 147 Stockdon, 9 TAW

Profile Features

Toe El. ft	8.4
Crest El. ft	27.8
Foreshore Slope (H:V)	9.3 : 1
Face Slope (H:V)	3.0 : 1

Event of Record and Runup Parameters

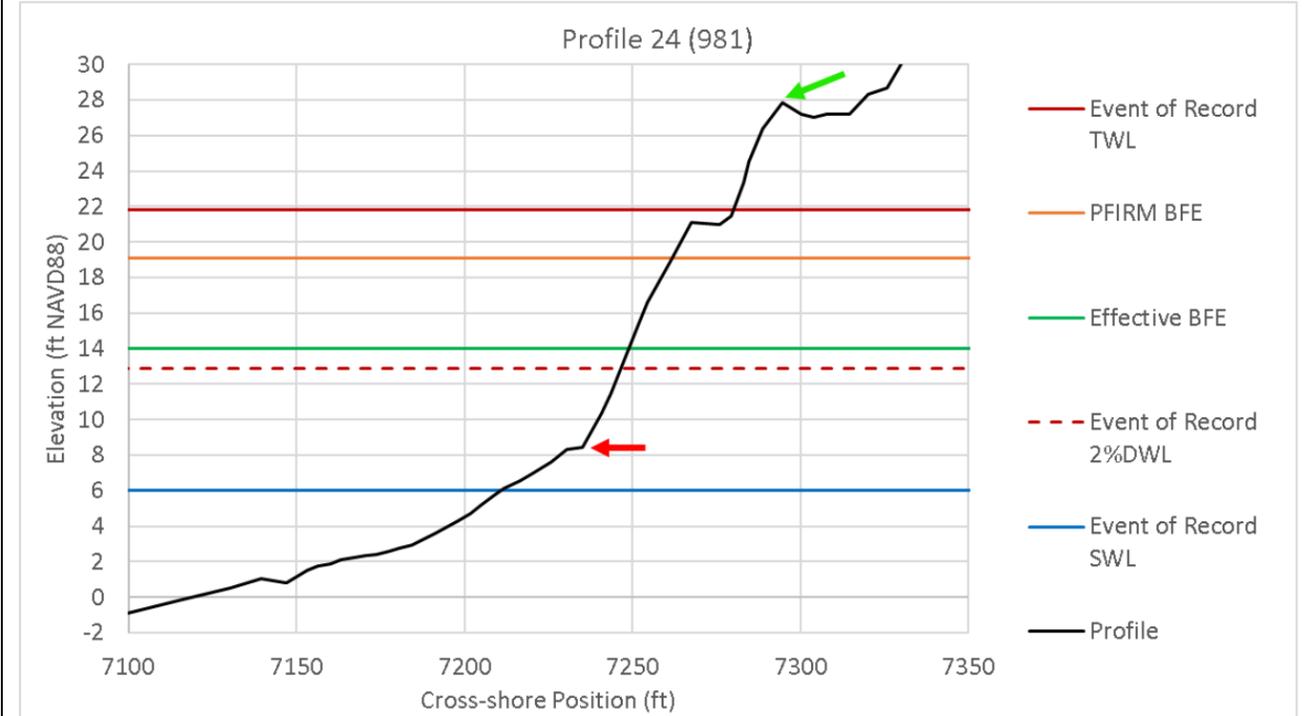
Date/Time	SWL ft	H _o ft	T _p seconds	H _o / Depth	DWL2% ft	TWL ft	Slope (H:V)	Roughness Factor
3/1/83 23:00	6.0	13.4	19.2	2.981	12.9	21.8	3.4 : 1	1.0

4. Analysis

- ▶ BFE is 3 ft lower than event of record TWL.
- ▶ Mild beach slope with DWL2% above toe; $TWL_{TAW} > TWL_s$ therefore, TAW runup method is appropriate for event of record. However, Stockdon calculations appear to be influencing the statistical TWL (BFE) analysis.
- ▶ Wave input parameters may not adequately characterize reduced nearshore wave heights due to oblique approach angles from west-northwest and sheltering from Point Dume.
- ▶ A reduction factor applied to the TAW calculation for oblique waves could reduce BFE by up to 2 ft. Stockdon Method does not have a reduction factor for oblique waves.
- ▶ Event of record parameters vary from the upcoast and downcoast transects. The H_o is 4.7 ft higher than the downcoast transect for the same event. The latter may be due to wave sheltering effect for the downcoast transect.
 - Transect 23: 1/29/83 9:00, SWL = 7.3 ft, H_o = 7.6 ft, T_p = 11.9 sec. Toe el. = 6.7 ft
 - Transect 25: 3/1/83 23:00, SWL = 6.0 ft, H_o = 8.7 ft, T_p = 19.2 sec, Toe el. = 6.6 ft
- ▶ The variation in BFE from the upcoast transect is difficult to explain given their similarities. However, the different wave parameters applied and runup methods are likely the cause.
 - Transect 23: 23 ft
 - Transect 25: 20 ft

5. Conclusion

The BFE considers a wave encountering the bluff behind the residential beachfront parcels. A majority of the structures appear to be pile-supported, which cannot be considered for shoreline protection under FEMA's Pacific Guidelines. At other parcels, the BFE will vary based on how waves interact with site specific structural and slope protection elements. The Stockdon Method was used for most events. If the DIM Method were used, the BFE may be lowered by a few feet.



Transect 24 (981) Profile and Runup Parameters



Oblique Aerial Image at Transect 24 (CCRP 2013)

TRANSECT NO. 25 (976) | Latigo Beach

1. Site Description

Narrow wet sand beach backed by residential parcels. Nearshore reef at western end of zone. Structures and coastal protection vary and include pile-supported structures, riprap, and seawalls. Transect characterizes a bluff backed beach without structures.



Excerpt from PEIRM Panel 1519G (FEMA 2016)

2. Mapping

Preliminary

- ▶ PFIRM BFE (Primary VE Zone): 20 ft
- ▶ Overtopping Treatment: Merge V and A to extend VE Zone 18.1 ft beyond crest.
- ▶ Landward Extent of Secondary VE Zone: 6.7 ft
- ▶ BFE of Secondary VE Zone: 17 ft

Effective

- ▶ Effective BFE: 14 ft
- ▶ Secondary Zone: VE Zone backed by AE zone with BFE of 14 ft

3. Transect Parameters

- ▶ Structure Treatment: Failed (riprap removed)
- ▶ Runup method: 82 TAW, 45 Stockdon

Profile Features

Toe El. ft	6.6
Crest El. ft	16.3
Foreshore Slope (H:V)	10 : 1
Face Slope (H:V)	1.6 : 1

Event of Record and Runup Parameters

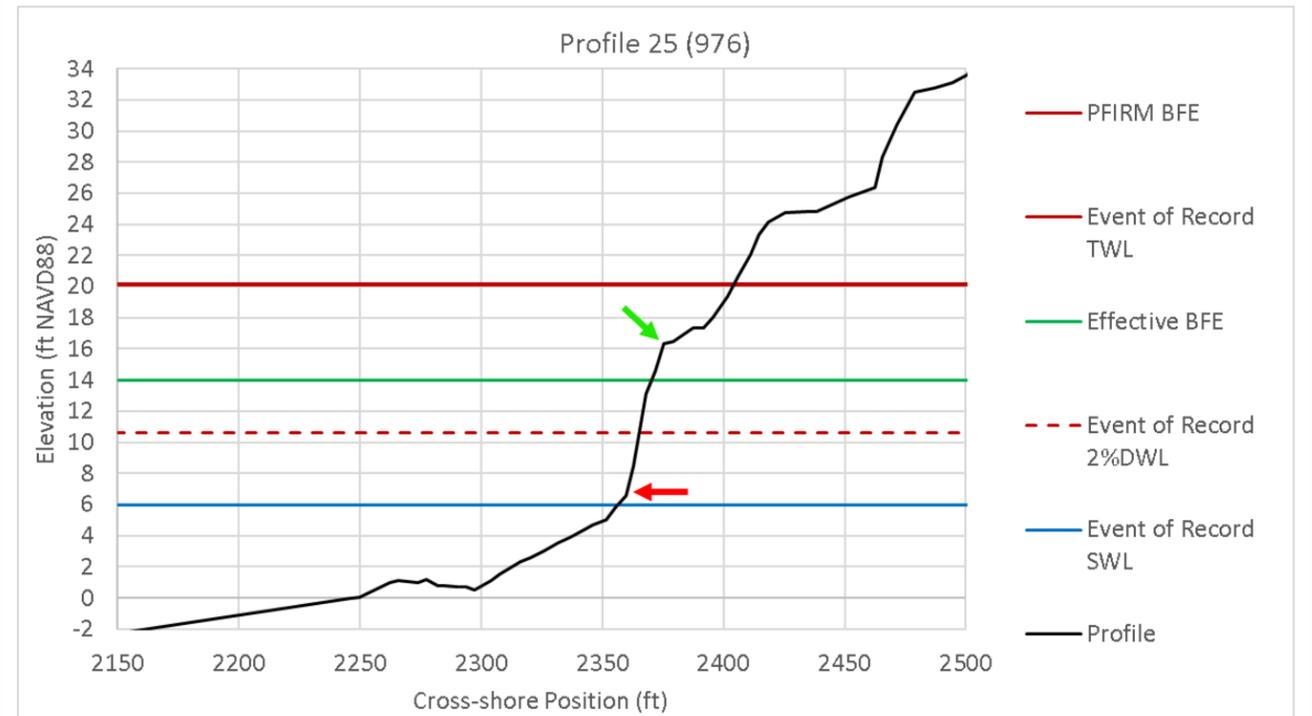
Date/Time	SWL ft	H _o ft	T _p seconds	H _o /Depth	DWL2% ft	TWL ft	Slope (H:V)	Roughness Factor
3/1/83 23:00	6.0	8.7	19.2	2.163	10.6	20.1	1.6 : 1	1.0

4. Analysis

- ▶ BFE is similar to event of record TWL.
- ▶ Mild beach slope with DWL2% above toe; $TWL_{TAW} > TWL_s$ therefore, TAW runup method is appropriate for event of record.
- ▶ Wave input parameters may not adequately characterize reduced nearshore wave heights due to oblique approach angles from west-northwest and sheltering from Point Dume.
- ▶ Event of record wave heights vary from the upcoast and downcoast transects.
 - Transect 24: 3/1/83 23:00, SWL = 6.0 ft, H_o = 13.4 ft, T_p = 19.2 sec. Toe el. = 8.4 ft
 - Transect 26: 3/1/83 23:00, SWL = 6.0 ft, H_o = 11.8 ft, T_p = 19.2 sec, Toe el. = 14.8 ft
- ▶ The upcoast BFE is similar to this zone despite differences in shoreline features, and the downcoast BFE varies significantly due to the different runup method used.
 - Transect 24: 19 ft | Runup method [Slope (H:V)] = 147 Stockdon, [9.3 : 1], 9 TAW [2.4 : 1 – 3.4:1]
 - Transect 26: 13 ft | Runup method [Slope (H:V)] = All 132 DIM, [9.7 : 1 – 34.5 : 1]
- ▶ Nearshore features like cobble, riprap, and the reef could potentially be considered for a reduction in BFE.

5. Conclusion

The BFE considers a wave encountering the bluff behind the residential beachfront parcels. Variations in coastal protection and structures throughout this zone could influence the BFE for specific parcels in this zone. If a slope roughness coefficient and oblique wave angle reduction factor were applied, the BFE would be lowered by several feet.



Transect 25 (976) Profile and Runup Parameters



Oblique Aerial Image at Transect 25 (CCRP 2013)

TRANSECT NO. 27 (956) | Corral Canyon Beach

1. Site Description

Narrow sandy beach (wet beach in some areas) backed by low bluff. PCH runs along the bluff top. Cluster of residential parcels that appear to be pile-supported at the western end of the zone. Transect intersects the narrow bluff backed beach fronting PCH and a commercial/parking area beyond.



Excerpt from DFIRM Panel 1536G (FEMA 2016)

2. Mapping

Preliminary

- ▶ PFIRM BFE (Primary VE Zone): 20 ft
- ▶ Overtopping treatment: Merge V and A to extend VE Zone 15.3 ft beyond crest.
- ▶ Landward extent of Secondary VE Zone: 2.8 ft
- ▶ BFE of Secondary VE Zone: 19.5 ft

Effective

- ▶ Effective BFE: 14 ft
- ▶ Secondary Zone: VE Zone backed by AE zone with BFE of 14 ft

3. Transect Parameters

- ▶ Structure Treatment: n/a
- ▶ Runup method: All 165 Stockdon

Profile Features

Toe El. ft	12.8
Crest El. ft	19.5
Foreshore Slope (H:V)	9.4 : 1
Face Slope (H:V)	3.2 : 1

Event of Record and Runup Parameters

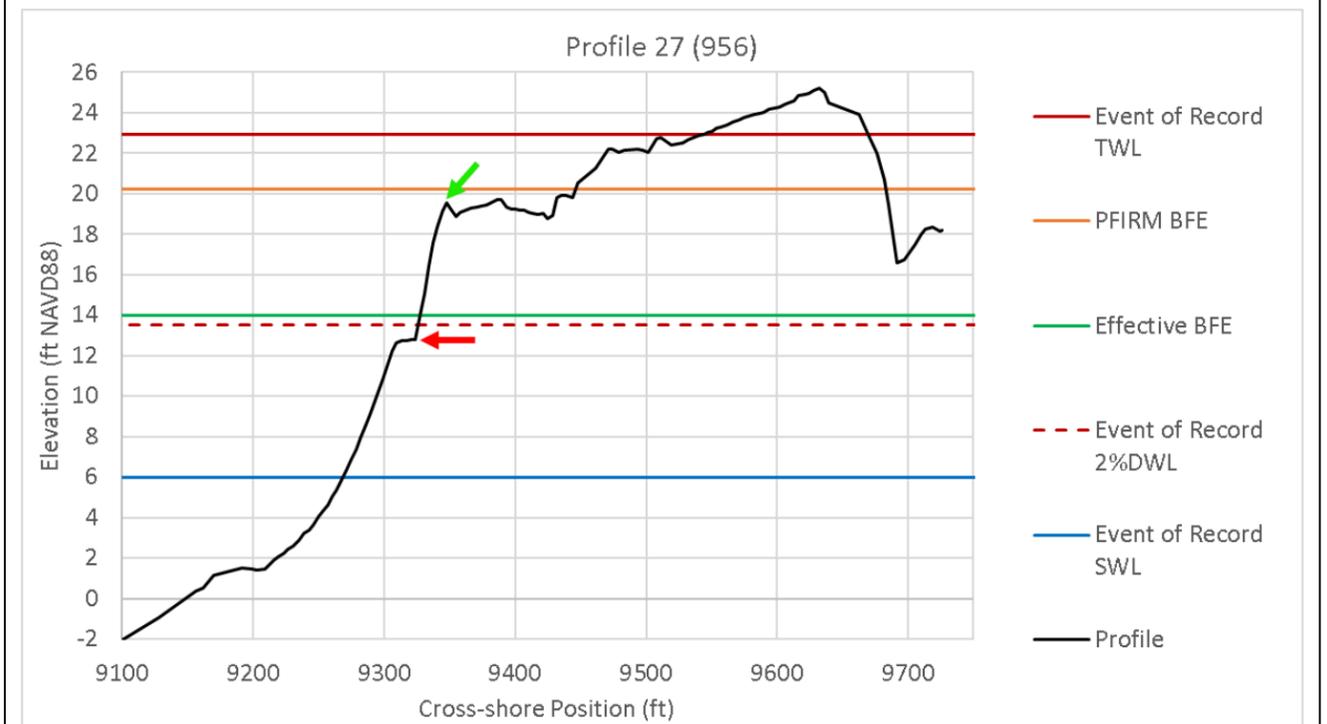
Date/Time	SWL ft	H _o ft	T _p seconds	H _o / Depth	DWL2% ft	TWL ft	Slope (H:V)	Roughness Factor
3/1/83 23:00	6.0	16.1	19.2	21.753	13.5	22.9	9.4 : 1	n/a

4. Analysis

- ▶ BFE is 3 ft lower than event of record TWL.
- ▶ Mild beach slope with DWL2% above toe for record event; $TWL_s > TWL_{TAW}$ hence, Stockdon runup method is used for event of record.
- ▶ Event of record wave heights are much lower at the upcoast. Wave input parameters may not adequately characterize reduced nearshore wave heights due to oblique approach angles and influence of nearshore bathymetric features. T_p is different than the downcoast transect for the same wave event.
 - Transect 26: 3/1/83 23:00, SWL = 6.0 ft, H_o = 11.8 ft, T_p = 19.2 sec, Toe el. = 14.8 ft
 - Transect 28: 3/1/83 23:00, SWL = 6.0 ft, H_o = 16.2 ft, T_p = 15.9 sec, Toe el. = 5.1 ft
- ▶ The slope at the upcoast transect is much steeper, which should have resulted in higher BFE, but the upcoast BFE is significantly lower, which is partially due to the difference in runup methods applied.
 - Transect 26: 13 ft | Runup method [Slope (H:V)] = All 132 DIM, [9.7 : 1 – 34.5 : 1]
 - Transect 28: 31 ft | Runup method [Slope (H:V)] = All 139 TAW, [2.5 : 1 – 2.7 : 1]

5. Conclusion

The wave period is different than that at the downcoast transect for the same storm event on 3/1/1983 and time step. The slope is mild; hence, the Stockdon Method is applied. The upcoast transect has a much steeper slope and its slope is outside of Stockdon Method application range; hence, the DIM Method is applied. If the DIM Method were used instead of Stockdon, the BFE would be several feet lower, as illustrated in Table 2-1.



Transect 27 (956) Profile and Runup Parameters



Oblique Aerial Image at Transect 27 (CCRP 2013)

TRANSECT NO. 28 (946) | Corral Canyon Beach

1. Site Description

Wet sand beach backed by residential parcels, and most appear to be pile-supported. Some variations in structures exist like seawalls and riprap. The transect intersects a parcel fronted by riprap and characterizes a wet sandy beach backed by a bluff.

2. Mapping

Preliminary

- ▶ PFIRM BFE (Primary VE Zone): 31 ft
- ▶ Overtopping Treatment: Merge V and A limits to map VE Zone 36.4 ft beyond crest. Apply 24 ft VE Zone BFE.
- ▶ Landward Extent of Secondary VE Zone: 22.8 ft
- ▶ BFE of Secondary VE Zone: 23.8 ft

Effective

- ▶ Effective BFE: 14 ft
- ▶ Secondary Zone: VE zone backed by AE zone with BFE of 14 ft



Excerpt from PFIRM Panel 1536G (FEMA 2016)

3. Transect Parameters

- ▶ Structure Treatment: Failed (riprap removed)
- ▶ Runup method: All 139 TAW

Profile Features

Toe El. ft	5.1
Crest El. ft	23.3
Foreshore Slope (H:V)	11.6 : 1
Face Slope (H:V)	2.7 : 1

Event of Record and Runup Parameters

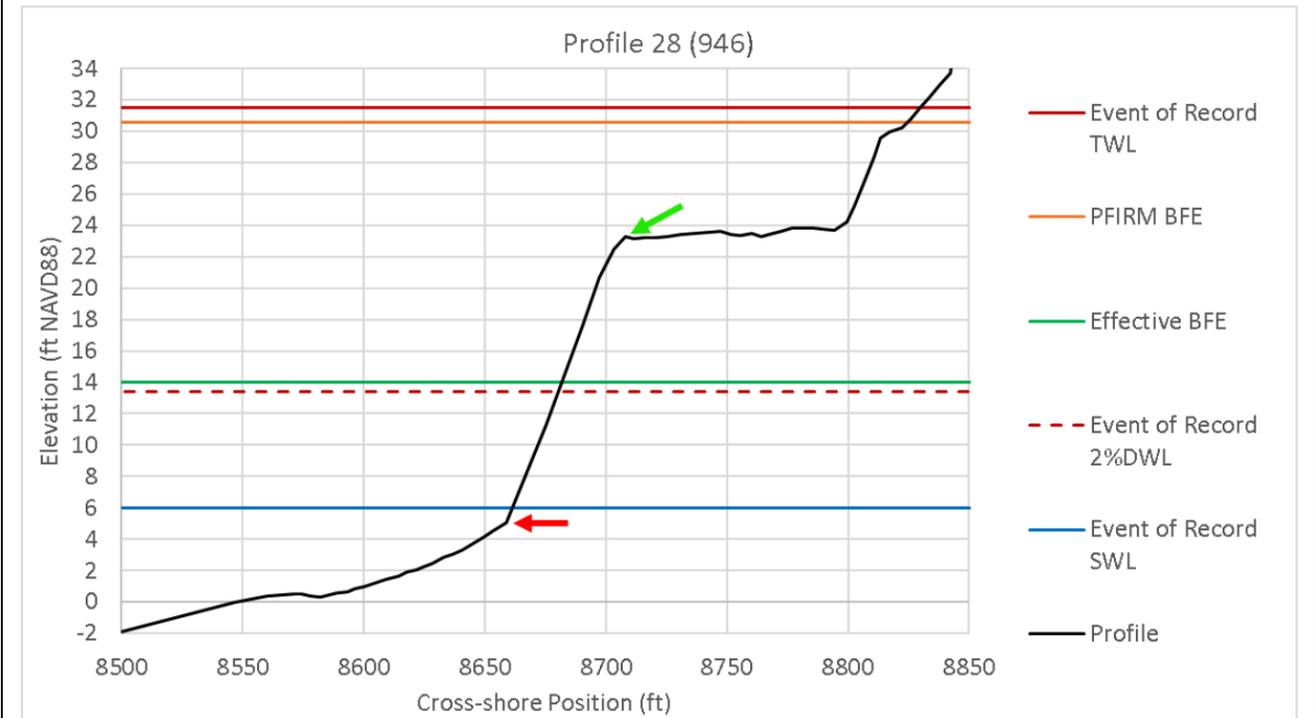
Date/Time	SWL ft	H ₀ ft	T _p seconds	H ₀ /Depth	DWL2% ft	TWL ft	Slope (H:V)	Roughness Factor
3/1/83 23:00	6.0	16.2	15.9	1.951	13.4	31.5	2.7 : 1	1.0

4. Analysis

- ▶ BFE is similar to event of record TWL.
- ▶ Mild beach slope with DWL2% above toe; $TWL_{TAW} > TWL_s$ therefore, TAW runup method is appropriate for event of record.
- ▶ Wave input parameters may not adequately characterize reduced nearshore wave heights due to oblique approach angles from west-northwest and sheltering from Point Dume.
- ▶ Event of record wave parameters vary from upcoast and downcoast transects. Note, wave period varies from upcoast transect for the same event and time step, which does not make sense.
 - Transect 27: 3/1/83 23:00, SWL = 6.0 ft, H₀ = 16.1 ft, T_p = 19.2 sec. Toe el. = 12.8 ft
 - Transect 29: 1/27/83 8:00, SWL = 7.3 ft, H₀ = 11.4 ft, T_p = 14.4 sec, Toe el. = 17.2 ft
- ▶ BFEs for upcoast and downcoast transects:
 - Transect 27: 20 ft; Transect 29: 16 ft
- ▶ The toe elevation seems low, especially compared to the adjacent transects with similar shore types.

5. Conclusion

The BFE in this zone may be overestimated. The bluff characterization at this transect is not representative of the overall zone. The low toe elevation results in TWL calculations assuming waves encounter the steep bluff slope. An appeal may be warranted to select a transect that is more representative of the zone. A higher bluff toe elevation would result in lower TWLs and a lower BFE. Variations in coastal protection and structures throughout this zone could influence the BFE for specific parcels in this zone. The BFE may be lowered by a few feet if a roughness factor were considered.



Transect 28 (946) Profile and Runup Parameters



Oblique Aerial Image at Transect 28 (CCRP 2013)

TRANSECT NO. 31 (914) | Malibu Colony Rd

1. Site Description

Narrow dry beach with some areas of wet sand beach backed by residential parcels with seawalls.

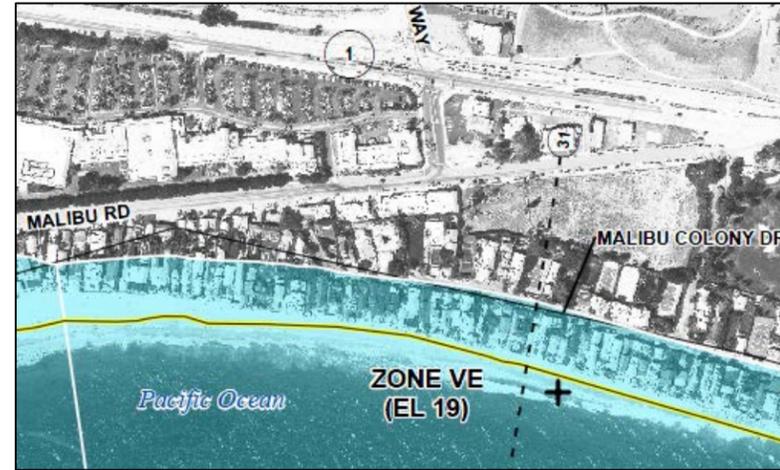
2. Mapping

Preliminary

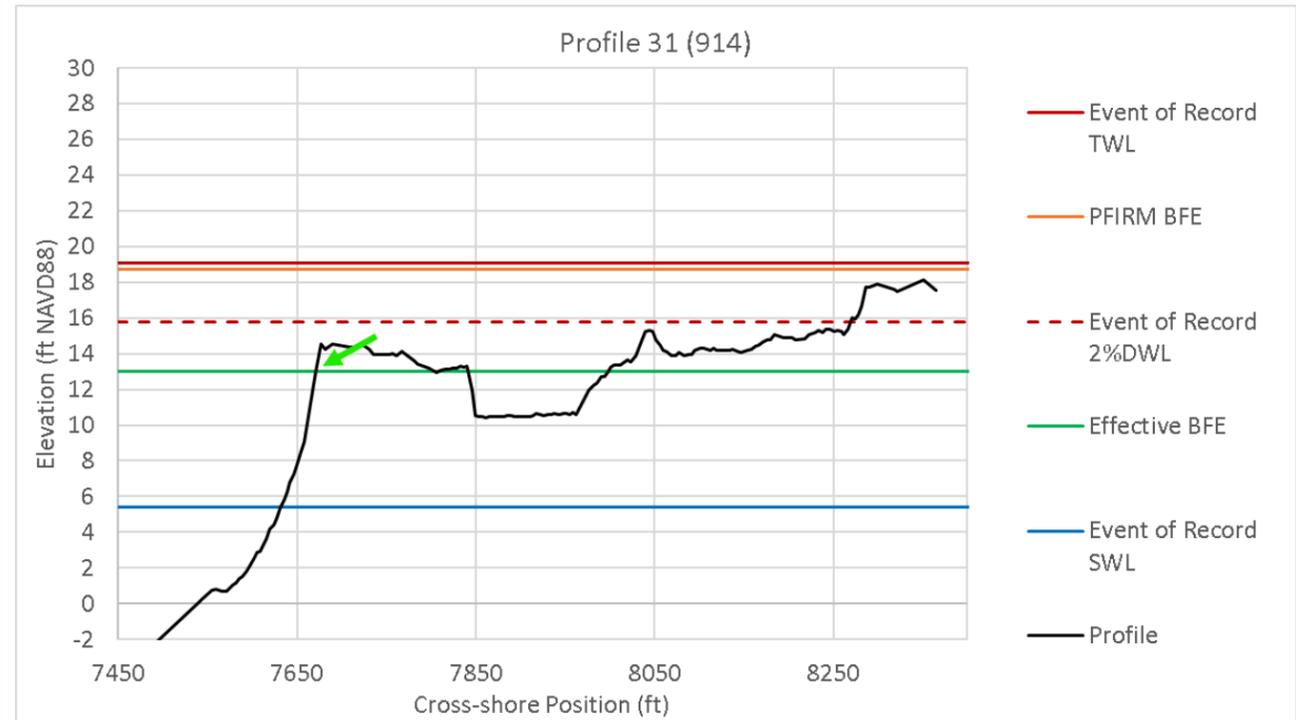
- ▶ PFIRM BFE (Primary VE Zone): 19 ft
- ▶ Overtopping Treatment: Merge V and A to extend VE Zone 32.5 ft beyond crest. Beach/backshore development was selected for overtopping.
- ▶ Landward Extent of Secondary VE Zone: 10.9
- ▶ BFE of Secondary VE Zone: 15.3 ft

Effective

- ▶ Effective BFE: 13 ft
- ▶ Secondary Zone: VE zone is backed by AE zone with BFE of 13ft, which is backed by AO zone with depth of 3 ft.



Excerpt from DEIRM Panel 1537G (FEMA 2016)



Transect 31 (914) Profile and Runup Parameters

3. Transect Parameters

- ▶ Structure Treatment: Structures not accounted for in runup calculation or floodplain mapping
- ▶ Runup method: All 170 Stockdon

Profile Features

Toe El. ft	n/a
Crest El. ft	13.2
Foreshore Slope (H:V)	8.9 : 1
Face Slope (H:V)	n/a

Event of Record and Runup Parameters

Date/Time	SWL ft	H _o ft	T _p seconds	H _o /Depth	DWL2% ft	TWL ft	Slope (H:V)	Roughness Factor
3/2/83 11:00	5.4	14.2	15.9	0.899	15.8	19.1	8.9 : 1	n/a

4. Analysis

- ▶ BFE is similar to event of record TWL.
- ▶ Event of record parameters vary significantly from the upcoast and downcoast transects, which have a different shoreline orientation and different shoreline features.
 - Transect 30: 5/11/80 19:00, SWL = 5.7 ft, H_o = 5.4 ft, T_p = 23.3 sec. Toe el. = 12.6 ft
 - Transect 32: 4/25/98 8:00, SWL = 4.8 ft, H_o = 5.0 ft, T_p = 25.6 sec, Toe el. = n/a
- ▶ The upcoast transect BFE is lower due to differences in orientation, exposure, and shoreline type; although these type of differences also exist at the downcoast transect, the BFE is similar.
 - Transect 30: 17 ft | Runup method [Slope (H:V)] = All 157 Stockdon, [9.9 : 1]
 - Transect 32: 19 ft | Runup method [Slope (H:V)] = All 157 Stockdon, [8.1 : 1]

5. Conclusion

The backshore seawalls and other structural elements were not factored into the runup analysis and floodplain mapping. Also, if the DIM Method were used instead of Stockdon, the BFE could be several feet lower.



Oblique Aerial Image at Transect 31 (CCRP 2013)

TRANSECT NO. 32 (906) | Malibu Lagoon

1. Site Description

Sandy beach fronting the Malibu Lagoon/mouth of Malibu Creek. Transect is located at western end lagoon.

2. Mapping

Preliminary

- ▶ PFIRM BFE (Primary VE Zone): 19 ft
- ▶ Overtopping Treatment: Merge V and A to extend VE Zone 33.5 ft beyond crest. Beach/backshore development was selected for overtopping.
- ▶ Landward Extent of Secondary VE Zone: 16.3
- ▶ BFE of Secondary VE Zone: 14.3 ft

Effective

- ▶ Effective BFE: 13 ft
- ▶ Secondary Zone: VE Zone is backed by AE zone with BFE of 13 ft, which is backed by AO zone with a depth of 3ft or an AE zone with a depth of 9 ft.



Excerpt from PFIRM Panel 1541G (FEMA 2016)

3. Transect Parameters

- ▶ Structure Treatment: Structures not accounted for in runup calculation or floodplain mapping
- ▶ Runup method: all 157 Stockdon

Profile Features

Toe El. ft	n/a
Crest El. ft	11.6
Foreshore Slope (H:V)	8.1 : 1
Face Slope (H:V)	n/a

Event of Record and Runup Parameters

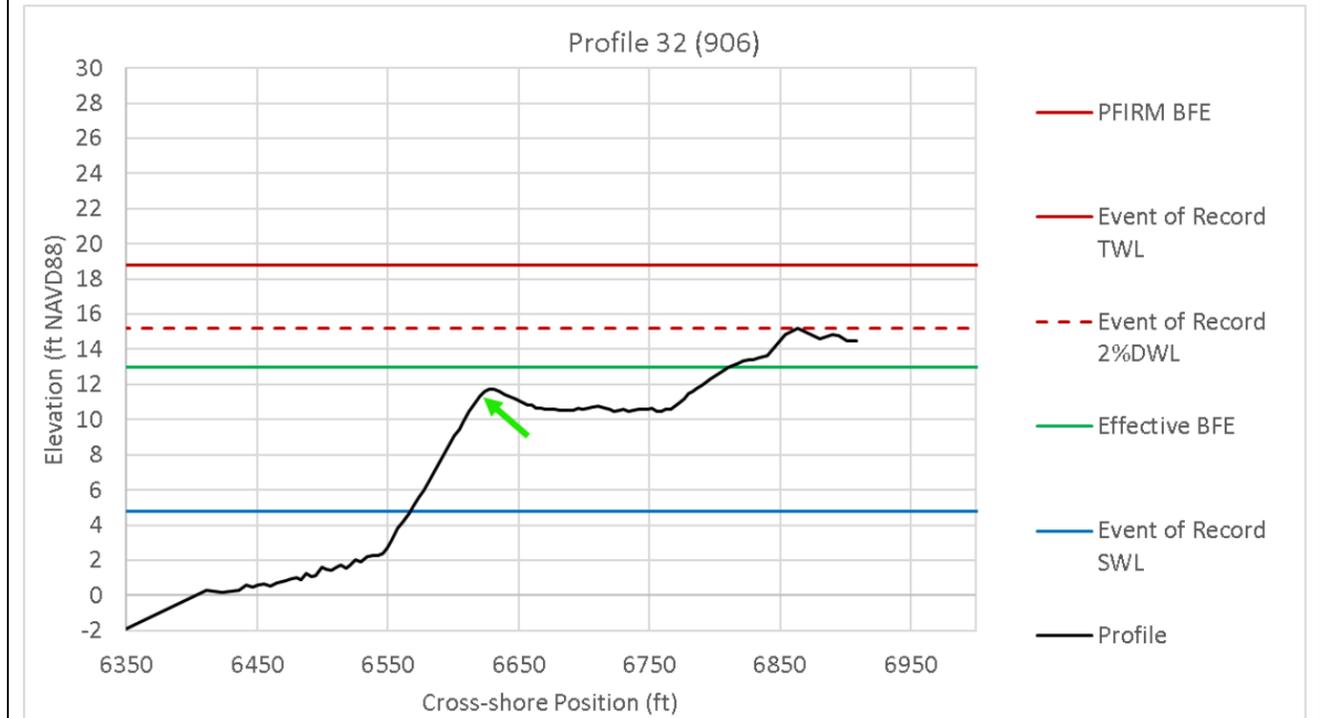
Date/Time	SWL ft	H _o ft	T _p seconds	H _o /Depth	DWL2% ft	TWL ft	Slope (H:V)	Roughness Factor
4/25/98 8:00	4.8	5.0	25.6	0.327	15.2	18.8	8.1 : 1	n/a

4. Analysis

- ▶ BFE is similar to event of record TWL.
- ▶ DWL2% exceeds beach crest for event of record (assumes the wave is breaking beyond crest).
- ▶ Event of record parameters vary from upcoast and downcoast transects due to differences in shore orientation and exposure.
 - Transect 31: 3/2/83 11:00, SWL = 5.4 ft, H_o = 14.2 ft, T_p = 15.9 sec. Toe el. = 15.9 ft
 - Transect 33: 1/29/83 9:00, SWL = 4.8 ft, H_o = 6.8 ft, T_p = 15.9 sec, Toe el. = 11.9 ft
- ▶ The downcoast transect BFE is lower due to differences in orientation, exposure, and shoreline type; although these type of differences also exist at the upcoast transect, the BFE is similar.
 - Transect 31: 19 ft
 - Transect 33: 13 ft

5. Conclusion

The transect is not representative of the west zone with structures. The backshore seawalls and other structural elements were not factored into the runup analysis and floodplain mapping. Also, if the DIM Method were used instead of Stockdon, the BFE would be several feet lower.



Transect 32 (906) Profile and Runup Parameters



Oblique Aerial Image at Transect 32 (CCRP 2013)

TRANSECT NO. 33 (894) | Malibu Pier

1. Site Description

Wet sand beach with some narrow sandy portions backed by residential and commercial parcels with various types of coastal protection including riprap and pile-supported structures.

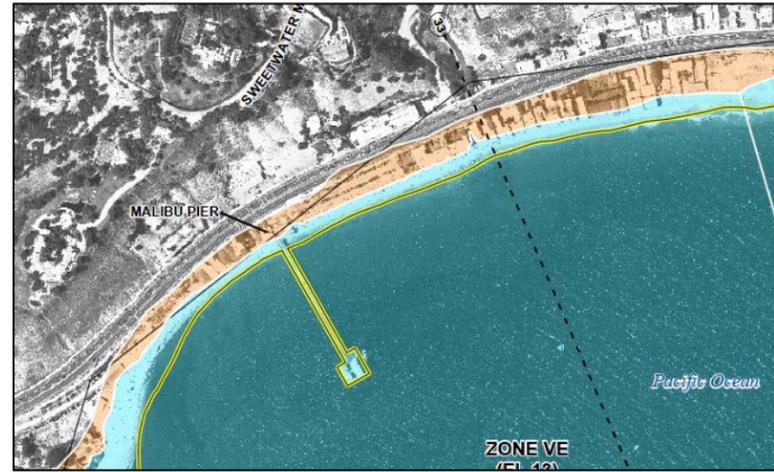
2. Mapping

Preliminary

- ▶ PFIRM BFE (Primary VE Zone): 13 ft
- ▶ Overtopping Treatment: none
- ▶ Riverine Flood Zone: VE Zone is backed by Zone X

Effective

- ▶ Effective BFE: 14 ft
- ▶ Secondary Zone: VE Zone backed by AE Zone with BFE of 14 ft



Excerpt from PFIRM Panel 1541G (FEMA 2016)

3. Transect Parameters

- ▶ Structure Treatment: Failed (rubble/riprap removed)
- ▶ Runup method: 2 TAW, 125 DIM

Profile Features

Toe El. ft	10.0
Crest El. ft	21.5
Foreshore Slope (H:V)	7.4 : 1
Face Slope (H:V)	3.6 : 1

Event of Record and Runup Parameters

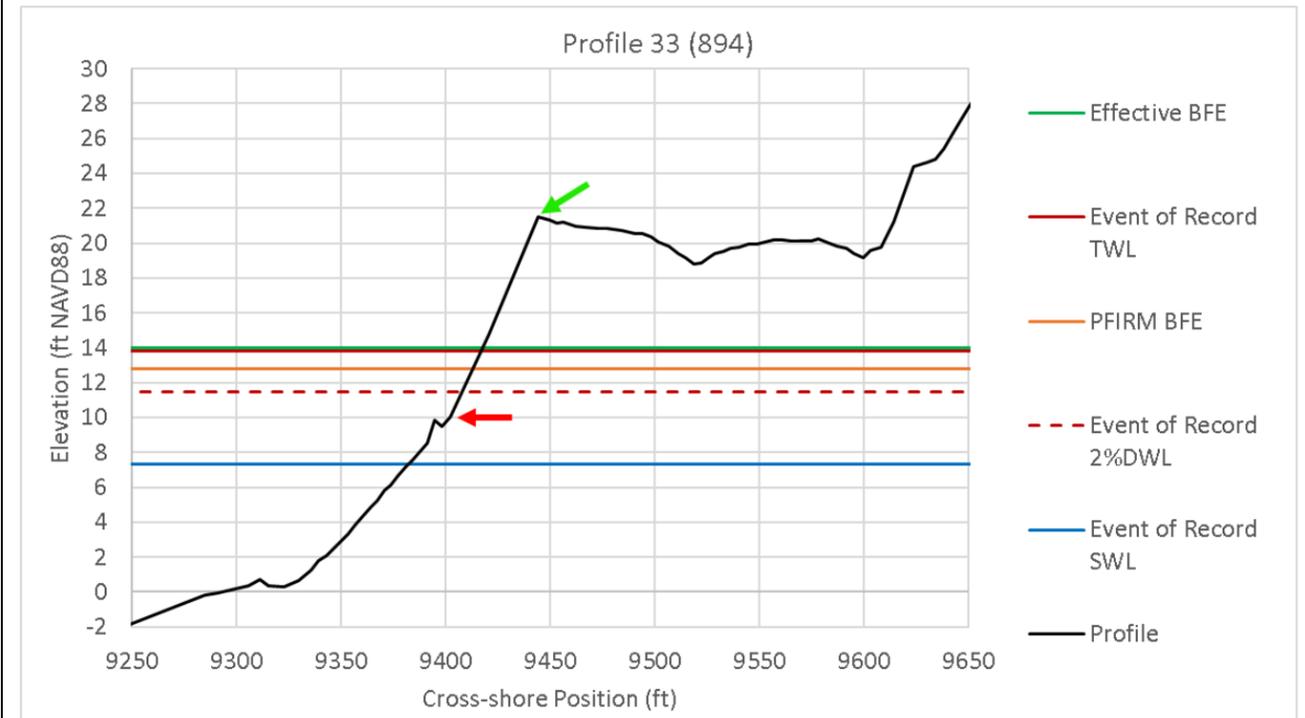
Date/Time	SWL ft	H _o ft	T _p seconds	H _o /Depth	DWL2% ft	TWL ft	Slope (H:V)	Roughness Factor
1/29/83 9:00	7.3	6.8	11.9	4.578	11.5	13.8	3.9 : 1	1.0

4. Analysis

- ▶ BFE is 1 ft lower than TWL.
- ▶ TAW Method appropriate for event of record, DWL2% exceeds toe elevation and beach has a steep foreshore slope.
- ▶ Event of record parameters vary from upcoast and downcoast transects due to differences in shore orientation and exposure.
 - Transect 32: 4/25/98 8:00, SWL = 4.8 ft, H_o = 5.0 ft, T_p = 25.6 sec, Toe el. = n/a
 - Transect 34: 5/11/80 19:00, SWL = 5.7 ft, H_o = 5.3 ft, T_p = 23.3 sec, Toe el. = 14.6 ft
- ▶ Although the upcoast and downcoast transects have different shoreline characteristics, this transect is significantly lower than both. This may also be due to the differences in slope calculation between runup methods, IDS3 detailed TWL results show a difference of 4 ft between the Stockdon and DIM Methods at transect 34.
 - Transect 32: 19 ft | Runup method [Slope (H:V)] = All 157 Stockdon, [8.1 : 1]
 - Transect 34: 17 ft | Runup method [Slope (H:V)] = All 157 Stockdon, [10.2 : 1]
- ▶ DIM slope values range from (H:V) 7.4 : 1 to 53.2 - 1
- ▶ The large variation between transect 32 through 34 is strange, longer term beach slope data and revised wave runup methods should be considered. If these large differences in BFE do exist, a transition zone could be included.

5. Conclusion

The BFE is lower in this zone due to the runup methodology used. Bounding transects were evaluated with the Stockdon Method and have a higher BFE. Comparing IDS3 detailed TWL results shows that the event of record at transect 34 has a TWL of 16.7 ft for Stockdon and 12.5 ft for DIM.



Transect 33 (894) Profile and Runup Parameters



Oblique Aerial Image at Transect 33 (CCRP 2013)

TRANSECT NO. 34 (885) | Malibu Beach

1. Site Description

Narrow sandy beach backed by residential parcels generally protected by seawalls with riprap in some areas. Some are pile-supported structures. Seawall is included in transect.

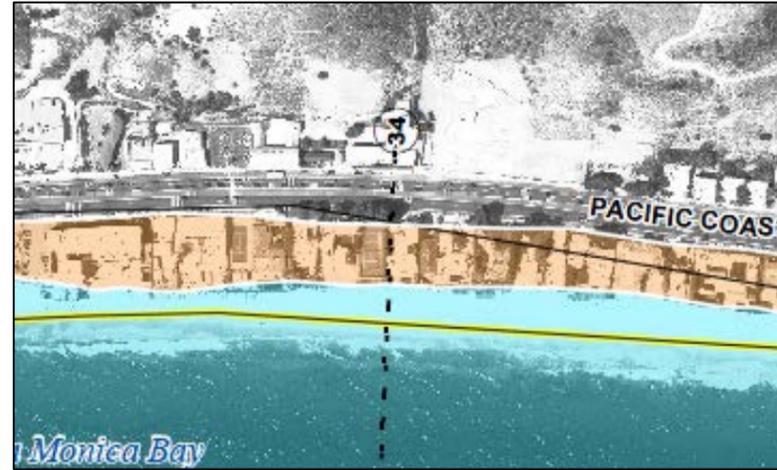
2. Mapping

Preliminary

- ▶ PFIRM BFE (Primary VE Zone): 17 ft
- ▶ Overtopping Treatment: none
- ▶ Riverine Flood Zone: VE Zone is backed by Zone X

Effective

- ▶ Effective BFE: 14 ft
- ▶ Secondary Zone: VE zone is backed by AE zone with BFE of 14 ft, backed by Zone X



Excerpt from PFIRM Panel 1541G (FEMA 2016)

3. Transect Parameters

- ▶ Structure Treatment: Structures not accounted for in runup calculation or floodplain mapping.
- ▶ Runup method: All 157 Stockdon

Profile Features

Toe El. ft	14.6
Crest El. ft	18.0
Foreshore Slope (H:V)	10.2 : 1
Face Slope (H:V)	1.0 : 1

Event of Record and Runup Parameters

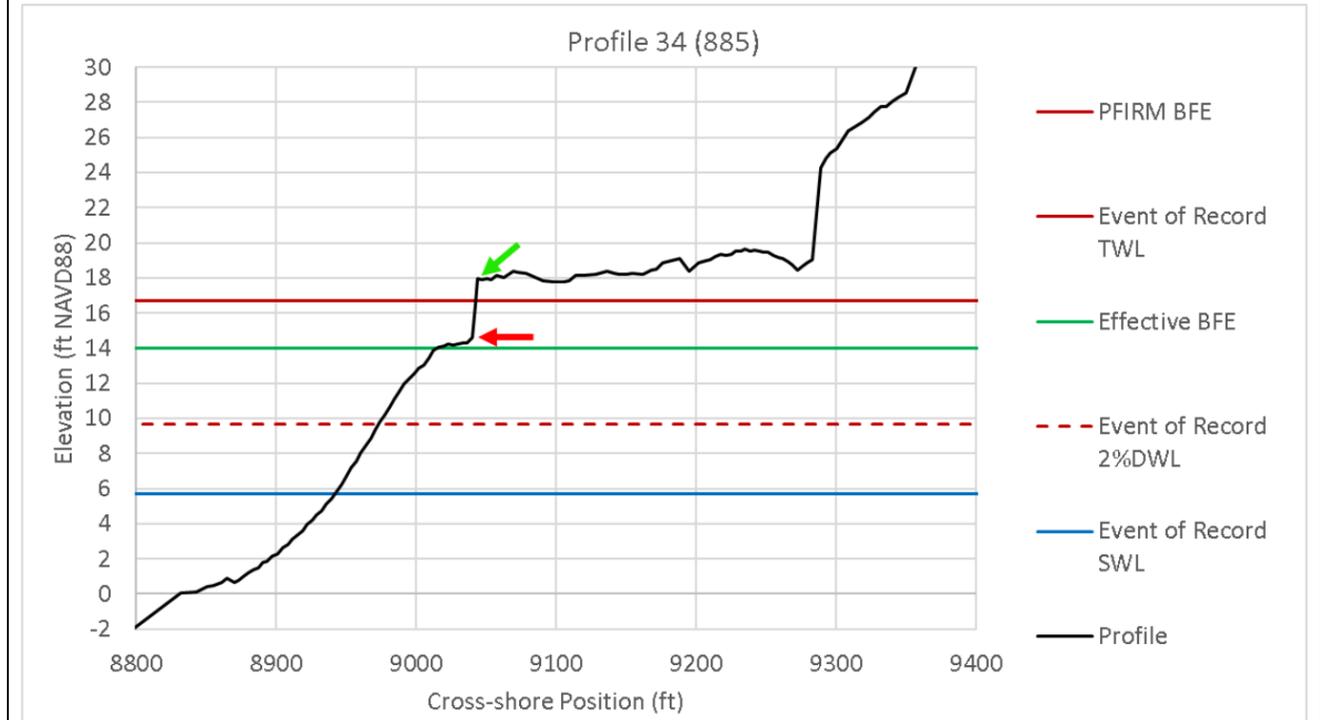
Date/Time	SWL ft	H _o ft	T _p seconds	H _o /Depth	DWL2% ft	TWL ft	Slope (H:V)	Roughness Factor
5/11/80 19:00	5.7	5.3	23.3	n/a	9.7	16.7	10.2 : 1	1.0

4. Analysis

- ▶ BFE is similar to event of record TWL.
- ▶ IDS3 detailed TWL results show the event of record has a TWL of 16.7 ft for Stockdon compared to 12.5 ft for DIM. Wave input parameters may not adequately characterize reduced nearshore wave heights due to oblique approach angles and influence of nearshore bathymetric features.
- ▶ Stockdon Method does not have a reduction factor for oblique waves approaching from a west-northwest direction.
- ▶ Event of record parameters vary from upcoast and downcoast transects.
 - Transect 33: 1/29/83 9:00, SWL = 4.8 ft, H_o = 6.8 ft, T_p = 15.9 sec, Toe el. = 11.9 ft
 - Transect 35: 3/2/83 11:00, SWL = 5.4 ft, H_o = 13.8 ft, T_p = 15.9 sec, Toe el. = n/a ft
- ▶ The BFE at the upcoast transect is significantly lower, which may also be due to the different runup method applied (Stockdon vs DIM). The downcoast transect used the same runup method as this one with a slightly steeper slope (9.7:1) and has a similar BFE.
 - Transect 33: 13 ft
 - Transect 35: 18 ft

5. Conclusion

The BFE is based on a wave encountering a sandy beach that slopes up to PCH. Variations in coastal protection and structures throughout this zone could influence the BFE for specific parcels in this zone. If the DIM Method were used instead of Stockdon, the BFE would be several feet lower, similar to the upcoast transect.



Transect 34 (885) Profile and Runup Parameters



Oblique Aerial Image at Transect 34 (CCRP 2013)

TRANSECT NO. 35 (873) | Malibu Beach

1. Site Description

Narrow sandy beach backed by residential parcels, with a mix of pile-supported structures and seawalls with riprap in some areas. No structure is included in transect that appears to intersect a pile-supported structure.



Excerpt from PFIRM Panel 1541G (FEMA 2016)

2. Mapping

Preliminary

- ▶ PFIRM BFE (Primary VE Zone): 18 ft
- ▶ Overtopping Treatment: none
- ▶ Riverine Flood Zone: VE Zone is backed by Zone X

Effective

- ▶ Effective BFE: 14 ft
- ▶ Secondary Zone: VE zone is backed by AE zone with BFE of 14ft, backed by Zone X

3. Transect Parameters

- ▶ Structure Treatment: Structures not accounted for in runup calculation or floodplain mapping.
- ▶ Runup method: All 160 Stockdon

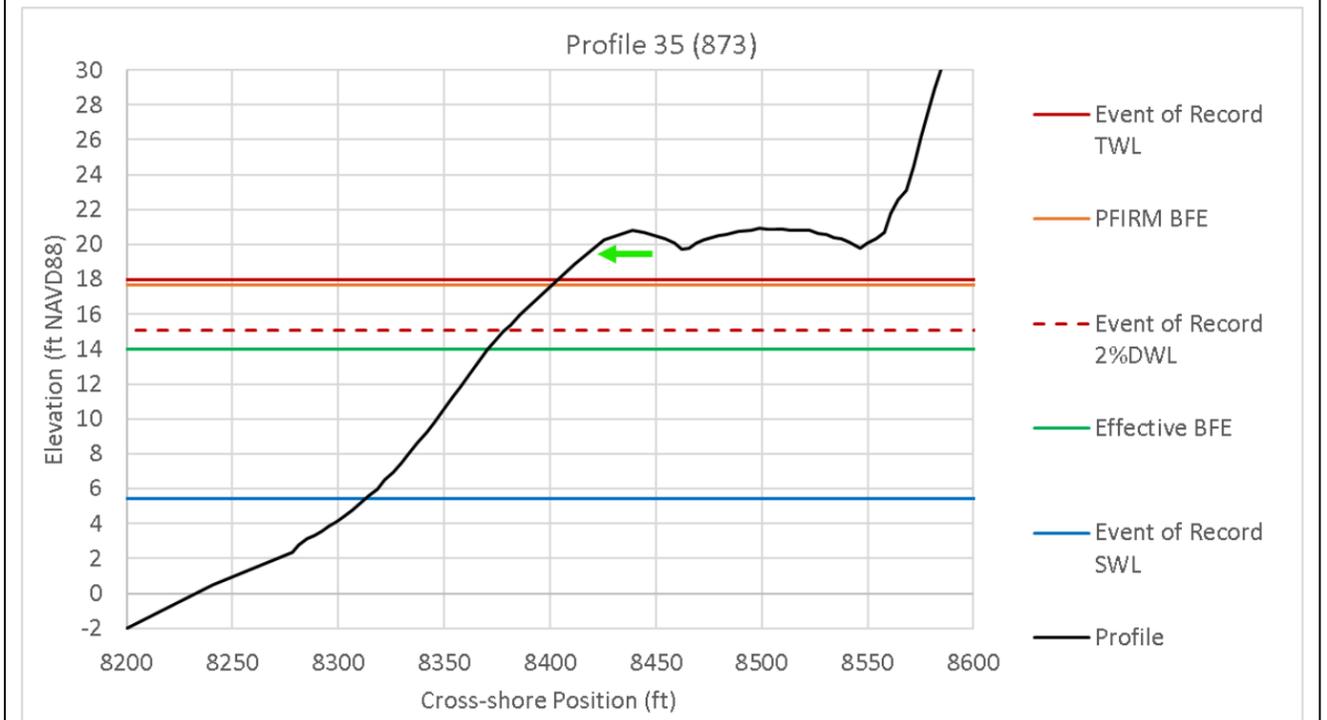
Profile Features		Event of Record and Runup Parameters								
Toe El. ft	n/a	Date/Time	SWL ft	H _o ft	T _p seconds	H _o /Depth	DWL2% ft	TWL ft	Slope (H:V)	Roughness Factor
Crest El. ft	19.7	3/2/83 11:00	5.4	13.8	15.9	0.916	15.1	18.0	9.7 : 1	n/a
Foreshore Slope (H:V)	9.7 : 1									
Face Slope (H:V)	n/a									

4. Analysis

- ▶ BFE is equal to the event of record.
- ▶ Wave input parameters may not adequately characterize reduced nearshore wave heights due to oblique approach angles and influence of nearshore bathymetric features.
- ▶ Stockdon Method does not have a reduction factor for oblique waves approaching from a west-northwest direction.
- ▶ Transect assumes a beach sloping beneath the residential parcels with a crest near the outside south shoulder of PCH. This is not representative of conditions in the zone that has variable types of structures (pile supported, seawalls, and riprap) spanning the entire beachfront.
- ▶ Event of record parameters vary significantly from upcoast and downcoast transects. Similar conditions would be expected at the upcoast transect, which has similar shore orientation, exposure, and shore type.
 - Transect 34: 5/11/80 19:00, SWL = 5.7 ft, H_o = 5.3 ft, T_p = 23.3 sec, Toe el. = 14.6 ft
 - Transect 36: 1/29/83 9:00, SWL = 7.3 ft, H_o = 8.3 ft, T_p = 11.9 sec, Toe el. = 8.2 ft
- ▶ Despite differences in shore features and wave parameters the upcoast and downcoast transect BFEs only differ by +/-1 ft.
 - Transect 34: 17 ft; and Transect 36: 19 ft

5. Conclusion

The BFE is based on a wave encountering a sandy beach that slopes up to PCH. Variations in coastal protection and structures throughout this zone could influence the BFE for specific parcels in this zone. If the DIM Method were used instead of Stockdon, the BFE would be several feet lower.



Transect 35 (873) Profile and Runup Parameters

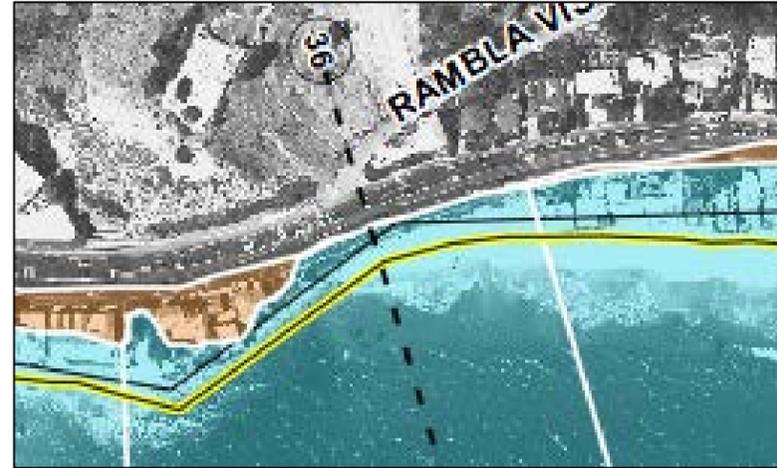


Oblique Aerial Image at Transect 35 (CCRP 2013)

TRANSECT NO. 36 (870) | Carbon Canyon

1. Site Description

Wet sand beach backed by bluff. Some cobble exists in the nearshore and along the bluff. Cluster of residential parcels at the western end of the zone along the bluff top. Transect intersects the wet beach and bluff on the eastern end at the intersection of Rambla Vista and PCH.



Excerpt from PFIRM Panel 1542G (FEMA 2016)

2. Mapping

Preliminary

- ▶ PFIRM BFE (Primary VE Zone): 19 ft
- ▶ Overtopping Treatment: Merge V and A to extend VE Zone 22.9 ft beyond crest.
- ▶ Landward Extent of Secondary VE Zone: 5.3
- ▶ BFE of Secondary VE Zone: 17.2 ft
- ▶ Riverine Flood Zone: VE Zone is backed by Zone X

Effective

- ▶ Effective BFE: 14 ft
- ▶ Secondary Zone: VE zone is backed by AE zone with BFE of 14 ft, backed by Zone X

3. Transect Parameters

- ▶ Structure Treatment: Failed (rubble/riprap removed)
- ▶ Runup method: 135 Stockdon, 18 TAW

Profile Features

Toe El. ft	8.2
Crest El. ft	16.9
Foreshore Slope (H:V)	9.9 : 1
Face Slope (H:V)	1.6 : 1

Event of Record and Runup Parameters

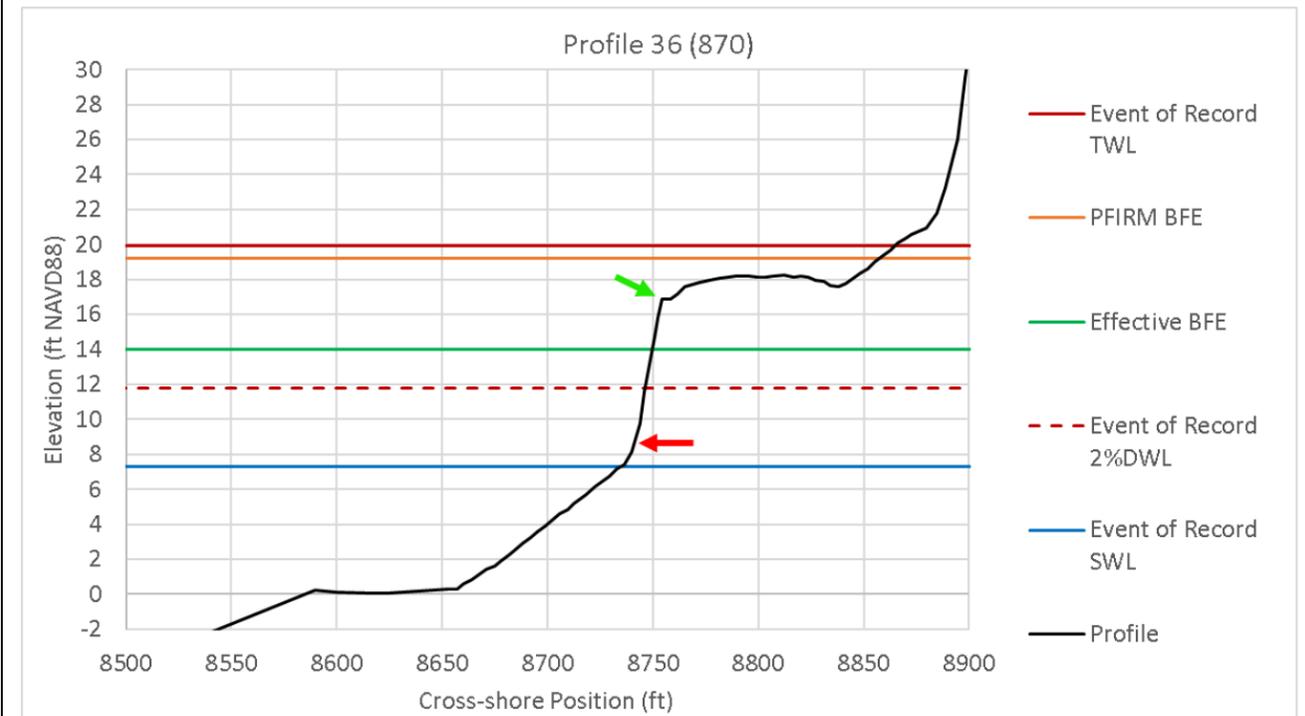
Date/Time	SWL ft	H _o ft	T _p seconds	H _o /Depth	DWL2% ft	TWL ft	Slope (H:V)	Roughness Factor
1/29/83 9:00	7.3	8.3	11.9	2.267	11.8	19.9	1.6 : 1	1.0

4. Analysis

- ▶ BFE is 1 ft lower than event of record TWL.
- ▶ Mild beach slope with DWL2% above toe; $TWL_{TAW} > TWL_s$ therefore, TAW runup method is appropriate for event of record.
- ▶ Event of record parameters vary from upcoast and downcoast transects.
 - Transect 35: 3/2/83 11:00, SWL = 5.4 ft, H_o = 13.8 ft, T_p = 15.9 sec, Toe el. = n/a
 - Transect 37: 3/2/83 11:00, SWL = 5.4 ft, H_o = 14.4 ft, T_p = 15.9 sec, Toe el. = n/a
- ▶ Despite differences in shore features and wave parameters the upcoast and downcoast transect BFEs only differ by 1 ft.
 - Transects 35 and 37 both have a BFE of 18 ft
- ▶ A TWL reduction factor due to roughness from the cobble along the shoreline and bluff could be applied to the TAW calculations.
- ▶ Wave input parameters may not adequately characterize reduced nearshore wave heights due to oblique approach angles and influence of nearshore bathymetric features (i.e., headland).

5. Conclusion

The shore type varies significantly within this reach. Addition of a transect to capture the headland versus sandy beach may be warranted. Adjustments for oblique wave angle, slope roughness coefficient in the TAW runup calculations could reduce BFE at this transect.



Transect 36 (870) Profile and Runup Parameters



Oblique Aerial Image at Transect 36 (CCRP 2002)

TRANSECT NO. 37 (865) | Malibu La Costa Beach Club

1. Site Description

Wet sandy beach with some narrow dry reaches. Beach is backed by residential parcels with a mix of pile-supported structures and seawalls. No structure is included in transect, which appears to intersect a pile-supported structure.



Excerpt from PFIRM Panel 1542G (FEMA 2016)

2. Mapping

Preliminary

- ▶ PFIRM BFE (Primary VE Zone): 18 ft
- ▶ Overtopping Treatment: none
- ▶ Riverine Flood Zone: VE Zone is backed by Zone X

Effective

- ▶ Effective BFE: 14 ft
- ▶ Secondary Zone: VE zone is backed by AE zone with BFE of 14 ft, backed by Zone X

3. Transect Parameters

- ▶ Structure Treatment: Structures not accounted for in runup calculation or floodplain mapping due to their high elevations
- ▶ Runup method: All 145 Stockdon

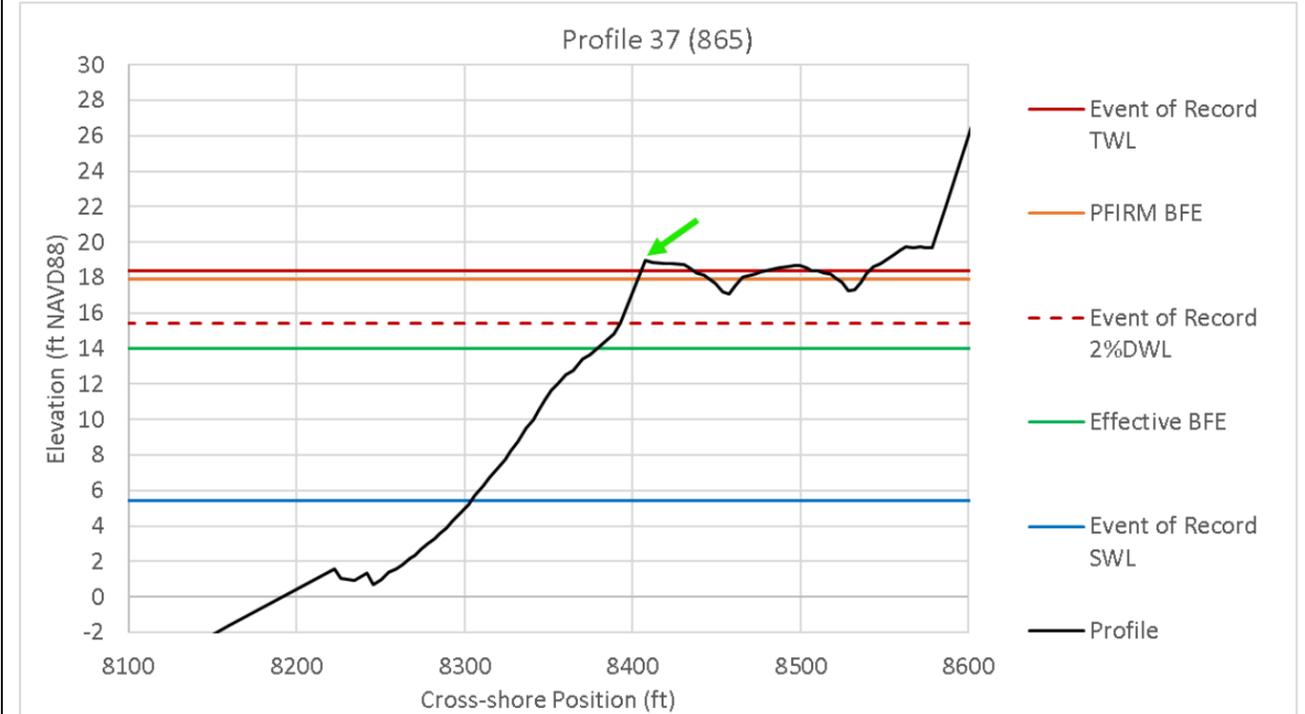
Profile Features		Event of Record and Runup Parameters								
Toe El. ft	n/a	Date/Time	SWL ft	H _o ft	T _p seconds	H _o /Depth	DWL2% ft	TWL ft	Slope (H:V)	Roughness Factor
Crest El. ft	17.2	3/2/83 11:00	5.4	14.4	15.9	0.933	15.4	18.4	9.7 : 1	n/a
Foreshore Slope (H:V)	9.7 : 1									
Face Slope (H:V)	n/a									

4. Analysis

- ▶ BFE is similar to event of record TWL.
- ▶ Transect assumes a beach sloping beneath the residential parcels with a crest near the outside south shoulder of PCH. This is not representative of conditions in the zone that has variable types of structures (pile supported and seawalls) spanning the entire beachfront.
- ▶ Event of record parameters vary between upcoast and downcoast transects.
 - Transect 36: 1/29/83 9:00, SWL = 7.3 ft, H_o = 8.3 ft, T_p = 11.9 sec, Toe el. = 8.2 ft
 - Transect 38: 3/1/83 23:00, SWL = 6.0 ft, H_o = 14.2 ft, T_p = 11.9 sec, Toe el. = 6.9 ft
- ▶ Wave input parameters may not adequately characterize reduced nearshore wave heights due to oblique approach angles and influence of nearshore bathymetric features.
- ▶ Stockdon Method does not have a reduction factor for oblique waves.
- ▶ The BFE at this transect is slightly lower than adjacent transects.
 - Transect 36: 19 ft
 - Transect 38: 20 ft

5. Conclusion

Variations in coastal protection and structures throughout this zone could influence the BFE for specific parcels in this zone. The location, type and condition of each structure would define the parcel specific BFE along this reach.



Transect 37 (865) Profile and Runup Parameters



Oblique Aerial Image at Transect 37 (CCRP 2002)

TRANSECT NO. 38 (859) | Duke's Malibu

1. Site Description

Narrow wet sandy beach backed by a rock revetment that fronts a commercial parcel. Still water reaches the revetment toe. The Las Flores Canyon drains to the west of this zone. The transect intersects the rock revetment.



Excerpt from PFIRM Panel 1542G (FEMA 2016)

2. Mapping

Preliminary

- ▶ PFIRM BFE (Primary VE Zone): 20 ft
- ▶ Overtopping Treatment: Merge V and A to extend VE Zone 32.7 ft beyond crest.
- ▶ Landward Extent of Secondary VE Zone 18.0
- ▶ BFE of Secondary VE Zone: 17.5 ft
- ▶ Riverine Flood Zone: VE Zone is backed by Zone X

Effective

- ▶ Effective BFE: 14 ft
- ▶ Secondary Zone: VE Zone is backed by AE zone with BFE of 14 ft, backed by Zone X

3. Transect Parameters

- ▶ Structure Treatment: Roughness factor is considered in the intact condition analysis and not in the failure condition analysis, but the TWL under the failure condition is lower than those under the intact condition
- ▶ Runup method: All 116 TAW

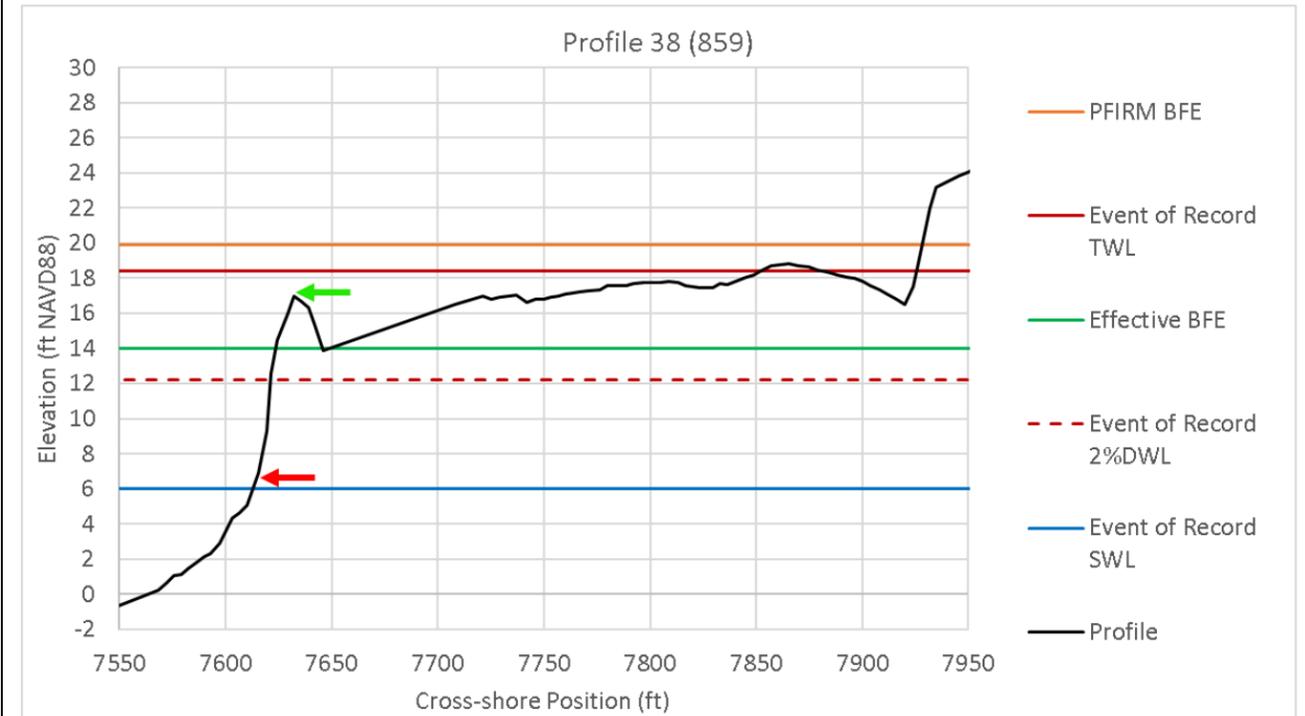
Profile Features		Event of Record and Runup Parameters								
Toe El. ft	6.9	Date/Time	SWL ft	H _o ft	T _p seconds	H _o /Depth	DWL2% ft	TWL ft	Slope (H:V)	Roughness Factor
Crest El. ft	17.0	3/1/83 23:00	6.0	14.2	11.9	2.695	12.2	18.4	1.7 : 1	0.6
Foreshore Slope (H:V)	4.7 : 1									
Face Slope (H:V)	1.7 : 1									

4. Analysis

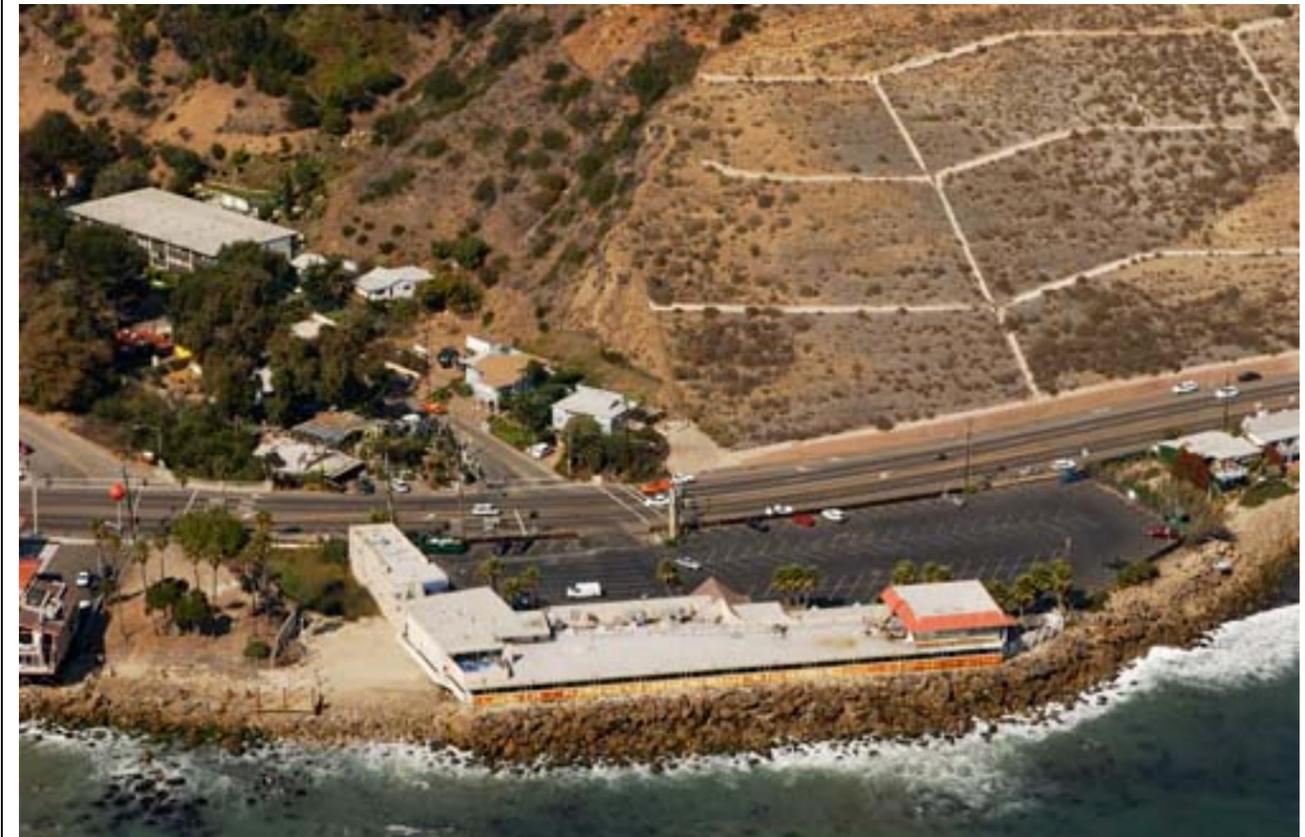
- ▶ BFE is based on intact condition calculations is 2 ft higher than the event of record, and is not justified by the TWL calculations
- ▶ Steep beach slope with DWL2% above toe; $TWL_{TAW} > TWL_{DIM}$ therefore, TAW runup method is appropriate for event of record.
- ▶ Event of record parameters vary from upcoast and downcoast transects.
 - Transect 37: 3/2/83 11:00, SWL = 5.4 ft, H_o = 14.4 ft, T_p = 15.9 sec, Toe el. = n/a
 - Transect 39: 3/2/83 11:00, SWL = 5.4 ft, H_o = 13.4 ft, T_p = 15.9 sec, Toe el. = 15.1 ft
- ▶ BFEs are lower for upcoast and downcoast transects, where Stockdon Method was used for calculating runup. At this transect, there is no beach and waves encounter the steep revetment slope, which explains the different runup method used.
 - Transect 37: 18 ft
 - Transect 39: 13 ft

5. Conclusion

The BFE is likely overestimated in this zone and not backed up by the TWL calculations in the IDS report. An appeal may be warranted to revise the BFE to match the TWL calculation for an intact revetment.



Transect 38 (859) Profile and Runup Parameters

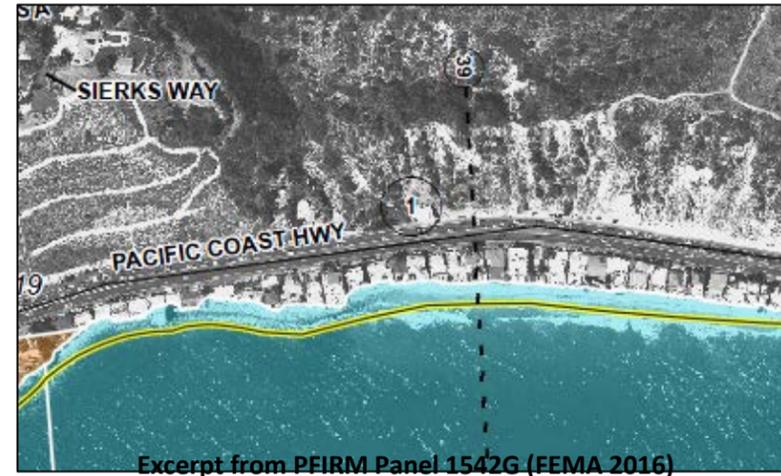


Oblique Aerial Image at Transect 38 (CCRP 2002)

TRANSECT NO. 39 (854) | Las Flores East

1. Site Description

Wet sandy beach backed by residential parcels with seawalls and pile-supported structures. Some cobble is visible in aerial imagery, and a nearshore reef is visible in the eastern end of the zone. Transect intersects a parcel with a seawall.



2. Mapping

Preliminary

- ▶ PFIRM BFE (Primary VE Zone): 14 ft
- ▶ Overtopping Treatment: none

Effective

- ▶ Effective BFE: 15 ft
- ▶ Secondary Zone: VE zone is backed by AE zone with BFE of 15 ft, backed by Zone X

3. Transect Parameters

- ▶ Structure Treatment: intact, but not factored into DIM calculations
- ▶ Runup method: All 119 DIM

Profile Features

Toe El. ft	15.1
Crest El. ft	28.4
Foreshore Slope (H:V)	6.3 : 1
Face Slope (H:V)	2.3 : 1

Event of Record and Runup Parameters

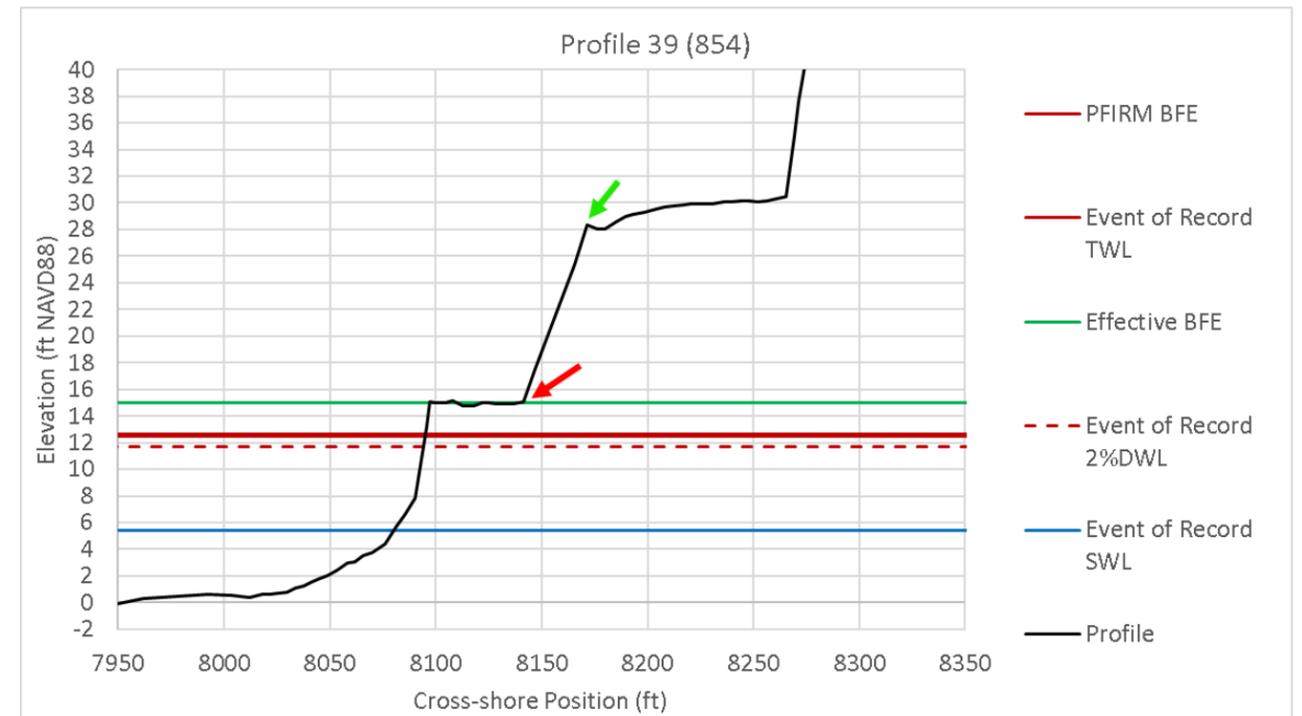
Date/Time	SWL ft	H _o ft	T _p seconds	H _o / Depth	DWL2% ft	TWL ft	Slope (H:V)	Roughness Factor
3/2/83 11:00	5.4	13.4	15.9	n/a	11.7	12.5	2.3 : 1	n/a

4. Analysis

- ▶ Shoreline conditions and transect features like the toe and crest are not correctly represented. If transect crest & toe were defined in a manner consistent with adjacent transects a different runup method (probably TAW) would have been applied, resulting in a BFE similar to adjacent transects.
- ▶ Event of record parameters vary from upcoast and downcoast transects.
 - Transect 38: 3/1/83 23:00, SWL = 6.0 ft, H_o = 14.2 ft, T_p = 11.9 sec, Toe el. = 6.9 ft
 - Transect 40: 1/29/83 9:00, SWL = 7.3 ft, H_o = 8.4 ft, T_p = 11.9 sec, Toe el. = 8.3 ft
- ▶ BFEs are significantly higher at the upcoast and downcoast transects even though their shore orientation and exposure is not significantly different.
 - Transect 38: 20 ft
 - Transect 40: 21 ft

5. Conclusion

The BFE is likely underestimated in this zone due to how the transect features (toe and crest) are characterized. The DIM runup method was exclusively applied to this transect and is not consistent with adjacent transects. Adjacent transects have similar orientation and exposure with a much higher BFE based on runup calculation using the TAW method.



Transect 39 (854) Profile and Runup Parameters

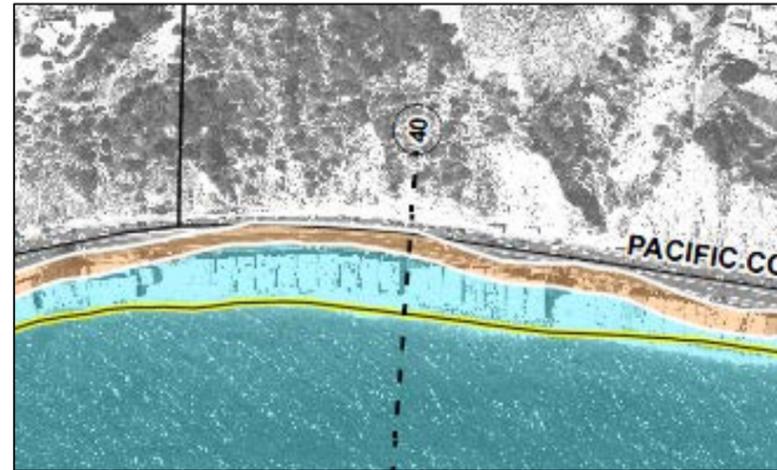


Oblique Aerial Image at Transect 39 (CCRP 2013)

TRANSECT NO. 40 (846) | PCH & Rockpoint

1. Site Description

Narrow wet sand beach with riprap and cobble in the foreshore. Shoreline is backed by residential parcels that are mostly pile-supported and some structures have seawalls. Quantities of cobble and riprap vary along shoreline. The transect geometry characterizes a bluff backed shoreline.



Excerpt from PFIRM Panel 1561G (FEMA 2016)

2. Mapping

Preliminary

- ▶ PFIRM BFE (Primary VE Zone): 21 ft
- ▶ Overtopping Treatment: Merge V and A to extend VE Zone 4.9 ft beyond crest
- ▶ Landward Extent of Secondary VE Zone: 0.6 ft
- ▶ BFE of Secondary VE Zone: 21.2 ft
- ▶ VE Zone is backed by Zone X (BFE 21.4 ft)

Effective

- ▶ Effective BFE: 15 ft
- ▶ Secondary Zone: VE zone is backed by AE zone with a BFE of 15ft, backed by Zone X

3. Transect Parameters

- ▶ Structure Treatment: Failed (rubble/riprap removed)
- ▶ Runup method: 30 TAW, 20 DIM

Profile Features

Toe El. ft	8.3
Crest El. ft	20.9
Foreshore Slope (H:V)	7.2 : 1
Face Slope (H:V)	5.3 : 1

Event of Record and Runup Parameters

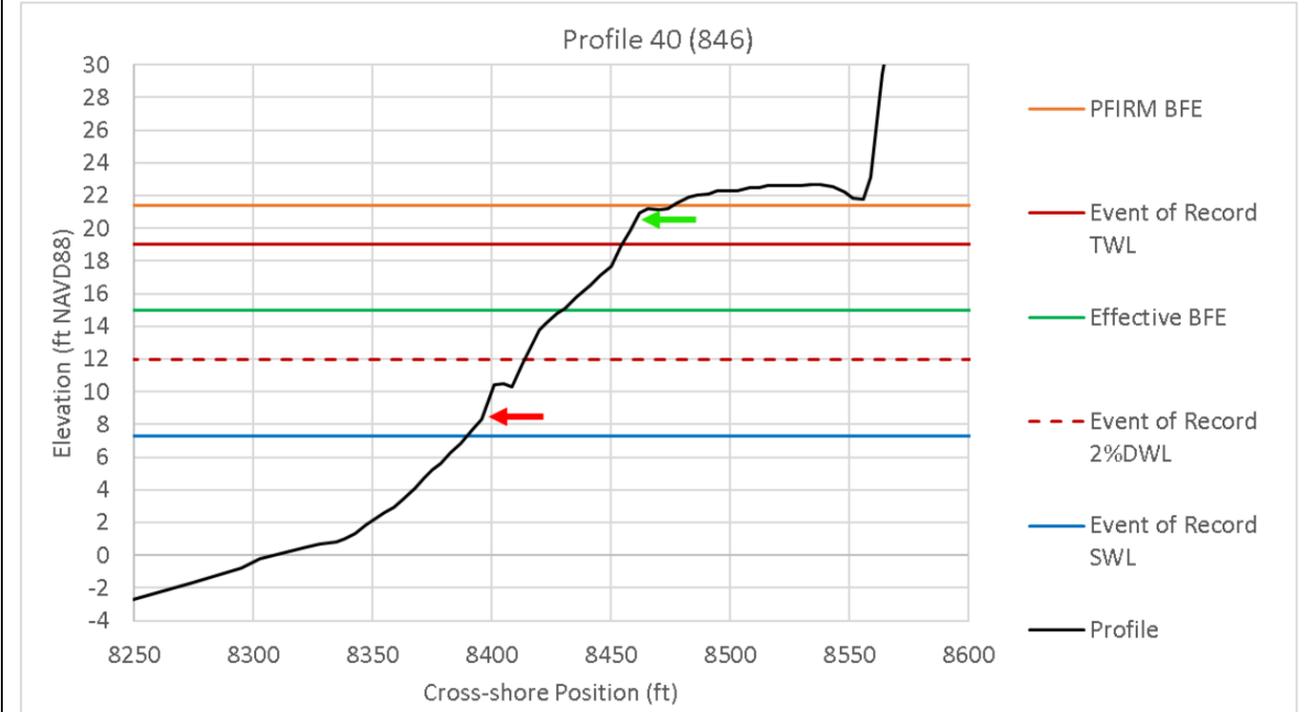
Date/Time	SWL ft	H _o ft	T _p seconds	H _o /Depth	DWL2% ft	TWL ft	Slope (H:V)	Roughness Factor
1/29/83 9:00	7.3	8.4	11.9	2.3	12.0	19.0	5.5 : 1	1.0

4. Analysis

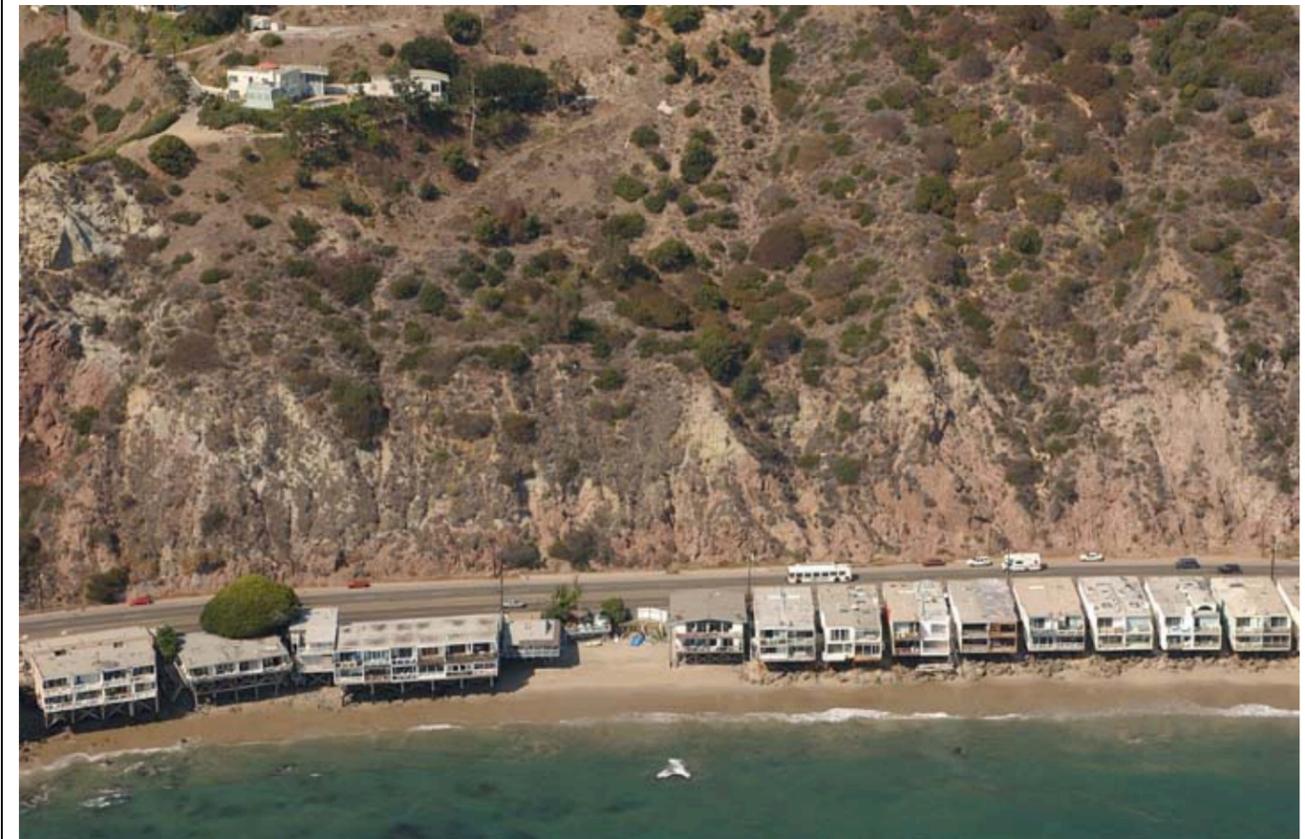
- ▶ BFE is 2 ft higher than the event of record TWL.
- ▶ Steep beach slope with DWL2% above toe; $TWL_{TAW} > TWL_{DIM}$ therefore, TAW runup method is appropriate for event of record.
- ▶ Wave parameters vary from upcoast and downcoast transects.
 - Transect 39: 3/2/83 11:00, SWL = 5.4 ft, H_o = 13.4 ft, T_p = 15.9 sec, Toe el. = 15.1 ft
 - Transect 41: 3/1/83 23:00, SWL = 6.0 ft, H_o = 11.2 ft, T_p = 11.9 sec, Toe el. = 5.6 ft
- ▶ BFEs for upcoast and downcoast transects:
 - Transect 39: 14 ft
 - Transect 41: 25 ft
- ▶ No roughness factor is assumed for the TAW runup calculations, which may overestimate some of the TWL calculations. Although the cobble and riprap is not a flood protection structure, it is persistent in the nearshore and unlikely to be carried offshore (as assumed "removed") during the 1% event. A composite roughness factor should be applied to the TAW runup calculations.

5. Conclusion

The BFE may be overestimated in this zone. The TAW runup calculations do not consider a roughness factor that can reduce the calculated TWL by several feet. The BFE considers a wave encountering a steep bluff behind the residential beachfront parcels. Variations in coastal protection and structures throughout this zone could influence the BFE for specific parcels.



Transect 40 (846) Profile and Runup Parameters

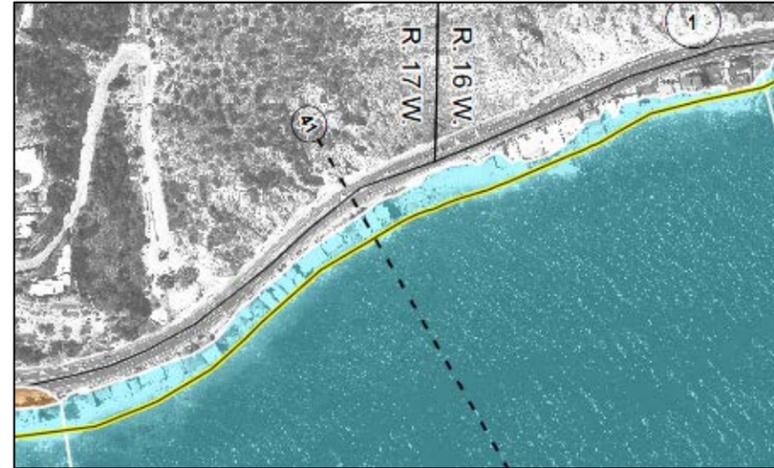


Oblique Aerial Image at Transect 40 (CCRP 2002)

TRANSECT NO. 41 (831) | Big Rock Beach

1. Site Description

Narrow wet sand beach with cobble and rock in the foreshore backed by residential parcels that are a mix of pile-supported structures and structures with seawalls. Big rock is a nearshore reef located at the western end of the zone. The transect depicts a steep bluff slope with the crest near the roadway.



Excerpt from PFIRM Panel 1561G (FEMA 2016)

2. Mapping

Preliminary

- ▶ PFIRM BFE (Primary VE Zone): 25 ft
- ▶ Overtopping Treatment: Merge V and A to extend VE Zone 15.3 ft beyond crest.
- ▶ Landward Extent of Secondary VE Zone: 3.9 ft
- ▶ BFE of Secondary VE Zone: 24 ft

Effective

- ▶ Effective BFE: 15 ft
- ▶ Secondary Zone: VE zone is backed by AE zone with a BFE of 15ft

3. Transect Parameters

- ▶ Structure Treatment: Failed (rubble/riprap and timber seawall removed)
- ▶ Runup method: All 109 TAW

Profile Features

Toe El. ft	5.6
Crest El. ft	23.8
Foreshore Slope (H:V)	8.5 : 1
Face Slope (H:V)	1.6 : 1

Event of Record and Runup Parameters

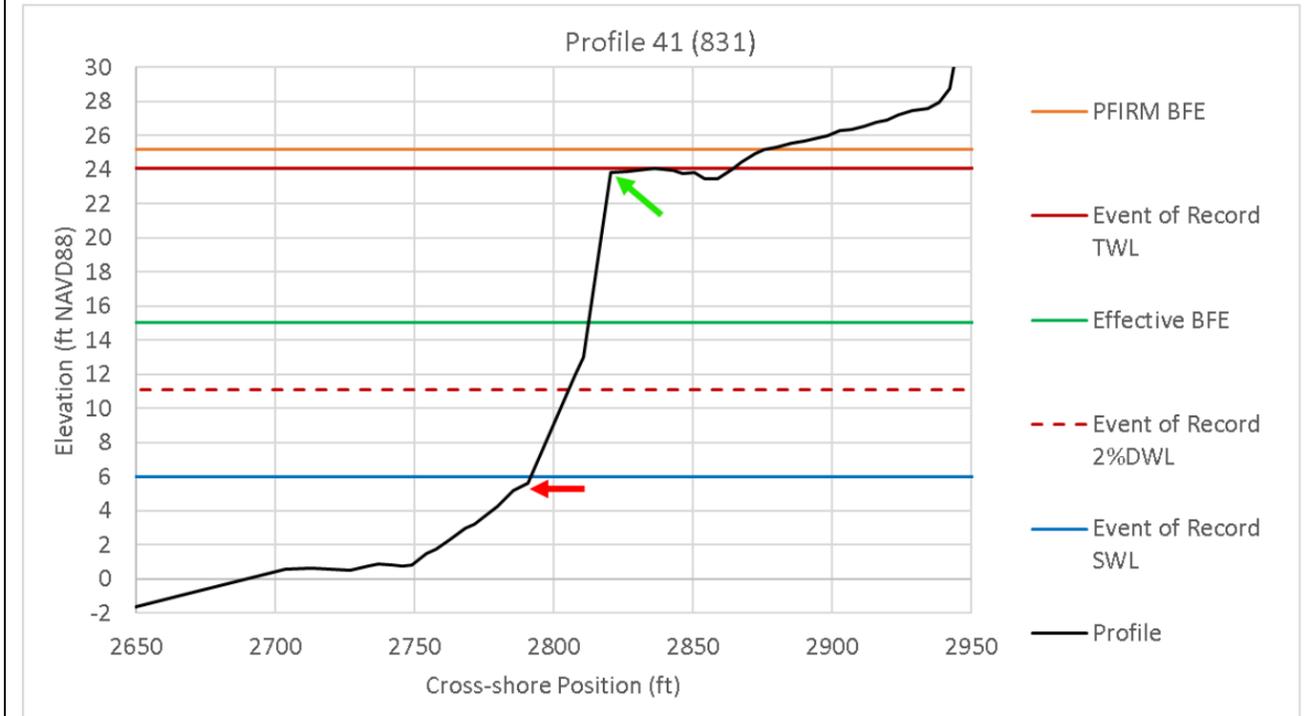
Date/Time	SWL ft	H _o ft	T _p seconds	H _o /Depth	DWL2% ft	TWL ft	Slope (H:V)	Roughness Factor
3/1/83 23:00	6.0	11.2	11.9	2.039	11.1	24.1	1.6 : 1	1.0

4. Analysis

- ▶ BFE is 1 ft higher than event of record TWL.
- ▶ Steep beach slope with DWL2% above toe; $TWL_{TAW} > TWL_{DIM}$ therefore, TAW runup method is appropriate for event of record
- ▶ Wave parameters vary from upcoast and downcoast transects even though time step is identical to transect 42 event of record.
 - Transect 40: 1/29/83 9:00, SWL = 7.3 ft, H_o = 8.4 ft, T_p = 11.9 sec, Toe el. = 8.3 ft
 - Transect 42: 3/1/83 23:00, SWL = 6.0 ft, H_o = 13.5 ft, T_p = 15.9 sec, Toe el. = 5.1 ft
- ▶ BFEs are lower at upcoast and downcoast transects: Transect 40 (21 ft) Transect 42 (22 ft)
- ▶ The oblique wave approach angle influenced by the nearshore bathymetry and headland feature was not accounted for in the analysis. A reduction factor applied to the TAW calculation for oblique waves could reduce BFE by up to 2 ft.
- ▶ This transect may not be representative of all structures and shoreline conditions in this zone. The geometry may be applicable to pile supported structures which are backed by the bluff, but is not representative of structures with seawalls.
- ▶ Although the cobble and riprap is not a flood protection structure, it is persistent in the nearshore and unlikely to be carried offshore during the 1% event. A composite roughness factor should be applied to the TAW runup calculations.

5. Conclusion

The BFE may be overestimated in this zone. The TAW runup calculations do not consider a roughness factor despite persistent cobble and riprap along the shoreline. Considering a roughness factor can reduce the calculated TWL by several feet. The steep bluff slope applied in the calculation can also over-estimates runup for structures with revetments or seawalls. An appeal may be warranted to lower the BFE with a proper roughness factor and oblique wave approach angle impact being considered.



Transect 41 (831) Profile and Runup Parameters



Oblique Aerial Image at Transect 41 (CCRP 2002)

TRANSECT NO. 42 (824) | Las Tunas Beach

1. Site Description

Cobble shoreline with few residential parcels. Transect intersects a revetment that fronts PCH.

2. Mapping

Preliminary

- ▶ PFIRM BFE (Primary VE Zone): 22 ft
- ▶ Overtopping Treatment: Merge V and A to extend VE Zone 31.1 ft beyond crest.
- ▶ Landward Extent of Secondary VE Zone 17.5 ft
- ▶ BFE of Secondary VE Zone: 24.7 ft. This secondary VE being higher than the primary BFE may be due to an error.

Effective

- ▶ Effective BFE: 15 ft
- ▶ Secondary Zone: VE zone is backed by AE zone with a BFE of 15 ft, backed by Zone X



Excerpt from PFIRM Panel 1561G (FEMA 2016)

3. Transect Parameters

- ▶ Structure Treatment: intact
- ▶ Runup method: 88 TAW, 46 Stockdon

Profile Features

Toe El. ft	5.1
Crest El. ft	23.0
Foreshore Slope (H:V)	9.3 : 1
Face Slope (H:V)	1 : 1

Event of Record and Runup Parameters

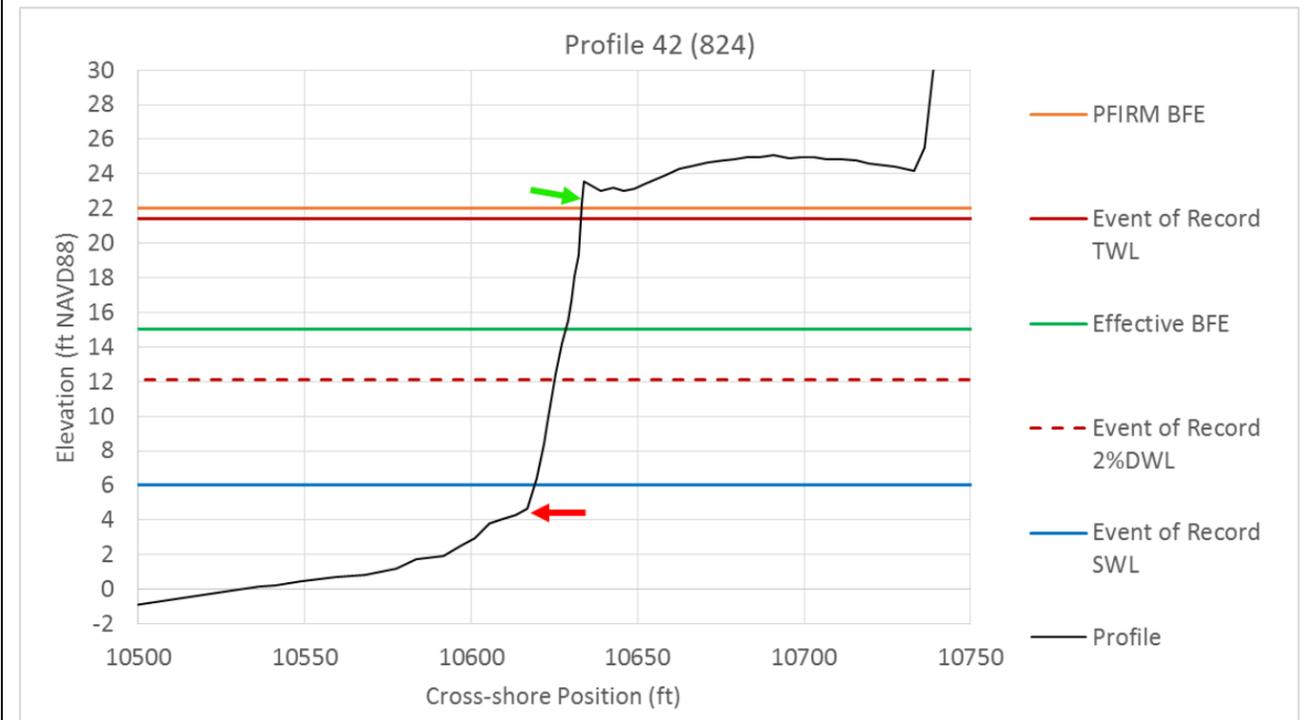
Date/Time	SWL ft	H _o ft	T _p seconds	H _o /Depth	DWL2% ft	TWL ft	Slope (H:V)	Roughness Factor
3/1/83 23:00	6.0	13.5	15.9	1.935	11.8	21.4	1 : 1	0.6

4. Analysis

- ▶ BFE is 1 ft higher than event of record TWL.
- ▶ Mild beach slope with DWL2% above toe; $TWL_{TAW} > TWL_5$ therefore, the TAW runup method is appropriate for event of record.
- ▶ Wave periods vary from upcoast transect for the same wave event and time.
 - Transect 41: 3/1/83 23:00, SWL = 6.0 ft, H_o = 11.2 ft, T_p = 11.9 sec, Toe el. = 5.6 ft
 - Transect 43: 3/1/83 23:00, SWL = 6.0 ft, H_o = 14.6 ft, T_p = 15.9 sec, Toe el. = 7.0 ft
- ▶ BFEs for upcoast and downcoast transects:
 - Transect 41: 25 ft
 - Transect 43: 24 ft
- ▶ This transect considers the revetment fronting PCH intact and assumes a roughness factor of 0.6. While this is a good assumption for the revetted section, only a small portion of the zone has a revetment. The cobble and rock in other portions of the zone are not as robust and should consider a lesser roughness reduction factor, which could result in higher TWLs.
- ▶ Same roughness value applied in both intact and failed TWL calculations.

5. Conclusion

The transect used to calculate the BFE characterizes a revetment that is not representative of conditions in the rest of the zone, particularly where structures are located. The BFE could vary at the residential parcels depending on their structural features and transect geometry.



Transect 42 (824) Profile and Runup Parameters



Oblique Aerial Image at Transect 42 (CCRP 2002)

TRANSECT NO. 43 (817) | Las Tunas Beach

1. Site Description

Narrow wet sand beach with small quantities of cobble and rock in the foreshore backed by residential parcels that are a mix of pile-supported structures and structures with seawalls. Transect intersects a pile-supported structure and depicts the bluff that backs the parcel.



Excerpt from PFIRM Panel 1562G (FEMA 2016)

2. Mapping

Preliminary

- ▶ PFIRM BFE (Primary VE Zone): 24 ft
- ▶ Overtopping Treatment: Merge V and A to extend VE Zone 27.3 ft beyond crest.
- ▶ Landward Extent of Secondary VE Zone 13.6 ft
BFE of Secondary VE Zone: 20.2 ft

Effective

- ▶ Effective BFE: 14 ft
- ▶ Secondary Zone: VE zone is backed by AE zone with a BFE of 14 ft, backed by Zone X

3. Transect Parameters

- ▶ Structure Treatment: n/a, no discussion of structures in IDS report or TWL calculations
- ▶ Runup method: All 50 TAW

Profile Features

Toe El. ft	7.0
Crest El. ft	18.9
Foreshore Slope (H:V)	8.5 : 1
Face Slope (H:V)	1.16 : 1

Event of Record and Runup Parameters

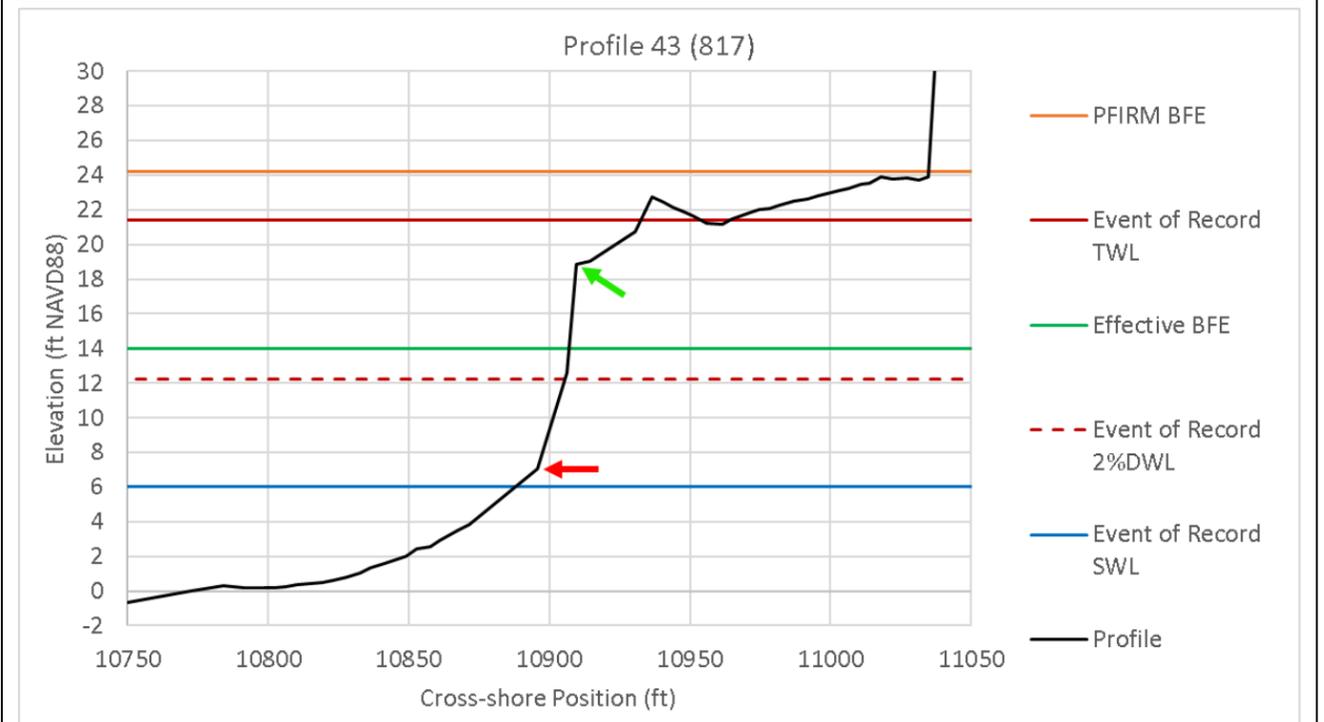
Date/Time	SWL ft	H _o ft	T _p seconds	H _o / Depth	DWL2% ft	TWL ft	Slope (H:V)	Roughness Factor
3/1/83 23:00	6.0	14.6	15.9	2.836	12.2	24.4	1.16 : 1	1.0

4. Analysis

- ▶ BFE is 0.4 ft less than event of record TWL.
- ▶ Steep beach slope with DWL2% above toe; $TWL_{TAW} > TWL_{DIM}$ therefore, TAW runup method is appropriate for event of record.
- ▶ Event of record parameters are similar to upcoast transect but differ from the downcoast transect.
 - Transect 42: 3/1/83 23:00, SWL = 6.0 ft, H_o = 13.5 ft, T_p = 15.9 sec. Toe el. = 5.1 ft
 - Transect 44: 1/27/83 7:00, SWL = 7.4 ft, H_o = 9.5 ft, T_p = 13.1 sec. Toe el. = 19 ft
- ▶ BFE differs significantly from downcoast transect, which has a wider sandy beach and a different runup (DIM) method was used.
 - Transect 42: 22
 - Transect 44: 13

5. Conclusion

The BFE considers a wave encountering the bluff behind the residential beachfront parcels. Variations in coastal protection and structures throughout this zone could influence the BFE for specific parcels in this zone. This BFE may not be representative for structures with seawalls.



Transect 43 (817) Profile and Runup Parameters



Oblique Aerial Image at Transect 43 (CCRP 2002)