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**Bluff Retreat Rates Analysis and
Response to March 24, 2014
California Coastal Commission Comments,
Newport Banning Ranch**

April 23, 2014

GMU Project 06-163-10



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TRANSMITTAL

BROOKS STREET

1300 Quail Street, Suite 100
Newport Beach, CA 92660

DATE: April 23, 2014

GMU PROJECT: 06-163-10

ATTENTION: Mr. Mike Mohler

WE ARE SENDING THE FOLLOWING:

Digital copy of our "Bluff Retreat Rates Analysis and Response to March 24, 2014
California Coastal Commission Comments," dated April 23, 2014.

DIGITAL COPY OF REPORT SENT TO:

Brooks Street
Attn: Rewdy Holstein

MConsensus
Attn: Marice White

Fuscoe Engineering
Attn: John Olivier

Dr. Jeffrey Johnson

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Mr. Mike Mohler, **BROOKSTREET**

Newport Banning Ranch Bluff Retreat Rates, Analysis and Response to CCC Comments

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INTRODUCTION

On March 13, 2014 a meeting was held at the California Coastal Commission's (CCC) office in Long Beach, California to discuss the Newport Banning Ranch (NBR) Coastal Development Application Number 5-13-032 and the two Notice of Incomplete Applications (NOIA) dated December 6, 2013 and February 7, 2014. During the meeting a history of the processes affecting bluff retreat rates (BRR) from 1874 to the present was presented, the BRR analysis, the rationale behind the selection of the recommended project BRR was discussed and the likely processes affecting the BRR during the 75 year design life of the project including the potential adverse effects of sea level rise was reviewed.

Several issues were raised, for purposes of discussion, including: (1) the use of variable BRR's for different sections of the bluff; (2) whether or not the existing Santa Ana River flood control improvements and the Coast Highway (PCH) can potentially "protect" the site from the estimated adverse effects of sea level rise; (3) should a time dependent BRR, that accounts for the potential future adverse effects of sea level, be used to compute the project bluff set back; and (4) will the recommended 60-foot bluff set back provide the desired level of safety assuming sea-level rise and a 75-year project life.

At the conclusion of the meeting CCC's staff requested documentation in support of the presentation. The request was formalized in a CCC e-mail dated March 24, 2014:

- 1) A bluff edge delineation, based on CCR Section 13577*
- 2) A quantitative analysis of the historic bluff edge retreat and its causes throughout the property. This should include the preparation of exhibits showing bluff position through time at various typical transects through the bluff. A justification for choosing a single average rate of 0.6 ft./yr., which does not represent the historic maximum, or even its average. A discussion of why expected future bluff retreat is expected to be lower than it has been in the past.*
- 3) A discussion of the effects of sea level rise, that includes an analysis of wave uprush forces during a 100 year wave event, including high tide, storm surge, as well as sea level rise.*
- 4) An analysis of the flood risk from the Santa Ana River during a 100-year flood event. This should include effects of higher sea level due to storm surge, high tides, and a 100-year wave event, and include the effects of sea level rise.*

Fusco Engineering surveyed the location of the bluff edge (Request No. 1) as shown on Plate 1. In response to Request No. 2 and for purposes of discussion the relative importance and history of the process affecting BRR was divided into four, sometimes overlapping, time periods: (1) pre-development; (2) channelization of the Santa Ana River and subsequent flood control improvements; (3) construction and widening of PCH and secondary roads; and (4) the 1943 discovery and development of the West Newport Oil Field. Requests 3 and 4 are also discussed below.

PROCESSES AFFECTING BLUFF RETREAT RATES PRE-DEVELOPMENT (1874 TO 1916)

Pre-development processes affecting NBR bluff erosion and retreat is documented on U. S. Coast Survey and U. S. Geological Survey topographic maps published between 1874 and 1901 respectively (Figures 1 and 2). During that time period bluff erosion and retreat was primarily the result of uncontrolled or natural surface drainage across the coastal tilted mesa and over the bluffs and fluvial erosion at the toe of the bluffs. A number of erosion gullies are visible on the mesa. The early topographic maps show the Santa Ana River at or near the toe of slope along the entire western and southern edge of the site. The location of the river channel appears to be due to the presence of a topographic high west of NBR (Figure 2) and a coastal barrier bar across the mouth of the Santa Ana River that extends from “Las Bolsas” to Newport Bay. It is likely the barrier bar was in existence for centuries precluding bluff erosion due to ocean waves (Figure 1).

The barrier bar appears to be a relatively stable protective structure due to the stabilization and subsequent slow rise of sea level in the last several hundred to several thousand years, sediment supply from the Santa Ana River and long shore transport of sediment to the south in the Newport Beach littoral cell that extends from Anaheim Bay to Corona del Mar (Pipkin and others, 1992). The construction of a branch of the Southern Pacific railroad, sometime between 1894 and 1900, along the barrier bar to the pier in Newport Beach suggests the sand bar was relatively stable. The tracks were removed sometime between 1951 and 1965. However, Pipkin and others (1992) indicated beach erosion became a problem only after construction of the jetties at the Santa Ana River and construction Prado Dam. Tides and storm surges, flowing into Newport Bay, may have affected site bluffs (Figure 2) at least up until the construction of PCH in the 1920's (Figure 3).

SANTA ANA RIVER FLOOD CONTROL IMPROVEMENTS

Between 1900 and 1916 the Santa Ana River was channelized and relocated to the west, no longer actively eroding the bluffs along the western edge of NBR (Figure 4). However, in 1916 there was no outlet across the barrier bar and the river was still a source of erosion along the

south facing bluffs. By 1927 jetties were constructed, allowing the Santa Ana River to flow directly into the ocean west of NBR (Figure 5). The levees, constructed before 1916, were not connected to the jetty system allowing fresh water and tidal flow to enter the wetlands and the older river channel(s) that drains toward Newport Bay (Figure 6).

The flood of March 1938, the result of “a series of storms, the greatest in 70 years” (Zielbauer, 1969), demonstrated the levee system was inadequate to contain Santa Ana River drainage and limit bluff erosion at NBR and regional flooding (Figure 7). Coastal flooding was exacerbated by the damming effect of the coastal barrier bar that is > 10 feet above sea-level (Figure 6 and Plate 2). In order to mitigate future flooding the levee system was improved and in 1941 Prado flood control dam was constructed (Figure 8). Subsequent to 1941 Prado dam has been improved providing additional flood control capacity.

The levee system near PCH was also improved. Today, two mechanical gates control river and tidal flow into the wetlands and the abandoned river channels west of NBR thereby controlling erosion even during levee-to-levee flow in the river (Figure 9). In addition, these mechanical gates are adjustable and can be re-configured in the future to adjust for increases in tides and sea level rise. The elevation of the eastern levee from just north of PCH to the northern edge of NBR ranges from 13.3 feet to 20.4 feet (Plate 2). The Santa Ana River flood control system, including Prado Dam, designed to contain a 190-year flood has eliminated the river as a source of erosion and prevents tidal flooding and erosion at NBR.

ROAD CONSTRUCTION AND IMPROVEMENTS

Roads on the mesa, east of NBR, are first evident on the 1901 USGS Quadrangle map (Figure 2). However, only “trails” existed on the NBR prior to the development of the West Newport oil field (Figure 7). The roads and associated development to the east of NBR, including farming, appear to have contributed surface drainage into the southwesterly draining gullies (Figure 10). Mapped trails on NBR first appear on the 1932/35 USGS Quadrangle maps (Figure 6). One of the trails is south of 16th St. the other is above the coast highway. Evidence of erosion due to trail use and surface flow along the trails is visible on the 1920’s and 1930’s aerial photographs (Figures 5 and 7).

Between 1900 and 1927 PCH was constructed on the landward side of the Santa River channel, that drains into Newport Bay (Figure 3), extending to the north on the landward side of the coastal barrier bar (Figure 6). A secondary road, visible on the 1931 aerial photos, was constructed, north of the coast highway, along the eastern edge of Semeniuk Slough and near the toe of the bluff (Figure 11). At the northern end the road connects with a trail on the mesa located south of 16th St.

During construction, of PCH and to a lesser extent the secondary highway, portions of the bluff were excavated reestablishing the toe of slope landward. Comparison of the 1927 and 1931 aerial photographs indicates the coast highway was widened and additional bluff was graded in the process (Figures 3 and 11). Review of aerial photographs, taken between 1927 and 1938, indicates road construction and improvements may have contributed to slope failures and erosion (Figures 3, 5, 7 and 11).

Currently, the coast highway is six-lanes. The expansion of the highway appears to have been completed prior to 1974 (Figure 12). Bluff slopes on the north side of the highway, visible in the 1974 USGS Orthophotoquad, appear to have been graded during the most recent widening process. The slopes appear to have stabilized and were apparently unaffected by the February-March rains of 1978 (CDMG, 1979). Slope erosion, above the highway, visible on aerial photos taken between 1993 and 2013 appears to be primarily related to the operation of the West Newport oil field (Figures 13 and 14).

PCH is located on the inland side of the barrier bar and extends southerly of the eastern property line to north of the Santa Ana River. The six-lane highway is therefore an important barrier to the potential adverse impacts of sea-level rise. Elevations along PCH range from approximately 10 to 15 feet. Locally, areas on the ocean side of PCH exceed the elevation of PCH and typically range two to three feet above PCH.

DISCOVERY AND DEVELOPMENT OF THE WEST NEWPORT OIL FIELD

The West Newport Oil Field (WNOF) was discovered in 1943. Aerial photographs taken in 1938 (Figure 7) show no evidence of activity on NBR other than farming. However, the 1949 USGS Newport Beach Quadrangle map (Figure 15) documents miles of roads, the location of 10's of oil wells and what appear to be storage tanks. The 1965 USGS Newport Beach Quadrangle (Figure 16) and the 1981 photo revised edition documents additional road construction and the installation of additional oil wells, on the mesa, as well as construction of buildings and additional storage tanks. The extent of WNOF development is visible on 1993 aerial photographs (Figure 13). Most of the grading for roads and drill pads is evident on the 1965 USGS Quadrangle map. Aerial images taken between 1993 and 2013 (Figures 13 and 14) indicate there has been re-vegetation of portions of the WNOF between roads and drill pads suggesting a recent reduction in erosion and possibly BRR.

PROCESSES AFFECTING BLUFF RETREAT RATE

The processes controlling bluff retreat and the rate of retreat has varied as a function of time since 1874 as shown in Table 1. Important processes included toe-of-slope fluvial erosion, bluff removal due to road construction, tidal action, development of the West Newport oil field and

uncontrolled surface drainage on the mesa. Historically, the processes caused gully and bluff erosion, bluff slope failure(s) and direct removal of bluff materials during road construction. Compelling evidence of historic bluff erosion due to ocean waves was not identified.

Table 1

Processes Affecting Bluff Retreat Rate¹	
1874 to Present	Affective Time Period
Erosion due to ocean waves	Pre-1874 (?)
Toe of slope fluvial erosion (Santa Ana River)	pre-1874 - 1938
Tidal action	Pre-1874 - ≤1965
Toe of bluff road construction	Pre-1927 - 1974
Oil Field development	1943 – ≈1965
Uncontrolled drainage across mesa	Pre-1874 - present
Future	
Controlled mesa drainage (<100%)	Project Completion + 75 yrs.
Sea Level Rise	?

1 Refer to attached Chronology

Review of Table 1 indicates, historically, the largest amount of “natural” bluff erosion and retreat occurred prior to 1965, direct removal of bluff, due to road construction, was complete by 1974 and the primary processes controlling bluff erosion and retreat currently are oil field grading and maintenance and uncontrolled drainage across the mesa, into gullies and over the bluffs.

Estimating BRR based on 1932 and 1965 data and maps, as was done in our prior study, captures a critical period with the largest number of processes affecting erosion rates. In summary, the project BRR was estimated by measuring separation between the 75-foot contour lines surveyed by the U. S. Geological Survey in 1932 and revised in 1965; a 33-year period. The measurements were made along the westerly bluff, generally between 16th St. and 18th St. The average BRR was approximately 2 ft./yr. The rate ranged from 0.6 ft./yr. to 4.2 ft./yr. The recommended rate, 0.6 ft./yr., was selected based on the change and reduction in the processes affecting BRR, as a function of time (Table 1), and the benefits of surface drainage control, on the mesa, upon completion of the NBR project.

BLUFF RETREAT RATE 75-YEAR PROJECT DESIGN LIFE

Surface drainage across the mesa, into gullies and over the bluffs will be mitigated, upon completion of the NBR project, thereby improving some of the natural drainage conditions and issues related to the development and operation of the oil field. It is our understanding there is no current plans to widen PCH or construct other public roads that could adversely impact the bluffs. Other than surface drainage the primary processes that could potentially affect BRR, over the 75-year project design life, is flooding and the impacts due to sea-level rise.

FLOODING

The Santa Ana River flood control system consists of a series of flood control dams, reservoirs, weirs, levees and tidal gates that contain and control the drainage near the coast and the mouth of the river (Figure 14). A portion of the flood control system was constructed in response to the flood of 1916 (Figure 4) and was further improved, due to flooding in 1938, with the construction of Prado Dam in 1941. Flood events between 1978 and 1983 caused a new analysis of the entire system resulting in the US Army Corps of Engineers (USACOE) Santa Ana River Mainstem Project. The Mainstem project included significant flood control improvements from the coast all the way upstream to Prado Dam to increase the river capacity to a 190-year protection level. The portion of the channel from the ocean outlet upstream to 17th Street in Santa Ana has been widened, deepened and entirely lined with reinforced concrete. Currently, the flood control system adjacent and upstream of the project is designed to contain the 190-year flood. The flood capacity improvements for this reach were completed in the early 2000's. Additional work is being conducted upstream from Yorba Linda to Prado Dam and is expected to be completed by 2020.

In response to CCC request No. 4 Fuscoe Engineering produced Plate 2- Baseline Inundation Level for Bluff Retreat and Sea Level Rise. The 100-year flood waters, shown on the plate, are from local inland tributary areas and are not from the Santa Ana River or Pacific Ocean. During large storm events, the tidal gates effectively close off the system and do not allow local flood waters to enter the Santa Ana River system and vice versa; tidal flows and SAR flows are not allowed to enter the NBR inland areas.

SEA LEVEL RISE

The potential impacts from sea-level rise are basically those that affect the erosion of coastal bluffs today including wave erosion, flooding, inundation, storm surge and low-pressure systems, and temperature driven water elevation change due to El Niño's (ENSO) and the Pacific Decadal Oscillations (PDO).

The CCC (2013) has developed guidelines to help estimate if a tipping point might occur during the project design life. The first step in the CCC guideline is to establish the project life. In this case the project life is considered 75 years based on CCC concurrence. The second step is to establish the range in projected sea-level rise for the duration of the project or 75 years. According to the CCC (2013) the best currently available study on sea-level rise, for California, was conducted by the National Research Council (NRC) Committee on Sea-level Rise in California, Oregon and Washington (2012). Assuming subsidence of approximately 0.04 inches/year the NRC estimated sea-level rise, south of Cape Mendocino, California, for the three time periods as shown in below in Table 2.

Table 2

<u>Years</u>	<u>Range of Sea-Level Rise (ft.)</u>	<u>Rate of Sea-Level Rise (ft./yr.)</u>
2000-2030	0.13 – 0.98	0.004 - .033
2000-2050	0.39 – 2.0	0.0078 - .04
2000-2100	1.38 – 5.48	0.0138 – 0.0548

Note that the estimated rate of sea-level rise increases as a function of time (i.e., non-linear relationship). Heberger and others (2009, Figure 2), based on the work of Cayan and others (2009), also estimated end of the century sea-level rise that ranged from approximately 3.28 feet (1 m) to 4.59 feet (1.4 m). By the year 2075 their sea-level rise estimate is approximately 2.89 feet (0.85 m).

Sea-level rise is only one of a number of processes potentially affecting estimated project high water levels. Other processes include tides, storm surge (wind and low atmospheric pressure effects), flooding and water temperature/volumetric changes due to the El Nino-Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO).

For purposes of this analysis processes affecting future water levels were divided into two categories: “fixed” and “short duration” (Table 3). The “fixed” processes include sea-level rise (i.e., estimated amplitude, in feet, of sea-level rise by a specific year), daily ocean tides and ENSO. ENSO was included with the “fixed” processes because the affects can last months and occur multiple times with in a 10-year period. The “short duration” processes (i.e., low pressure, storm surge, and storm wave) are generally related or caused by variations in atmospheric conditions and occur episodically with varying degrees of impact on still water levels.

A tide gauge is located at the entrance (inside) to the Santa Ana River (33.6300° N, 117.9583°W). The tide chart for the year 2013 is included as Appendix A.

Analysis of the data indicates the relative sea level change due to the annual high tides ranges from 1.46 to 3.83 feet. There is a maximum of three high tides per day. The average of the annual high tides, or approximate mean high water, is 2.55 feet. The median is 2.54 feet. For conservative purposes, the City of Newport Beach Tide Planes and Tidal Data Relationships (July 2004) was referenced to identify the Mean Higher-Water (MHHW) which is consistent with the baseline parameters used in the Pacific Institute study. This results in a starting tidal elevation of 5.02 feet. (NAVD88 vertical datum) which is nearly twice the mean or median values.

Table 3**Local Water Level Controlling Processes**

"Fixed" Process	Range (feet)	Duration	Frequency
Estimate No. 1			
Sea-Level Rise (CCC, 2013)			
2000-2100	1.38	5.48	
Mean Higher High Tide (MHHW)	5.02'	5.02	
ENSO	<u>1.5</u>	<u>1.5</u>	Months
Subtotal	7.9'	12'	2-7 years
Average	9.95		
Estimate No. 2			
Sea-Level Rise			
Heberger and others (2009)			
2000-2100	3.28	4.59	
Mean Higher High Tide (MHHW)	5.02'	5.02'	
ENSO	<u>1.5</u>	<u>1.5</u>	Months
Subtotal	9.8'	11.11	2-7 years
Average	10.46		
Estimate No. 3			
Heberger and others (2009)			
2075		2.89	
Mean Higher High Tide		5.02'	
ENSO		<u>1.5</u>	Months
Subtotal		9.41'	2-7 years

"Short Duration" Processes

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Newport Banning Ranch Bluff Retreat Rates, Analysis and Response to CCC Comments

Storm Surge	2	3	Day(s)	Multi Events/yr.
Low Pressure	1.5	1.5	Day(s)	Multi Events/yr.
Storm Waves	<u>3</u>	<u>15</u>	< 1 day	Multi Events/yr.
Total	6.5	19.5		

Ref:

CCC (2013) Tables 1 and 15

2013 Santa Ana
River Tide Chart

Heberger and others (2009)
Figure 2

By the year 2075 “fixed” still water levels (Estimate No. 3) will not exceed the current elevation of either the Santa Ana River levee system or PCH. In addition, as shown on Plate 2, the 100-year flood will not impact the site bluffs as there is an approximately three foot buffer between existing flood conditions and the toe of the existing bluffs.

The three “short duration” processes that affect local water levels, shown in Table 3, were taken from CCC Table 15 (CCC, 2013). Because these processes are a function of atmospheric conditions and/or oscillations of the ocean-atmosphere system the timing, size and whether or not they occur at the same time or even during the same time period is difficult to predict. The occurrence of the three, at the same time, is considered a low probability short-term event that would not alter the long term BRR. For example, the addition of approximately 4 feet. (average storm surge and low pressure effects) to the 9.41-foot Estimate No. 3 (i.e., total of 13.41 feet.) could potentially cause localized flooding but not erosion (Plate 2). The addition of storm waves could potentially cause additional flooding assuming an average value of 9 feet. However, the short-term exposure to storm waves, the fact that the large waves would break at distance from the toe of the bluffs, due to existing structures (PCH, Santa Ana River levees, dry beach), and the loss of wave energy as the waves spill toward the bluffs indicates storm waves would also not alter the long term BRR.

POTENTIAL IMPACTS OF SEA-LEVEL RISE SCENARIO BASED ANALYSIS

The bluffs at NBR are not currently and there are no data to suggest they were historically affected by erosion due to ocean waves. Currently, the subject inland site is protected, from ocean waves, by the existing beach, PCH, the Santa Ana River flood control system and

development inland and southerly of PCH. Flooding and tidal effects are controlled by the Santa Ana River flood control system that includes levees, tide gates and flood control dams. The flood control system is designed to contain the 190-year flood (Plate 2).

During the 75-year life of the project the existing beach and barrier bar could migrate inland due to the impacts of sea-level rise unless the dry beach is adequately maintained or replenished. However, PCH and the Santa Ana River flood control system will not migrate and will dissipate storm wave energy and therefore provide protection from wave erosion.

For purposes of discussion site bluffs were divided into two sections: western and southern. The western section is along the east side of the Semeniuk Slough. The southern section is adjacent and north of PCH. There are several high water level scenarios that should be considered during the 75-year project life.

1. Still water levels, increased by the “fixed” processes (Estimate No. 3, Table 3), do not result in overwash of PCH or the levees but flooding and possibly overwash, due to a combination of “short duration” processes can potentially occur episodically. Because of the short duration of expected flooding and the very limited fetch and shallow depth of water, inland of PCH, significant waves would not develop and there will be little or no effect on the western bluffs. PCH and the elevated land area south of PCH will protect the southern bluffs, from wave erosion (Plate 2)
2. Still water levels, increased due to “fixed” processes, reach the maximum potential 2100 levels (Estimate No. 2) result in potentially more frequent flooding and inundation, due to a combination of “short duration” processes, than noted in scenario number one. The short duration of expected episodic events, the very limited fetch and shallow depth of water inland of PCH, and the ability of PCH and the flood control system to dissipate wave energy (i.e., act as a breakwater) indicates significant wave erosion would not develop along the western bluffs (Plate 2). The 13.5 to 15.8 foot elevations of the land area on the ocean side of PCH, the elevation of PCH, and the hundreds of feet separating the coast from PCH, indicate large storm waves would break at some distance from the southern bluffs thereby mitigating wave uprush forces (Plate 2). The ability of PCH and the flood control system to dissipate wave energy is reduced but not zero. The size of the fetch is a function of the ability of PCH and the flood control system to dissipate wave energy.

BLUFF RETREAT RATE ANALYSIS

In response to CCC data request No. 2 an analysis of BRR's was conducted. The analytical procedure utilized is summarized below:

- Identified the most accurate and relevant historical topographic maps for use in the BRR analysis. The following maps were selected: 1901, 1935, 1951, 1965 and 2011.
- Evaluated the selected topographic maps to determine base coordinate systems used.
- Determined that the selected maps used should be in or converted to the NAD 1927 Zone VI coordinate system for accurate comparison.
- Analyzed and categorized all topographic features in the pre-1927 topographic map (i.e., 1901) that could be used with the post 1927 maps – i.e., for overlay comparison.
- Rectified all maps with two key intersecting longitude and latitude points on opposite corners of the map and verified all other points within project boundaries.
- Identified all horizontal monuments and further corrected all of the maps overlay accuracy. PCH was used as a primary alignment feature.
- Identified 3 representative bluff sections for use in the bluff retreat analysis.
- Identified 3 representative elevation contour elevations for overlay comparison to determine bluff retreat rate. The selected elevations were: 25', 50' and 745 contour levels.
- Overplayed selected coordinate corrected contour maps using all relevant monuments and coordinates. Then digitized selected contour lines to determine bluff retreat rate (BRR) at selected bluff sections.

Incremental BRR determined from the above analytical procedure are summarized in Appendix A -- 2013 Tide Table. Shown on Figure 18A to 18D are the locations of the BRR measurements (i.e., Sections 1, 2 and 3) and the contours representing five different time periods (i.e., 1901, 1935, 1951, 1965 and 2011).

Table 4**Banning Ranch Historical Topography Comparison Tables**

1901 to 1935				
Time Range (yrs.)	Points	Contour	Retreat Distance (ft.)	Bluff Retreat Rate (ft./yr.)
34	1	25	135	3.97
34	1	50	15	0.44
34	2	25	163	4.79
34	2	50	83	2.44
34	3	25	251	7.38
34	3	75	184	5.41
				Average = 4.07
				Range = 0.44 – 7.38
1935 to 1951				
Time Range (yrs.)	Points	Contour	Retreat Distance (ft.)	Bluff Retreat Rate (ft./yr.)
16	1	25	54	3.38
16	1	50	71	4.44
16	2	25	57	3.56
16	2	50	22	1.38
16	3	25	80	5
16	3	75	90	5.63
				Average = 3.89
				Range = 1.38 – 5.63
1951 to 1965				
Time Range (yrs.)	Points	Contour	Retreat Distance (ft.)	Bluff Retreat Rate (ft./yr.)
14	1	25	18	1.29
14	1	50	11	0.79
14	2	25	8	0.57
14	2	50	8	0.57
14	3	25	0*	0*
14	3	75	0*	0*
				Average = 0.53
				Range = 0.57 – 1.29
1965 to 2011				
Time Range (yrs.)	Points	Contour	Retreat Distance (ft.)	Bluff Retreat Rate (ft./yr.)
46	1	25	0	0
46	1	50	7.33	0.16
46	2	25	23	0.5
46	2	50	20	0.43
46	3	25	67	1.46
46	3	75	63	1.37
				Average = 0.65
				Range = 0 – 1.46
*Bluff accretion noted likely due to local slumping. Retreat noted as zero and excluded from Bluff Retreat Rate.				

In order to determine if bluff erosion changed as a function of time (Table 1) the resultant BRR measurements were averaged as a function of the three contour elevations and the four non-overlapping time period and tabulated below in Table 5.

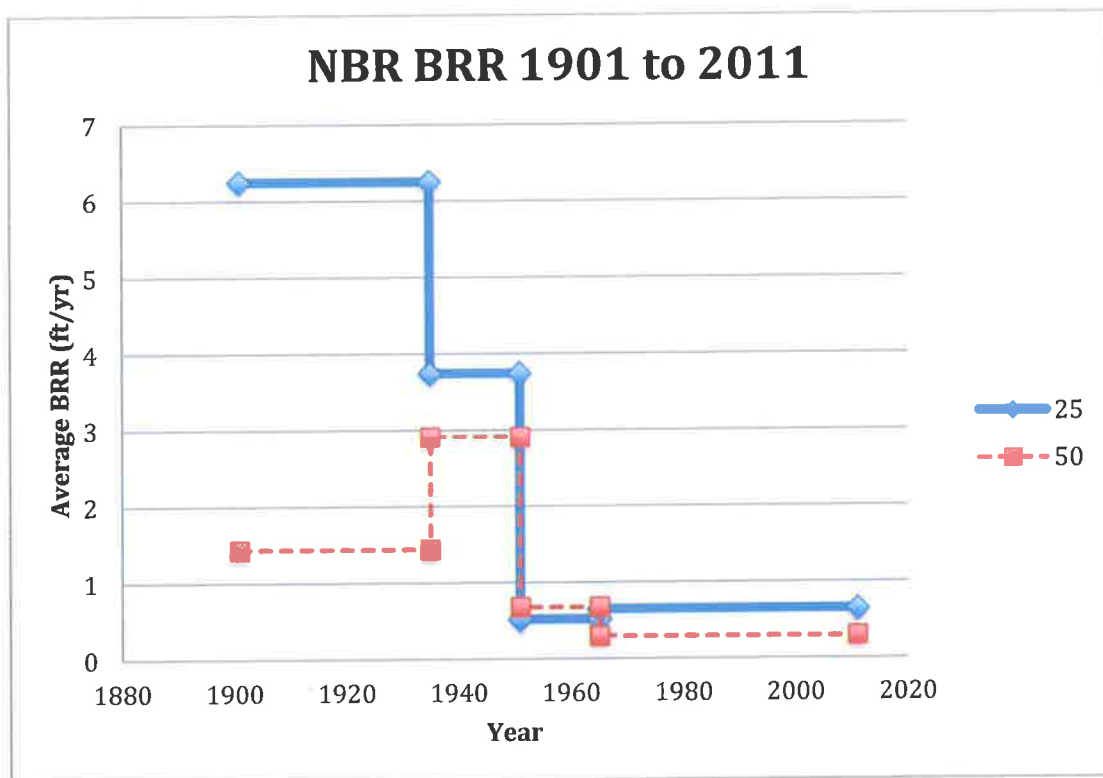
Table 5

Average BRR (ft/yr)

CI	1901	1935	1935	1951	1951	1965	1965	2011
25	6.25	6.25	3.74	3.74	0.52	0.52	0.65	0.65
50	1.44	1.44	2.91	2.91	0.68	0.68	0.3	0.3
75	3.81	3.81	3.19	3.19	0.535	0.535	1.37	1.37

The 25-foot and 50-foot contour data were then plotted in Chart 1.

Chart 1



The 25-foot and the 50-foot contours are shown because the potential effects of sea level rise will concentrate erosion near the toe of the bluffs. The average BRR data from 1901 to 2011 decreases as a function of time with the larger rates occurring in the 1945 and older time periods.

SUMMARY OF RESPONSES TO CCC DATA REQUEST

1) A bluff edge delineation, based on CCR Section 13577

The bluff edge is delineated on Plate 1.

2) A quantitative analysis of the historic bluff edge retreat and its causes throughout the property. This should include the preparation of exhibits showing bluff position through time at various typical transects through the bluff. A justification for choosing a single average rate of 0.6 ft./yr., which does not represent the historic maximum, or even its average. A discussion of why expected future bluff retreat is expected to be lower than it has been in the past.

A quantitative analysis of BRR, which affects the location of the bluff edge, was conducted by measuring the distance between elevation contours (Figures 17A to 17D) represented by the four non-overlapping time periods (Table 4). The measurements at the three transects (Points 1, 2 and 3) were tabulated and are shown in Table 4. The resultant BRR measurements were averaged as a function of the three contour elevations and the four non-overlapping time periods and tabulated in Table 5. The BRR for the 25-foot and 50-foot contours were then plotted on Chart 1. The 25-foot and 50-foot contours were selected because they are potentially directly affected by sea-level rise. The data indicate there was a large reduction in BRR as a function of time as noted above and shown in Table 1.

Over the last 60 years the BRR has stabilized (Table 5 and Chart 1). BRR today is primarily affected by uncontrolled surface drainage on the coastal tilting mesa. The drainage will be improved upon completion of the NBR project. The average BRR, over the last 60 years (i.e., 1951 to 2011) supports the use of the recommended design BRR of 0.6 ft./yr.

Sea-level rise could potentially affect BRR if the “short duration” effects are added to the “fixed” effects (Table 3). For example, the average of the three “fixed” process estimates ranges from 9.41 to 10.46 feet. It should be noted the average values are projected to occur near or beyond the 75-year design life of the project. Based on the existing elevations (Plate 2) and the wave protection capabilities of PCH and the Santa Ana River levees estimated “fixed” sea-level rise would not adversely affect BRR at NBR.

The addition of water elevation changes due to average “short duration” processes (Table 3), to the estimated average “fixed” values, could potentially cause flooding inland of PCH and east of the Santa Ana River levees. However, existing flood control facilities and wave protection

provided by PCH, etc. precludes flooding today and for decades in the future. The “short duration” processes include storm surge (2 to 3 feet), low pressure affects (1.5 feet) and storm waves (3 to 15 feet). Storm surge and low pressure affects, taken together, would add approximately 4 feet to the “fixed” still water levels bring the average range to approximately 13.41 to 14.46 feet. These water levels could potentially result in localized flooding (Plate 2) but not affect the recommended BRR. The addition of storms waves (i.e., 3 to 15 feet) could potentially exacerbate flooding and cause erosion at the toe of the bluffs. The adverse effects would be mitigated by PCH and the Santa Ana River levees and the shallow water levels that would be present between the existing coastline and the toe of the bluffs (Plate 2). The shallow water would extend 100’s of feet ocean ward, from the toe of the bluffs, causing potentially large erosive waves to become unstable and break at or ocean ward of PCH and then spill toward the bluffs.

If erosion at the toe of the bluff, due to ocean waves were to occur, the bluff edge, generally located in the terrace materials, would not be affected for years or possibly 10’s of years because the terrace (Q_{tm})/bedrock (Q_{sp}) contact is located 10’s of feet inland from the toe of the bluffs (Geologic Cross Sections 6, 7, 9 and 10; GMU, Inc. July 2011). In order for wave erosion to adversely affect the location of the bluff edge the terrace/bedrock contact would have to migrate inland.

In summary, the future BRR will be less than historic high values (Tables 4 and 5) and approximately equal to the stabilized values observed over the last 60 years of 0.6 ft./yr. (Table 5 and Chart 1) because: (1) surface drainage will be the primary source of bluff erosion during the 75-yr project life; (2) “fixed” still water levels will not adversely affect BRR over the next 75 to 100 years; (3) the large area of potential shallow water that may occur due to the combined effects of “fixed” and “short duration” processes on water levels will preclude large ocean waves from breaking at or near the toe of the bluffs; and (4) 10’s of feet of bedrock would have to be eroded before the terrace bedrock contact or the bluff edge would begin to migrate inland. A single BRR value of 0.6 ft./yr. is therefore justified for the entire 75-year design life of the project.

- 3) *A discussion of the effects of sea level rise, that includes an analysis of wave uprush forces during a 100 year wave event, including high tide, storm surge, as well as sea level rise.*

The results of our analysis indicated the potential increase in still water levels, due to the combined effects of tides, storm surge and sea-level rise (i.e., 9.41 to 10.46 feet) would not adversely affect the recommended design BRR (Plate 2). Resultant flooding cannot be precluded. However, as noted above the large flooded shallow water area, ocean ward of the bluffs, would cause the storm waves to break at distance from the bluffs and then spill with minimal energy toward the bluffs. Wave uprush forces would be minimal, occur over a short time period and not significantly affect the recommended long term BRR.

- 4) *An analysis of the flood risk from the Santa Ana River during a 100-year flood event. This should include effects of higher sea level due to storm surge, high tides, and a 100-year wave event, and include the effects of sea level rise.*

During our analysis of the “flood risk” the 1938 flood was considered an analog. During the 1938 flood the bluffs were eroded due to a combination of river flow and surface drainage from the mesa (Figure 7). In addition, during the flood the barrier bar remained, protecting bluffs from storm surge, tides and ocean waves but allowing river flow to be a maximum due to the lack of interaction with the ocean. For example, when a river flows into a body of water it will slow down and deposit its sediment load.

It is our understanding the Santa Ana River flood control system is designed to contain a 190-year flood event assuming a MHHW of 5.02 ft. The 5.02 ft. exceeds the average relative annual high tide levels, at the mouth of the Santa Ana River, by 1.19 ft. to 3.56 ft. (2013 Tide Table – Appendix A) thereby including the effects of “high tides” and mitigating the effects of “storm surge.” If the effects of flooding due to high river flow and future high ocean levels combine and interact, as suggested in No. 4 above, the adverse effects will be minimal and occur over a short period of time. For example, the river flow will slow, as it enters into the area flooded by the ocean thereby mitigating its erosive force. In addition, the volume and velocity of river flow will mitigate the potential adverse effects of the ocean waves most notably when the volume and rate of flow is the greatest.

In summary, the potential for flooding as noted above cannot be precluded during the 75-year life of the project. However, the “flood risk” from the Santa Ana River combined with the “fixed” and “short duration” processes noted in No. 4 will have a minimal effect on the BRR because: (1) the Santa Ana River flood control system is designed for a 190-year flood; (2) river flood waters flowing into elevated ocean waters will slow or reduce its erosion potential and deposit sediment; (3) the potential for ocean waves to increase bluff erosion, due to the deeper river flood waters near the bluffs will be mitigated by the ocean ward flow of water from the river; (4) the duration of the “flood risk” event is short; and (5) the adverse effects of surface drainage will be mitigated upon completion of the project.

Mr. Mike Mohler, **BROOKSTREET**

Newport Banning Ranch Bluff Retreat Rates, Analysis and Response to CCC Comments

CONCLUSION

The 60-foot bluff set back provides adequate protection for the proposed development taking into account the potential impacts of sea-level rise.

Sincerely,

GMU GEOTECHNICAL, INC.



A handwritten signature in cursive script that reads "Jeffrey A. Johnson".

Jeffrey A. Johnson, Ph.D., PG, CEG 981
Professional Geologist

A handwritten signature in cursive script that reads "Gregory P. Silver".

Gregory Silver, M.Sc., PE, GE 2336
Civil Engineer
Geotechnical Engineer
President

REFERENCES

Aerial Photographs/Images

Fairchild Aerial Photograph Collection

<u>Date</u>	<u>Flight Number</u>	<u>Frame Numbers</u>	<u>Scale</u>
1927	C-113	716,717,763,764	1" = 1500'
1928	C-278	#2 B: 8,9,10	1" = 2000'
5/22/31	C-1590	33, 34, 35	1' = 1500'
3/4/38	C-5029	47, 48	1' = 2640'

Earth Graphics

<u>Date</u>	<u>Flight No.</u>	<u>Frame No.</u>	<u>Scale</u>
6/10/93	93-125	1 to 9, 11 to 13	1"≈500'

Google Earth Images

Date

1994.05.31
2003.04.15
2003.11.30
2004.12.31
2005.06.11
2005.12.31
2007.11.22
2009.05.24
2009.11.14
2010.04.24
2011.03.07
2013.04.16

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Mr. Mike Mohler, **BROOKSTREET**

Newport Banning Ranch Bluff Retreat Rates, Analysis and Response to CCC Comments

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APPENDIX A

2013 Tide Table

2013 Tide Table: Santa Ana River Entrance (Inside), California

Location 33.6300° N, 117.9583° W

Jan-13	High	Low	High	Low	High	Moon	Sunrise	Sunset
Tue 1	12:12 AM PST / 2.18 ft	6:36 AM PST / 0.47 ft	11:04 AM PST / 2.69 ft	7:31 PM PST / 0.04 ft			6:56 AM PST	4:54 PM PST
Wed 2	12:52 AM PST / 2.24 ft	7:33 AM PST / 0.47 ft	11:48 AM PST / 2.40 ft	8:07 PM PST / 0.11 ft			6:56 AM PST	4:55 PM PST
Thu 3	1:37 AM PST / 2.32 ft	8:48 AM PST / 0.46 ft	12:47 PM PST / 2.08 ft	8:48 PM PST / 0.20 ft			6:56 AM PST	4:56 PM PST
Fri 4	2:28 AM PST / 2.45 ft	10:23 AM PST / 0.41 ft	2:14 PM PST / 1.78 ft	9:40 PM PST / 0.28 ft		Last Quarter	6:56 AM PST	4:57 PM PST
Sat 5	3:25 AM PST / 2.63 ft	11:57 AM PST / 0.29 ft	4:10 PM PST / 1.64 ft	10:45 PM PST / 0.35 ft			6:57 AM PST	4:58 PM PST
Sun 6	4:22 AM PST / 2.86 ft	1:09 PM PST / 0.14 ft	5:50 PM PST / 1.70 ft	11:56 PM PST / 0.39 ft			6:57 AM PST	4:58 PM PST
Mon 7	5:18 AM PST / 3.13 ft	2:05 PM PST / -0.02 ft	7:01 PM PST / 1.87 ft				6:57 AM PST	4:59 PM PST
Tue 8		1:02 AM PST / 0.39 ft	6:10 AM PST / 3.39 ft	2:53 PM PST / -0.16 ft	7:54 PM PST / 2.05 ft		6:57 AM PST	5:00 PM PST
Wed 9		2:01 AM PST / 0.37 ft	7:00 AM PST / 3.62 ft	3:38 PM PST / -0.26 ft	8:40 PM PST / 2.22 ft		6:57 AM PST	5:01 PM PST
Thu 10		2:55 AM PST / 0.34 ft	7:48 AM PST / 3.77 ft	4:21 PM PST / -0.32 ft	9:22 PM PST / 2.36 ft		6:56 AM PST	5:02 PM PST
Fri 11		3:46 AM PST / 0.30 ft	8:35 AM PST / 3.80 ft	5:03 PM PST / -0.33 ft	10:04 PM PST / 2.47 ft	New Moon	6:56 AM PST	5:03 PM PST
Sat 12		4:35 AM PST / 0.28 ft	9:21 AM PST / 3.71 ft	5:44 PM PST / -0.30 ft	10:45 PM PST / 2.55 ft		6:56 AM PST	5:04 PM PST
Sun 13		5:25 AM PST / 0.27 ft	10:06 AM PST / 3.48 ft	6:24 PM PST / -0.23 ft	11:27 PM PST / 2.59 ft		6:56 AM PST	5:05 PM PST
Mon 14		6:16 AM PST / 0.29 ft	10:52 AM PST / 3.15 ft	7:03 PM PST / -0.12 ft			6:56 AM PST	5:05 PM PST
Tue 15	12:10 AM PST / 2.60 ft	7:12 AM PST / 0.31 ft	11:39 AM PST / 2.74 ft	7:42 PM PST / 0.00 ft			6:56 AM PST	5:06 PM PST
Wed 16	12:57 AM PST / 2.58 ft	8:15 AM PST / 0.34 ft	12:32 PM PST / 2.30 ft	8:22 PM PST / 0.13 ft			6:55 AM PST	5:07 PM PST
Thu 17	1:47 AM PST / 2.56 ft	9:34 AM PST / 0.36 ft	1:38 PM PST / 1.89 ft	9:06 PM PST / 0.26 ft			6:55 AM PST	5:08 PM PST
Fri 18	2:44 AM PST / 2.54 ft	11:11 AM PST / 0.33 ft	3:17 PM PST / 1.60 ft	9:59 PM PST / 0.36 ft		First Quarter	6:55 AM PST	5:09 PM PST
Sat 19	3:46 AM PST / 2.57 ft	12:42 PM PST / 0.26 ft	5:22 PM PST / 1.53 ft	11:08 PM PST / 0.44 ft			6:54 AM PST	5:10 PM PST
Sun 20	4:46 AM PST / 2.64 ft	1:48 PM PST / 0.16 ft	6:51 PM PST / 1.63 ft				6:54 AM PST	5:11 PM PST
Mon 21		12:21 AM PST / 0.48 ft	5:38 AM PST / 2.75 ft	2:34 PM PST / 0.08 ft	7:42 PM PST / 1.76 ft		6:53 AM PST	5:12 PM PST
Tue 22		1:21 AM PST / 0.48 ft	6:22 AM PST / 2.87 ft	3:10 PM PST / 0.01 ft	8:17 PM PST / 1.88 ft		6:53 AM PST	5:13 PM PST
Wed 23		2:08 AM PST / 0.46 ft	7:01 AM PST / 3.00 ft	3:41 PM PST / -0.05 ft	8:45 PM PST / 1.97 ft		6:53 AM PST	5:14 PM PST
Thu 24		2:46 AM PST / 0.43 ft	7:35 AM PST / 3.10 ft	4:09 PM PST / -0.09 ft	9:10 PM PST / 2.06 ft		6:52 AM PST	5:15 PM PST
Fri 25		3:21 AM PST / 0.40 ft	8:08 AM PST / 3.18 ft	4:36 PM PST / -0.11 ft	9:35 PM PST / 2.15 ft		6:52 AM PST	5:16 PM PST
Sat 26		3:55 AM PST / 0.37 ft	8:40 AM PST / 3.20 ft	5:03 PM PST / -0.12 ft	10:00 PM PST / 2.23 ft	Full Moon	6:51 AM PST	5:17 PM PST
Sun 27		4:29 AM PST / 0.34 ft	9:11 AM PST / 3.16 ft	5:29 PM PST / -0.11 ft	10:26 PM PST / 2.31 ft		6:51 AM PST	5:18 PM PST
Mon 28		5:05 AM PST / 0.32 ft	9:44 AM PST / 3.06 ft	5:56 PM PST / -0.08 ft	10:54 PM PST / 2.38 ft		6:50 AM PST	5:19 PM PST
Tue 29		5:43 AM PST / 0.31 ft	10:18 AM PST / 2.88 ft	6:24 PM PST / -0.02 ft	11:24 PM PST / 2.45 ft		6:49 AM PST	5:20 PM PST
Wed 30		6:26 AM PST / 0.30 ft	10:56 AM PST / 2.63 ft	6:53 PM PST / 0.05 ft	11:59 PM PST / 2.50 ft		6:49 AM PST	5:21 PM PST
Thu 31		7:18 AM PST / 0.30 ft	11:41 AM PST / 2.32 ft	7:25 PM PST / 0.14 ft			6:48 AM PST	5:22 PM PST
Feb-13								
Fri 1	12:39 AM PST / 2.55 ft	8:23 AM PST / 0.30 ft	12:38 PM PST / 1.97 ft	8:02 PM PST / 0.24 ft			6:47 AM PST	5:23 PM PST
Sat 2	1:28 AM PST / 2.60 ft	9:49 AM PST / 0.28 ft	2:05 PM PST / 1.65 ft	8:49 PM PST / 0.34 ft			6:47 AM PST	5:24 PM PST
Sun 3	2:31 AM PST / 2.67 ft	11:29 AM PST / 0.21 ft	4:13 PM PST / 1.52 ft	10:02 PM PST / 0.42 ft		Last Quarter	6:46 AM PST	5:25 PM PST
Mon 4	3:45 AM PST / 2.80 ft	12:52 PM PST / 0.08 ft	6:00 PM PST / 1.65 ft	11:37 PM PST / 0.45 ft			6:45 AM PST	5:26 PM PST
Tue 5	4:57 AM PST / 2.99 ft	1:53 PM PST / -0.05 ft	7:03 PM PST / 1.87 ft				6:44 AM PST	5:27 PM PST
Wed 6		12:58 AM PST / 0.43 ft	5:59 AM PST / 3.22 ft	2:42 PM PST / -0.16 ft	7:47 PM PST / 2.10 ft		6:43 AM PST	5:28 PM PST
Thu 7		2:02 AM PST / 0.37 ft	6:54 AM PST / 3.41 ft	3:25 PM PST / -0.23 ft	8:26 PM PST / 2.31 ft		6:43 AM PST	5:29 PM PST
Fri 8		2:56 AM PST / 0.29 ft	7:43 AM PST / 3.53 ft	4:05 PM PST / -0.27 ft	9:02 PM PST / 2.48 ft		6:42 AM PST	5:30 PM PST
Sat 9		3:44 AM PST / 0.22 ft	8:29 AM PST / 3.54 ft	4:42 PM PST / -0.26 ft	9:37 PM PST / 2.62 ft	New Moon	6:41 AM PST	5:30 PM PST
Sun 10		4:30 AM PST / 0.17 ft	9:12 AM PST / 3.43 ft	5:18 PM PST / -0.21 ft	10:12 PM PST / 2.72 ft		6:40 AM PST	5:31 PM PST
Mon 11		5:15 AM PST / 0.15 ft	9:55 AM PST / 3.21 ft	5:52 PM PST / -0.13 ft	10:46 PM PST / 2.76 ft		6:39 AM PST	5:32 PM PST
Tue 12		6:00 AM PST / 0.15 ft	10:37 AM PST / 2.90 ft	6:25 PM PST / -0.03 ft	11:22 PM PST / 2.74 ft		6:38 AM PST	5:33 PM PST
Wed 13		6:47 AM PST / 0.17 ft	11:20 AM PST / 2.54 ft	6:56 PM PST / 0.09 ft	11:58 PM PST / 2.67 ft		6:37 AM PST	5:34 PM PST
Thu 14		7:39 AM PST / 0.22 ft	12:06 PM PST / 2.15 ft	7:28 PM PST / 0.21 ft			6:36 AM PST	5:35 PM PST
Fri 15	12:38 AM PST / 2.57 ft	8:42 AM PST / 0.26 ft	1:03 PM PST / 1.78 ft	8:00 PM PST / 0.32 ft			6:35 AM PST	5:36 PM PST
Sat 16	1:25 AM PST / 2.47 ft	10:05 AM PST / 0.28 ft	2:36 PM PST / 1.50 ft	8:39 PM PST / 0.43 ft			6:34 AM PST	5:37 PM PST
Sun 17	2:27 AM PST / 2.38 ft	11:50 AM PST / 0.26 ft	5:15 PM PST / 1.46 ft	9:50 PM PST / 0.51 ft		First Quarter	6:33 AM PST	5:38 PM PST
Mon 18	3:46 AM PST / 2.37 ft	1:12 PM PST / 0.19 ft	6:49 PM PST / 1.61 ft	11:47 PM PST / 0.53 ft			6:32 AM PST	5:39 PM PST
Tue 19	4:59 AM PST / 2.46 ft	2:03 PM PST / 0.11 ft	7:27 PM PST / 1.76 ft				6:31 AM PST	5:40 PM PST
Wed 20		1:06 AM PST / 0.51 ft	5:55 AM PST / 2.60 ft	2:40 PM PST / 0.04 ft	7:52 PM PST / 1.90 ft		6:30 AM PST	5:41 PM PST
Thu 21		1:56 AM PST / 0.45 ft	6:39 AM PST / 2.76 ft	3:10 PM PST / -0.01 ft	8:13 PM PST / 2.04 ft		6:29 AM PST	5:41 PM PST
Fri 22		2:35 AM PST / 0.39 ft	7:17 AM PST / 2.89 ft	3:38 PM PST / -0.05 ft	8:34 PM PST / 2.17 ft		6:28 AM PST	5:42 PM PST
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Sun 24		3:44 AM PST / 0.26 ft	8:25 AM PST / 3.03 ft	4:29 PM PST / -0.08 ft	9:19 PM PST / 2.45 ft		6:25 AM PST	5:44 PM PST
Mon 25		4:18 AM PST / 0.20 ft	8:59 AM PST / 3.00 ft	4:55 PM PST / -0.06 ft	9:44 PM PST / 2.57 ft	Full Moon	6:24 AM PST	5:45 PM PST
Tue 26		4:54 AM PST / 0.15 ft	9:34 AM PST / 2.90 ft	5:21 PM PST / -0.02 ft	10:11 PM PST / 2.68 ft		6:23 AM PST	5:46 PM PST
Wed 27		5:33 AM PST / 0.12 ft	10:12 AM PST / 2.73 ft	5:50 PM PST / 0.04 ft	10:41 PM PST / 2.76 ft		6:22 AM PST	5:47 PM PST
Thu 28		6:17 AM PST / 0.10 ft	10:54 AM PST / 2.48 ft	6:19 PM PST / 0.12 ft	11:15 PM PST / 2.79 ft		6:21 AM PST	5:47 PM PST
Mar-13								
Fri 1		7:07 AM PST / 0.11 ft	11:43 AM PST / 2.17 ft	6:52 PM PST / 0.21 ft	11:55 PM PST / 2.78 ft		6:19 AM PST	5:48 PM PST
Sat 2		8:09 AM PST / 0.12 ft	12:47 PM PST / 1.85 ft	7:30 PM PST / 0.31 ft			6:18 AM PST	5:49 PM PST
Sun 3	12:46 AM PST / 2.74 ft	9:29 AM PST / 0.13 ft	2:22 PM PST / 1.60 ft	8:23 PM PST / 0.41 ft			6:17 AM PST	5:50 PM PST

Mon 4	1:53 AM PST / 2.68 ft	11:05 AM PST / 0.10 ft	4:30 PM PST / 1.59 ft	9:54 PM PST / 0.48 ft		Last Quarter	6:16 AM PST	5:51 PM PST
Tue 5	3:19 AM PST / 2.68 ft	12:30 PM PST / 0.03 ft	5:58 PM PST / 1.79 ft	11:46 PM PST / 0.48 ft			6:14 AM PST	5:52 PM PST
Wed 6	4:43 AM PST / 2.78 ft	1:33 PM PST / -0.06 ft	6:49 PM PST / 2.03 ft				6:13 AM PST	5:52 PM PST
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Fri 8		2:08 AM PST / 0.30 ft	6:49 AM PST / 3.08 ft	3:03 PM PST / -0.15 ft	8:01 PM PST / 2.48 ft		6:11 AM PST	5:54 PM PST
Sat 9		2:57 AM PST / 0.20 ft	7:38 AM PST / 3.14 ft	3:40 PM PST / -0.16 ft	8:33 PM PST / 2.66 ft		6:09 AM PST	5:55 PM PST
Sun 10		4:41 AM PDT / 0.12 ft	9:22 AM PDT / 3.12 ft	5:14 PM PDT / -0.13 ft	10:04 PM PDT / 2.80 ft		7:08 AM PDT	6:56 PM PDT
Mon 11		5:23 AM PDT / 0.05 ft	10:04 AM PDT / 3.01 ft	5:45 PM PDT / -0.07 ft	10:34 PM PDT / 2.88 ft	New Moon	7:07 AM PDT	6:56 PM PDT
Tue 12		6:03 AM PDT / 0.02 ft	10:44 AM PDT / 2.82 ft	6:16 PM PDT / 0.01 ft	11:04 PM PDT / 2.90 ft		7:05 AM PDT	6:57 PM PDT
Wed 13		6:43 AM PDT / 0.02 ft	11:23 AM PDT / 2.57 ft	6:45 PM PDT / 0.10 ft	11:34 PM PDT / 2.85 ft		7:04 AM PDT	6:58 PM PDT
Thu 14		7:24 AM PDT / 0.05 ft	12:04 PM PDT / 2.28 ft	7:12 PM PDT / 0.20 ft			7:03 AM PDT	6:59 PM PDT
Fri 15	12:05 AM PDT / 2.76 ft	8:08 AM PDT / 0.09 ft	12:49 PM PDT / 1.99 ft	7:39 PM PDT / 0.29 ft			7:01 AM PDT	6:59 PM PDT
Sat 16	12:38 AM PDT / 2.62 ft	8:59 AM PDT / 0.15 ft	1:44 PM PDT / 1.71 ft	8:06 PM PDT / 0.39 ft			7:00 AM PDT	7:00 PM PDT
Sun 17	1:16 AM PDT / 2.47 ft	10:05 AM PDT / 0.20 ft	3:10 PM PDT / 1.50 ft	8:35 PM PDT / 0.47 ft			6:59 AM PDT	7:01 PM PDT
Mon 18	2:07 AM PDT / 2.31 ft	11:37 AM PDT / 0.22 ft	5:52 PM PDT / 1.49 ft	9:35 PM PDT / 0.54 ft			6:57 AM PDT	7:02 PM PDT
Tue 19	3:27 AM PDT / 2.19 ft	1:08 PM PDT / 0.19 ft	7:19 PM PDT / 1.65 ft			First Quarter	6:56 AM PDT	7:02 PM PDT
Wed 20		12:15 AM PDT / 0.56 ft	5:02 AM PDT / 2.19 ft	2:10 PM PDT / 0.14 ft	7:47 PM PDT / 1.81 ft		6:55 AM PDT	7:03 PM PDT
Thu 21		1:47 AM PDT / 0.51 ft	6:15 AM PDT / 2.30 ft	2:52 PM PDT / 0.09 ft	8:08 PM PDT / 1.98 ft		6:53 AM PDT	7:04 PM PDT
Fri 22		2:39 AM PDT / 0.43 ft	7:08 AM PDT / 2.45 ft	3:25 PM PDT / 0.05 ft	8:28 PM PDT / 2.15 ft		6:52 AM PDT	7:05 PM PDT
Sat 23		3:18 AM PDT / 0.33 ft	7:51 AM PDT / 2.58 ft	3:53 PM PDT / 0.02 ft	8:49 PM PDT / 2.33 ft		6:51 AM PDT	7:06 PM PDT
Sun 24		3:53 AM PDT / 0.24 ft	8:30 AM PDT / 2.68 ft	4:20 PM PDT / 0.00 ft	9:11 PM PDT / 2.52 ft		6:49 AM PDT	7:06 PM PDT
Mon 25		4:28 AM PDT / 0.14 ft	9:07 AM PDT / 2.74 ft	4:47 PM PDT / 0.01 ft	9:35 PM PDT / 2.71 ft		6:48 AM PDT	7:07 PM PDT
Tue 26		5:04 AM PDT / 0.05 ft	9:46 AM PDT / 2.73 ft	5:16 PM PDT / 0.03 ft	10:02 PM PDT / 2.88 ft		6:47 AM PDT	7:08 PM PDT
Wed 27		5:42 AM PDT / -0.02 ft	10:26 AM PDT / 2.65 ft	5:45 PM PDT / 0.07 ft	10:32 PM PDT / 3.01 ft	Full Moon	6:45 AM PDT	7:09 PM PDT
Thu 28		6:23 AM PDT / -0.07 ft	11:09 AM PDT / 2.50 ft	6:16 PM PDT / 0.13 ft	11:05 PM PDT / 3.08 ft		6:44 AM PDT	7:09 PM PDT
Fri 29		7:08 AM PDT / -0.09 ft	11:57 AM PDT / 2.29 ft	6:50 PM PDT / 0.21 ft	11:42 PM PDT / 3.07 ft		6:42 AM PDT	7:10 PM PDT
Sat 30		8:00 AM PDT / -0.08 ft	12:53 PM PDT / 2.05 ft	7:29 PM PDT / 0.30 ft			6:41 AM PDT	7:11 PM PDT
Sun 31	12:26 AM PDT / 2.99 ft	9:01 AM PDT / -0.04 ft	2:04 PM PDT / 1.82 ft	8:15 PM PDT / 0.39 ft			6:40 AM PDT	7:11 PM PDT
Apr-13								
Mon 1	1:20 AM PDT / 2.84 ft	10:15 AM PDT / -0.01 ft	3:40 PM PDT / 1.72 ft	9:25 PM PDT / 0.47 ft		Last Quarter	6:38 AM PDT	7:12 PM PDT
Tue 2	2:31 AM PDT / 2.66 ft	11:39 AM PDT / 0.01 ft	5:22 PM PDT / 1.81 ft	11:13 PM PDT / 0.50 ft			6:37 AM PDT	7:13 PM PDT
Wed 3	4:01 AM PDT / 2.54 ft	12:58 PM PDT / -0.01 ft	6:31 PM PDT / 2.02 ft				6:36 AM PDT	7:14 PM PDT
Thu 4		12:59 AM PDT / 0.45 ft	5:30 AM PDT / 2.53 ft	2:00 PM PDT / -0.03 ft	7:18 PM PDT / 2.26 ft		6:34 AM PDT	7:14 PM PDT
Fri 5		2:13 AM PDT / 0.34 ft	6:43 AM PDT / 2.60 ft	2:50 PM PDT / -0.04 ft	7:56 PM PDT / 2.49 ft		6:33 AM PDT	7:15 PM PDT
Sat 6		3:09 AM PDT / 0.22 ft	7:42 AM PDT / 2.66 ft	3:31 PM PDT / -0.04 ft	8:29 PM PDT / 2.70 ft		6:32 AM PDT	7:16 PM PDT
Sun 7		3:55 AM PDT / 0.11 ft	8:31 AM PDT / 2.67 ft	4:07 PM PDT / -0.01 ft	8:59 PM PDT / 2.85 ft		6:31 AM PDT	7:17 PM PDT
Mon 8		4:37 AM PDT / 0.02 ft	9:16 AM PDT / 2.63 ft	4:40 PM PDT / 0.04 ft	9:29 PM PDT / 2.96 ft		6:29 AM PDT	7:17 PM PDT
Tue 9		5:15 AM PDT / -0.04 ft	9:57 AM PDT / 2.53 ft	5:10 PM PDT / 0.10 ft	9:57 PM PDT / 3.01 ft	New Moon	6:28 AM PDT	7:18 PM PDT
Wed 10		5:52 AM PDT / -0.07 ft	10:36 AM PDT / 2.40 ft	5:38 PM PDT / 0.16 ft	10:24 PM PDT / 3.01 ft		6:27 AM PDT	7:19 PM PDT
Thu 11		6:28 AM PDT / -0.07 ft	11:15 AM PDT / 2.24 ft	6:05 PM PDT / 0.23 ft	10:52 PM PDT / 2.95 ft		6:25 AM PDT	7:20 PM PDT
Fri 12		7:05 AM PDT / -0.05 ft	11:56 AM PDT / 2.06 ft	6:32 PM PDT / 0.31 ft	11:21 PM PDT / 2.85 ft		6:24 AM PDT	7:20 PM PDT
Sat 13		7:45 AM PDT / -0.01 ft	12:41 PM PDT / 1.87 ft	6:59 PM PDT / 0.38 ft	11:51 PM PDT / 2.71 ft		6:23 AM PDT	7:21 PM PDT
Sun 14		8:30 AM PDT / 0.04 ft	1:36 PM PDT / 1.70 ft	7:27 PM PDT / 0.44 ft			6:22 AM PDT	7:22 PM PDT
Mon 15	12:26 AM PDT / 2.54 ft	9:23 AM PDT / 0.10 ft	2:54 PM PDT / 1.59 ft	8:02 PM PDT / 0.51 ft			6:20 AM PDT	7:23 PM PDT
Tue 16	1:10 AM PDT / 2.35 ft	10:31 AM PDT / 0.14 ft	4:46 PM PDT / 1.61 ft	9:10 PM PDT / 0.57 ft			6:19 AM PDT	7:23 PM PDT
Wed 17	2:13 AM PDT / 2.16 ft	11:47 AM PDT / 0.16 ft	6:08 PM PDT / 1.74 ft	11:32 PM PDT / 0.58 ft		First Quarter	6:18 AM PDT	7:24 PM PDT
Thu 18	3:46 AM PDT / 2.04 ft	12:54 PM PDT / 0.15 ft	6:45 PM PDT / 1.91 ft				6:17 AM PDT	7:25 PM PDT
Fri 19		1:14 AM PDT / 0.51 ft	5:16 AM PDT / 2.05 ft	1:44 PM PDT / 0.13 ft	7:10 PM PDT / 2.10 ft		6:16 AM PDT	7:26 PM PDT
Sat 20		2:12 AM PDT / 0.41 ft	6:25 AM PDT / 2.13 ft	2:23 PM PDT / 0.12 ft	7:33 PM PDT / 2.30 ft		6:14 AM PDT	7:26 PM PDT
Sun 21		2:55 AM PDT / 0.29 ft	7:18 AM PDT / 2.23 ft	2:57 PM PDT / 0.11 ft	7:57 PM PDT / 2.53 ft		6:13 AM PDT	7:27 PM PDT
Mon 22		3:33 AM PDT / 0.16 ft	8:06 AM PDT / 2.33 ft	3:30 PM PDT / 0.11 ft	8:23 PM PDT / 2.77 ft		6:12 AM PDT	7:28 PM PDT
Tue 23		4:11 AM PDT / 0.04 ft	8:50 AM PDT / 2.40 ft	4:02 PM PDT / 0.12 ft	8:52 PM PDT / 3.00 ft		6:11 AM PDT	7:29 PM PDT
Wed 24		4:49 AM PDT / -0.08 ft	9:35 AM PDT / 2.42 ft	4:36 PM PDT / 0.15 ft	9:24 PM PDT / 3.20 ft		6:10 AM PDT	7:29 PM PDT
Thu 25		5:31 AM PDT / -0.17 ft	10:21 AM PDT / 2.39 ft	5:11 PM PDT / 0.18 ft	9:59 PM PDT / 3.33 ft	Full Moon	6:09 AM PDT	7:30 PM PDT
Fri 26		6:15 AM PDT / -0.22 ft	11:09 AM PDT / 2.30 ft	5:48 PM PDT / 0.24 ft	10:37 PM PDT / 3.38 ft		6:08 AM PDT	7:31 PM PDT
Sat 27		7:02 AM PDT / -0.24 ft	12:02 PM PDT / 2.18 ft	6:29 PM PDT / 0.30 ft	11:20 PM PDT / 3.33 ft		6:07 AM PDT	7:31 PM PDT
Sun 28		7:54 AM PDT / -0.22 ft	1:02 PM PDT / 2.05 ft	7:17 PM PDT / 0.37 ft			6:06 AM PDT	7:32 PM PDT
Mon 29	12:08 AM PDT / 3.17 ft	8:53 AM PDT / -0.17 ft	2:12 PM PDT / 1.96 ft	8:16 PM PDT / 0.44 ft			6:04 AM PDT	7:33 PM PDT
Tue 30	1:05 AM PDT / 2.92 ft	9:58 AM PDT / -0.11 ft	3:32 PM PDT / 1.97 ft	9:37 PM PDT / 0.48 ft			6:03 AM PDT	7:34 PM PDT
May-13								
Wed 1	2:15 AM PDT / 2.65 ft	11:08 AM PDT / -0.05 ft	4:50 PM PDT / 2.10 ft	11:21 PM PDT / 0.47 ft		Last Quarter	6:02 AM PDT	7:35 PM PDT
Thu 2	3:42 AM PDT / 2.41 ft	12:17 PM PDT / -0.01 ft	5:51 PM PDT / 2.30 ft				6:01 AM PDT	7:36 PM PDT
Fri 3		12:57 AM PDT / 0.39 ft	5:11 AM PDT / 2.28 ft	1:18 PM PDT / 0.03 ft	6:40 PM PDT / 2.52 ft		6:00 AM PDT	7:36 PM PDT
Sat 4		2:09 AM PDT / 0.27 ft	6:29 AM PDT / 2.24 ft	2:09 PM PDT / 0.07 ft	7:19 PM PDT / 2.72 ft		6:00 AM PDT	7:37 PM PDT
Sun 5		3:04 AM PDT / 0.15 ft	7:32 AM PDT / 2.24 ft	2:52 PM PDT / 0.11 ft	7:54 PM PDT / 2.89 ft		5:59 AM PDT	7:38 PM PDT
Mon 6		3:50 AM PDT / 0.05 ft	8:26 AM PDT / 2.23 ft	3:30 PM PDT / 0.16 ft	8:26 PM PDT / 3.01 ft		5:58 AM PDT	7:39 PM PDT
Tue 7		4:30 AM PDT / -0.03 ft	9:12 AM PDT / 2.20 ft	4:03 PM PDT / 0.21 ft	8:55 PM PDT / 3.08 ft		5:57 AM PDT	7:39 PM PDT
Wed 8		5:07 AM PDT / -0.08 ft	9:54 AM PDT / 2.15 ft	4:34 PM PDT / 0.26 ft	9:23 PM PDT / 3.11 ft	New Moon	5:56 AM PDT	7:40 PM PDT
Thu 9		5:42 AM PDT / -0.11 ft	10:34 AM PDT / 2.09 ft	5:03 PM PDT / 0.31 ft	9:51 PM PDT / 3.10 ft		5:55 AM PDT	7:41 PM PDT
Fri 10		6:16 AM PDT / -0.11 ft	11:13 AM PDT / 2.02 ft	5:31 PM PDT / 0.35 ft	10:19 PM PDT / 3.05 ft		5:54 AM PDT	7:42 PM PDT

Sat 11		6:51 AM PDT / -0.10 ft	11:53 AM PDT / 1.94 ft	6:00 PM PDT / 0.40 ft	10:49 PM PDT / 2.96 ft	5:53 AM PDT	7:42 PM PDT
Sun 12		7:28 AM PDT / -0.07 ft	12:37 PM PDT / 1.85 ft	6:31 PM PDT / 0.44 ft	11:20 PM PDT / 2.83 ft	5:53 AM PDT	7:43 PM PDT
Mon 13		8:07 AM PDT / -0.03 ft	1:28 PM PDT / 1.79 ft	7:06 PM PDT / 0.49 ft	11:55 PM PDT / 2.67 ft	5:52 AM PDT	7:44 PM PDT
Tue 14		8:51 AM PDT / 0.02 ft	2:28 PM PDT / 1.76 ft	7:50 PM PDT / 0.53 ft		5:51 AM PDT	7:45 PM PDT
Wed 15	12:34 AM PDT / 2.47 ft	9:40 AM PDT / 0.07 ft	3:36 PM PDT / 1.79 ft	8:58 PM PDT / 0.57 ft		5:50 AM PDT	7:45 PM PDT
Thu 16	1:24 AM PDT / 2.26 ft	10:34 AM PDT / 0.11 ft	4:40 PM PDT / 1.90 ft	10:43 PM PDT / 0.57 ft		5:50 AM PDT	7:46 PM PDT
Fri 17	2:36 AM PDT / 2.05 ft	11:30 AM PDT / 0.15 ft	5:27 PM PDT / 2.06 ft		First Quarter	5:49 AM PDT	7:47 PM PDT
Sat 18		12:26 AM PDT / 0.51 ft	4:06 AM PDT / 1.91 ft	12:23 PM PDT / 0.17 ft	6:03 PM PDT / 2.26 ft	5:48 AM PDT	7:48 PM PDT
Sun 19		1:36 AM PDT / 0.40 ft	5:33 AM PDT / 1.88 ft	1:12 PM PDT / 0.19 ft	6:34 PM PDT / 2.50 ft	5:48 AM PDT	7:48 PM PDT
Mon 20		2:27 AM PDT / 0.26 ft	6:44 AM PDT / 1.93 ft	1:55 PM PDT / 0.21 ft	7:06 PM PDT / 2.76 ft	5:47 AM PDT	7:49 PM PDT
Tue 21		3:12 AM PDT / 0.11 ft	7:44 AM PDT / 2.02 ft	2:37 PM PDT / 0.23 ft	7:39 PM PDT / 3.03 ft	5:47 AM PDT	7:50 PM PDT
Wed 22		3:54 AM PDT / -0.03 ft	8:37 AM PDT / 2.11 ft	3:18 PM PDT / 0.24 ft	8:15 PM PDT / 3.28 ft	5:46 AM PDT	7:50 PM PDT
Thu 23		4:37 AM PDT / -0.16 ft	9:28 AM PDT / 2.18 ft	4:00 PM PDT / 0.26 ft	8:54 PM PDT / 3.49 ft	5:46 AM PDT	7:51 PM PDT
Fri 24		5:21 AM PDT / -0.25 ft	10:18 AM PDT / 2.22 ft	4:43 PM PDT / 0.28 ft	9:35 PM PDT / 3.62 ft	Full Moon	5:45 AM PDT
Sat 25		6:07 AM PDT / -0.31 ft	11:09 AM PDT / 2.23 ft	5:28 PM PDT / 0.31 ft	10:19 PM PDT / 3.64 ft	5:45 AM PDT	7:52 PM PDT
Sun 26		6:54 AM PDT / -0.32 ft	12:02 PM PDT / 2.22 ft	6:17 PM PDT / 0.35 ft	11:06 PM PDT / 3.54 ft	5:44 AM PDT	7:53 PM PDT
Mon 27		7:45 AM PDT / -0.30 ft	12:58 PM PDT / 2.20 ft	7:12 PM PDT / 0.39 ft	11:57 PM PDT / 3.32 ft	5:44 AM PDT	7:54 PM PDT
Tue 28		8:37 AM PDT / -0.23 ft	1:58 PM PDT / 2.22 ft	8:17 PM PDT / 0.43 ft		5:43 AM PDT	7:54 PM PDT
Wed 29	12:54 AM PDT / 3.01 ft	9:33 AM PDT / -0.15 ft	3:02 PM PDT / 2.28 ft	9:36 PM PDT / 0.45 ft		5:43 AM PDT	7:55 PM PDT
Thu 30	1:59 AM PDT / 2.65 ft	10:31 AM PDT / -0.05 ft	4:06 PM PDT / 2.40 ft	11:09 PM PDT / 0.43 ft		5:43 AM PDT	7:56 PM PDT
Fri 31	3:18 AM PDT / 2.30 ft	11:31 AM PDT / 0.04 ft	5:05 PM PDT / 2.55 ft		Last Quarter	5:42 AM PDT	7:56 PM PDT

Jun-13							
Sat 1		12:40 AM PDT / 0.35 ft	4:46 AM PDT / 2.06 ft	12:29 PM PDT / 0.13 ft	5:56 PM PDT / 2.72 ft	5:42 AM PDT	7:57 PM PDT
Sun 2		1:55 AM PDT / 0.24 ft	6:12 AM PDT / 1.94 ft	1:23 PM PDT / 0.20 ft	6:41 PM PDT / 2.87 ft	5:42 AM PDT	7:57 PM PDT
Mon 3		2:54 AM PDT / 0.13 ft	7:24 AM PDT / 1.92 ft	2:10 PM PDT / 0.26 ft	7:20 PM PDT / 3.00 ft	5:41 AM PDT	7:58 PM PDT
Tue 4		3:42 AM PDT / 0.04 ft	8:24 AM PDT / 1.93 ft	2:52 PM PDT / 0.31 ft	7:54 PM PDT / 3.09 ft	5:41 AM PDT	7:58 PM PDT
Wed 5		4:23 AM PDT / -0.03 ft	9:13 AM PDT / 1.95 ft	3:30 PM PDT / 0.35 ft	8:27 PM PDT / 3.15 ft	5:41 AM PDT	7:59 PM PDT
Thu 6		4:59 AM PDT / -0.08 ft	9:55 AM PDT / 1.97 ft	4:04 PM PDT / 0.38 ft	8:57 PM PDT / 3.18 ft	5:41 AM PDT	7:59 PM PDT
Fri 7		5:33 AM PDT / -0.10 ft	10:34 AM PDT / 1.97 ft	4:36 PM PDT / 0.41 ft	9:27 PM PDT / 3.18 ft	5:41 AM PDT	8:00 PM PDT
Sat 8		6:05 AM PDT / -0.11 ft	11:10 AM PDT / 1.97 ft	5:08 PM PDT / 0.43 ft	9:58 PM PDT / 3.15 ft	New Moon	5:41 AM PDT
Sun 9		6:37 AM PDT / -0.11 ft	11:46 AM PDT / 1.97 ft	5:41 PM PDT / 0.45 ft	10:29 PM PDT / 3.09 ft	5:41 AM PDT	8:01 PM PDT
Mon 10		7:11 AM PDT / -0.09 ft	12:23 PM PDT / 1.96 ft	6:15 PM PDT / 0.47 ft	11:01 PM PDT / 2.98 ft	5:41 AM PDT	8:01 PM PDT
Tue 11		7:45 AM PDT / -0.06 ft	1:03 PM PDT / 1.97 ft	6:54 PM PDT / 0.50 ft	11:34 PM PDT / 2.82 ft	5:41 AM PDT	8:02 PM PDT
Wed 12		8:20 AM PDT / -0.01 ft	1:46 PM PDT / 1.99 ft	7:40 PM PDT / 0.52 ft		5:41 AM PDT	8:03 PM PDT
Thu 13	12:11 AM PDT / 2.62 ft	8:57 AM PDT / 0.04 ft	2:32 PM PDT / 2.03 ft	8:39 PM PDT / 0.54 ft		5:41 AM PDT	8:03 PM PDT
Fri 14	12:54 AM PDT / 2.38 ft	9:36 AM PDT / 0.10 ft	3:20 PM PDT / 2.12 ft	9:57 PM PDT / 0.54 ft		5:41 AM PDT	8:03 PM PDT
Sat 15	1:50 AM PDT / 2.12 ft	10:19 AM PDT / 0.16 ft	4:07 PM PDT / 2.26 ft	11:30 PM PDT / 0.49 ft		5:41 AM PDT	8:03 PM PDT
Sun 16	3:08 AM PDT / 1.88 ft	11:07 AM PDT / 0.22 ft	4:52 PM PDT / 2.45 ft		First Quarter	5:41 AM PDT	8:04 PM PDT
Mon 17		12:54 AM PDT / 0.38 ft	4:46 AM PDT / 1.74 ft	12:00 PM PDT / 0.27 ft	5:36 PM PDT / 2.69 ft	5:41 AM PDT	8:04 PM PDT
Tue 18		1:59 AM PDT / 0.24 ft	6:17 AM PDT / 1.74 ft	12:56 PM PDT / 0.32 ft	6:19 PM PDT / 2.95 ft	5:41 AM PDT	8:04 PM PDT
Wed 19		2:52 AM PDT / 0.09 ft	7:31 AM PDT / 1.83 ft	1:51 PM PDT / 0.34 ft	7:03 PM PDT / 3.23 ft	5:41 AM PDT	8:04 PM PDT
Thu 20		3:40 AM PDT / -0.06 ft	8:31 AM PDT / 1.97 ft	2:44 PM PDT / 0.35 ft	7:48 PM PDT / 3.49 ft	5:41 AM PDT	8:05 PM PDT
Fri 21		4:26 AM PDT / -0.18 ft	9:24 AM PDT / 2.10 ft	3:35 PM PDT / 0.35 ft	8:34 PM PDT / 3.69 ft	5:42 AM PDT	8:05 PM PDT
Sat 22		5:11 AM PDT / -0.28 ft	10:12 AM PDT / 2.22 ft	4:26 PM PDT / 0.34 ft	9:20 PM PDT / 3.81 ft	5:42 AM PDT	8:05 PM PDT
Sun 23		5:56 AM PDT / -0.33 ft	11:00 AM PDT / 2.32 ft	5:17 PM PDT / 0.34 ft	10:08 PM PDT / 3.80 ft	Full Moon	5:42 AM PDT
Mon 24		6:41 AM PDT / -0.33 ft	11:47 AM PDT / 2.39 ft	6:10 PM PDT / 0.34 ft	10:56 PM PDT / 3.67 ft	5:42 AM PDT	8:05 PM PDT
Tue 25		7:27 AM PDT / -0.29 ft	12:36 PM PDT / 2.45 ft	7:06 PM PDT / 0.35 ft	11:47 PM PDT / 3.40 ft	5:43 AM PDT	8:05 PM PDT
Wed 26		8:13 AM PDT / -0.21 ft	1:26 PM PDT / 2.51 ft	8:08 PM PDT / 0.37 ft		5:43 AM PDT	8:06 PM PDT
Thu 27	12:40 AM PDT / 3.04 ft	9:00 AM PDT / -0.10 ft	2:19 PM PDT / 2.57 ft	9:19 PM PDT / 0.39 ft		5:43 AM PDT	8:06 PM PDT
Fri 28	1:40 AM PDT / 2.62 ft	9:49 AM PDT / 0.02 ft	3:15 PM PDT / 2.63 ft	10:42 PM PDT / 0.38 ft		5:44 AM PDT	8:06 PM PDT
Sat 29	2:50 AM PDT / 2.21 ft	10:40 AM PDT / 0.14 ft	4:13 PM PDT / 2.71 ft		Last Quarter	5:44 AM PDT	8:06 PM PDT
Sun 30		12:12 AM PDT / 0.33 ft	4:18 AM PDT / 1.90 ft	11:35 AM PDT / 0.25 ft	5:09 PM PDT / 2.80 ft	5:44 AM PDT	8:06 PM PDT

Jul-13							
Mon 1		1:34 AM PDT / 0.25 ft	5:56 AM PDT / 1.76 ft	12:33 PM PDT / 0.34 ft	6:01 PM PDT / 2.90 ft	5:45 AM PDT	8:06 PM PDT
Tue 2		2:40 AM PDT / 0.15 ft	7:21 AM PDT / 1.76 ft	1:30 PM PDT / 0.40 ft	6:47 PM PDT / 2.99 ft	5:45 AM PDT	8:06 PM PDT
Wed 3		3:31 AM PDT / 0.07 ft	8:25 AM PDT / 1.83 ft	2:22 PM PDT / 0.44 ft	7:28 PM PDT / 3.07 ft	5:46 AM PDT	8:05 PM PDT
Thu 4		4:12 AM PDT / 0.01 ft	9:13 AM PDT / 1.91 ft	3:06 PM PDT / 0.46 ft	8:05 PM PDT / 3.14 ft	5:46 AM PDT	8:05 PM PDT
Fri 5		4:47 AM PDT / -0.04 ft	9:51 AM PDT / 1.98 ft	3:45 PM PDT / 0.46 ft	8:39 PM PDT / 3.20 ft	5:47 AM PDT	8:05 PM PDT
Sat 6		5:19 AM PDT / -0.07 ft	10:23 AM PDT / 2.03 ft	4:21 PM PDT / 0.46 ft	9:11 PM PDT / 3.23 ft	5:47 AM PDT	8:05 PM PDT
Sun 7		5:49 AM PDT / -0.08 ft	10:53 AM PDT / 2.08 ft	4:55 PM PDT / 0.45 ft	9:43 PM PDT / 3.23 ft	5:48 AM PDT	8:05 PM PDT
Mon 8		6:18 AM PDT / -0.09 ft	11:23 AM PDT / 2.13 ft	5:29 PM PDT / 0.45 ft	10:14 PM PDT / 3.19 ft	New Moon	5:48 AM PDT
Tue 9		6:47 AM PDT / -0.07 ft	11:53 AM PDT / 2.17 ft	6:05 PM PDT / 0.45 ft	10:46 PM PDT / 3.09 ft	5:49 AM PDT	8:04 PM PDT
Wed 10		7:16 AM PDT / -0.04 ft	12:23 PM PDT / 2.22 ft	6:44 PM PDT / 0.45 ft	11:19 PM PDT / 2.94 ft	5:49 AM PDT	8:04 PM PDT
Thu 11		7:45 AM PDT / 0.00 ft	12:56 PM PDT / 2.26 ft	7:26 PM PDT / 0.46 ft	11:54 PM PDT / 2.73 ft	5:50 AM PDT	8:04 PM PDT
Fri 12		8:15 AM PDT / 0.06 ft	1:31 PM PDT / 2.32 ft	8:17 PM PDT / 0.47 ft		5:50 AM PDT	8:03 PM PDT
Sat 13	12:34 AM PDT / 2.47 ft	8:46 AM PDT / 0.13 ft	2:10 PM PDT / 2.39 ft	9:21 PM PDT / 0.46 ft		5:51 AM PDT	8:03 PM PDT
Sun 14	1:24 AM PDT / 2.18 ft	9:22 AM PDT / 0.21 ft	2:55 PM PDT / 2.50 ft	10:43 PM PDT / 0.43 ft		5:52 AM PDT	8:03 PM PDT
Mon 15	2:36 AM PDT / 1.88 ft	10:05 AM PDT / 0.30 ft	3:47 PM PDT / 2.63 ft		First Quarter	5:52 AM PDT	8:02 PM PDT
Tue 16		12:14 AM PDT / 0.35 ft	4:19 AM PDT / 1.68 ft	11:00 AM PDT / 0.37 ft	4:45 PM PDT / 2.82 ft	5:53 AM PDT	8:02 PM PDT
Wed 17		1:34 AM PDT / 0.22 ft	6:09 AM PDT / 1.67 ft	12:10 PM PDT / 0.42 ft	5:43 PM PDT / 3.05 ft	5:54 AM PDT	8:01 PM PDT

Thu 18		2:36 AM PDT / 0.08 ft	7:30 AM PDT / 1.82 ft	1:23 PM PDT / 0.44 ft	6:39 PM PDT / 3.31 ft	5:54 AM PDT	8:01 PM PDT
Fri 19		3:27 AM PDT / -0.06 ft	8:28 AM PDT / 2.00 ft	2:28 PM PDT / 0.42 ft	7:32 PM PDT / 3.56 ft	5:55 AM PDT	8:00 PM PDT
Sat 20		4:13 AM PDT / -0.17 ft	9:15 AM PDT / 2.20 ft	3:26 PM PDT / 0.39 ft	8:22 PM PDT / 3.75 ft	5:55 AM PDT	8:00 PM PDT
Sun 21		4:57 AM PDT / -0.25 ft	9:58 AM PDT / 2.37 ft	4:19 PM PDT / 0.34 ft	9:11 PM PDT / 3.84 ft	5:56 AM PDT	7:59 PM PDT
Mon 22		5:39 AM PDT / -0.28 ft	10:39 AM PDT / 2.53 ft	5:11 PM PDT / 0.30 ft	9:59 PM PDT / 3.81 ft	5:57 AM PDT	7:58 PM PDT
Tue 23		6:21 AM PDT / -0.26 ft	11:20 AM PDT / 2.65 ft	6:02 PM PDT / 0.27 ft	10:46 PM PDT / 3.64 ft	5:57 AM PDT	7:58 PM PDT
Wed 24		7:01 AM PDT / -0.20 ft	12:01 PM PDT / 2.74 ft	6:55 PM PDT / 0.27 ft	11:34 PM PDT / 3.35 ft	5:58 AM PDT	7:57 PM PDT
Thu 25		7:41 AM PDT / -0.11 ft	12:44 PM PDT / 2.79 ft	7:51 PM PDT / 0.28 ft		5:59 AM PDT	7:56 PM PDT
Fri 26	12:24 AM PDT / 2.97 ft	8:21 AM PDT / 0.01 ft	1:29 PM PDT / 2.80 ft	8:52 PM PDT / 0.31 ft		6:00 AM PDT	7:56 PM PDT
Sat 27	1:18 AM PDT / 2.54 ft	9:03 AM PDT / 0.14 ft	2:18 PM PDT / 2.78 ft	10:05 PM PDT / 0.33 ft		6:00 AM PDT	7:55 PM PDT
Sun 28	2:23 AM PDT / 2.13 ft	9:47 AM PDT / 0.27 ft	3:13 PM PDT / 2.76 ft	11:32 PM PDT / 0.32 ft		6:01 AM PDT	7:54 PM PDT
Mon 29	3:51 AM PDT / 1.82 ft	10:38 AM PDT / 0.39 ft	4:14 PM PDT / 2.75 ft			6:02 AM PDT	7:54 PM PDT
Tue 30		1:04 AM PDT / 0.27 ft	5:46 AM PDT / 1.70 ft	11:44 AM PDT / 0.47 ft	5:18 PM PDT / 2.78 ft	6:02 AM PDT	7:53 PM PDT
Wed 31		2:18 AM PDT / 0.20 ft	7:23 AM PDT / 1.77 ft	1:00 PM PDT / 0.52 ft	6:16 PM PDT / 2.86 ft	6:03 AM PDT	7:52 PM PDT

Full Moon

Last Quarter

Aug-13

Thu 1		3:11 AM PDT / 0.12 ft	8:22 AM PDT / 1.90 ft	2:05 PM PDT / 0.53 ft	7:05 PM PDT / 2.96 ft	6:04 AM PDT	7:51 PM PDT
Fri 2		3:52 AM PDT / 0.06 ft	9:01 AM PDT / 2.01 ft	2:55 PM PDT / 0.51 ft	7:47 PM PDT / 3.06 ft	6:04 AM PDT	7:50 PM PDT
Sat 3		4:26 AM PDT / 0.02 ft	9:30 AM PDT / 2.11 ft	3:35 PM PDT / 0.48 ft	8:23 PM PDT / 3.16 ft	6:05 AM PDT	7:49 PM PDT
Sun 4		4:55 AM PDT / -0.01 ft	9:56 AM PDT / 2.19 ft	4:11 PM PDT / 0.44 ft	8:56 PM PDT / 3.22 ft	6:06 AM PDT	7:48 PM PDT
Mon 5		5:23 AM PDT / -0.03 ft	10:20 AM PDT / 2.28 ft	4:45 PM PDT / 0.41 ft	9:29 PM PDT / 3.24 ft	6:07 AM PDT	7:47 PM PDT
Tue 6		5:49 AM PDT / -0.03 ft	10:45 AM PDT / 2.37 ft	5:19 PM PDT / 0.38 ft	10:00 PM PDT / 3.20 ft	6:07 AM PDT	7:47 PM PDT
Wed 7		6:14 AM PDT / -0.02 ft	11:10 AM PDT / 2.45 ft	5:53 PM PDT / 0.36 ft	10:32 PM PDT / 3.11 ft	6:08 AM PDT	7:46 PM PDT
Thu 8		6:40 AM PDT / 0.02 ft	11:36 AM PDT / 2.52 ft	6:30 PM PDT / 0.35 ft	11:06 PM PDT / 2.95 ft	6:09 AM PDT	7:45 PM PDT
Fri 9		7:06 AM PDT / 0.07 ft	12:04 PM PDT / 2.59 ft	7:10 PM PDT / 0.34 ft	11:41 PM PDT / 2.73 ft	6:09 AM PDT	7:44 PM PDT
Sat 10		7:33 AM PDT / 0.13 ft	12:35 PM PDT / 2.64 ft	7:57 PM PDT / 0.34 ft		6:10 AM PDT	7:43 PM PDT
Sun 11	12:23 AM PDT / 2.46 ft	8:02 AM PDT / 0.21 ft	1:11 PM PDT / 2.68 ft	8:55 PM PDT / 0.34 ft		6:11 AM PDT	7:42 PM PDT
Mon 12	1:15 AM PDT / 2.15 ft	8:35 AM PDT / 0.30 ft	1:55 PM PDT / 2.72 ft	10:10 PM PDT / 0.33 ft		6:12 AM PDT	7:40 PM PDT
Tue 13	2:29 AM PDT / 1.85 ft	9:17 AM PDT / 0.39 ft	2:52 PM PDT / 2.77 ft	11:44 PM PDT / 0.28 ft		6:12 AM PDT	7:39 PM PDT
Wed 14	4:24 AM PDT / 1.68 ft	10:19 AM PDT / 0.48 ft	4:03 PM PDT / 2.87 ft			6:13 AM PDT	7:38 PM PDT
Thu 15		1:12 AM PDT / 0.19 ft	6:20 AM PDT / 1.76 ft	11:51 AM PDT / 0.52 ft	5:18 PM PDT / 3.03 ft	6:14 AM PDT	7:37 PM PDT
Fri 16		2:19 AM PDT / 0.07 ft	7:30 AM PDT / 1.96 ft	1:21 PM PDT / 0.51 ft	6:25 PM PDT / 3.25 ft	6:14 AM PDT	7:36 PM PDT
Sat 17		3:11 AM PDT / -0.04 ft	8:17 AM PDT / 2.19 ft	2:30 PM PDT / 0.44 ft	7:23 PM PDT / 3.46 ft	6:15 AM PDT	7:35 PM PDT
Sun 18		3:56 AM PDT / -0.12 ft	8:56 AM PDT / 2.42 ft	3:27 PM PDT / 0.36 ft	8:16 PM PDT / 3.62 ft	6:16 AM PDT	7:34 PM PDT
Mon 19		4:37 AM PDT / -0.17 ft	9:33 AM PDT / 2.63 ft	4:18 PM PDT / 0.28 ft	9:04 PM PDT / 3.67 ft	6:17 AM PDT	7:32 PM PDT
Tue 20		5:15 AM PDT / -0.17 ft	10:09 AM PDT / 2.81 ft	5:06 PM PDT / 0.21 ft	9:50 PM PDT / 3.61 ft	6:17 AM PDT	7:31 PM PDT
Wed 21		5:52 AM PDT / -0.14 ft	10:45 AM PDT / 2.94 ft	5:53 PM PDT / 0.17 ft	10:35 PM PDT / 3.42 ft	6:18 AM PDT	7:30 PM PDT
Thu 22		6:29 AM PDT / -0.06 ft	11:21 AM PDT / 3.02 ft	6:40 PM PDT / 0.15 ft	11:21 PM PDT / 3.14 ft	6:19 AM PDT	7:29 PM PDT
Fri 23		7:04 AM PDT / 0.04 ft	11:57 AM PDT / 3.03 ft	7:29 PM PDT / 0.17 ft		6:19 AM PDT	7:28 PM PDT
Sat 24	12:07 AM PDT / 2.78 ft	7:39 AM PDT / 0.15 ft	12:36 PM PDT / 2.97 ft	8:23 PM PDT / 0.21 ft		6:20 AM PDT	7:27 PM PDT
Sun 25	12:58 AM PDT / 2.41 ft	8:14 AM PDT / 0.28 ft	1:17 PM PDT / 2.87 ft	9:25 PM PDT / 0.26 ft		6:21 AM PDT	7:25 PM PDT
Mon 26	1:59 AM PDT / 2.05 ft	8:51 AM PDT / 0.39 ft	2:06 PM PDT / 2.74 ft	10:43 PM PDT / 0.29 ft		6:21 AM PDT	7:24 PM PDT
Tue 27	3:30 AM PDT / 1.79 ft	9:37 AM PDT / 0.50 ft	3:07 PM PDT / 2.63 ft			6:22 AM PDT	7:23 PM PDT
Wed 28		12:18 AM PDT / 0.28 ft	5:43 AM PDT / 1.74 ft	10:54 AM PDT / 0.58 ft	4:25 PM PDT / 2.58 ft	6:23 AM PDT	7:22 PM PDT
Thu 29		1:41 AM PDT / 0.23 ft	7:17 AM PDT / 1.87 ft	12:40 PM PDT / 0.60 ft	5:40 PM PDT / 2.64 ft	6:23 AM PDT	7:20 PM PDT
Fri 30		2:38 AM PDT / 0.17 ft	8:02 AM PDT / 2.02 ft	1:56 PM PDT / 0.57 ft	6:39 PM PDT / 2.75 ft	6:24 AM PDT	7:19 PM PDT
Sat 31		3:19 AM PDT / 0.12 ft	8:31 AM PDT / 2.15 ft	2:46 PM PDT / 0.51 ft	7:25 PM PDT / 2.88 ft	6:25 AM PDT	7:18 PM PDT

First Quarter

Full Moon

Last Quarter

Sep-13

Sun 1		3:52 AM PDT / 0.08 ft	8:55 AM PDT / 2.28 ft	3:25 PM PDT / 0.45 ft	8:04 PM PDT / 2.99 ft	6:25 AM PDT	7:16 PM PDT
Mon 2		4:20 AM PDT / 0.05 ft	9:16 AM PDT / 2.40 ft	3:59 PM PDT / 0.38 ft	8:39 PM PDT / 3.07 ft	6:26 AM PDT	7:15 PM PDT
Tue 3		4:46 AM PDT / 0.04 ft	9:38 AM PDT / 2.53 ft	4:32 PM PDT / 0.32 ft	9:12 PM PDT / 3.10 ft	6:27 AM PDT	7:14 PM PDT
Wed 4		5:10 AM PDT / 0.05 ft	10:00 AM PDT / 2.65 ft	5:05 PM PDT / 0.27 ft	9:45 PM PDT / 3.07 ft	6:27 AM PDT	7:12 PM PDT
Thu 5		5:35 AM PDT / 0.07 ft	10:23 AM PDT / 2.77 ft	5:39 PM PDT / 0.22 ft	10:19 PM PDT / 2.98 ft	6:28 AM PDT	7:11 PM PDT
Fri 6		6:00 AM PDT / 0.10 ft	10:49 AM PDT / 2.87 ft	6:16 PM PDT / 0.19 ft	10:55 PM PDT / 2.82 ft	6:29 AM PDT	7:10 PM PDT
Sat 7		6:26 AM PDT / 0.16 ft	11:17 AM PDT / 2.94 ft	6:56 PM PDT / 0.18 ft	11:35 PM PDT / 2.61 ft	6:30 AM PDT	7:08 PM PDT
Sun 8		6:54 AM PDT / 0.23 ft	11:48 AM PDT / 2.97 ft	7:42 PM PDT / 0.18 ft		6:30 AM PDT	7:07 PM PDT
Mon 9	12:21 AM PDT / 2.35 ft	7:24 AM PDT / 0.31 ft	12:25 PM PDT / 2.97 ft	8:39 PM PDT / 0.19 ft		6:31 AM PDT	7:06 PM PDT
Tue 10	1:20 AM PDT / 2.07 ft	8:00 AM PDT / 0.40 ft	1:10 PM PDT / 2.92 ft	9:51 PM PDT / 0.20 ft		6:32 AM PDT	7:04 PM PDT
Wed 11	2:45 AM PDT / 1.84 ft	8:47 AM PDT / 0.49 ft	2:12 PM PDT / 2.86 ft	11:21 PM PDT / 0.19 ft		6:32 AM PDT	7:03 PM PDT
Thu 12	4:47 AM PDT / 1.80 ft	10:09 AM PDT / 0.57 ft	3:34 PM PDT / 2.83 ft			6:33 AM PDT	7:01 PM PDT
Fri 13		12:48 AM PDT / 0.13 ft	6:22 AM PDT / 1.97 ft	12:04 PM PDT / 0.57 ft	5:02 PM PDT / 2.90 ft	6:34 AM PDT	7:00 PM PDT
Sat 14		1:56 AM PDT / 0.06 ft	7:16 AM PDT / 2.21 ft	1:34 PM PDT / 0.50 ft	6:17 PM PDT / 3.05 ft	6:34 AM PDT	6:59 PM PDT
Sun 15		2:47 AM PDT / -0.01 ft	7:55 AM PDT / 2.46 ft	2:38 PM PDT / 0.39 ft	7:18 PM PDT / 3.20 ft	6:35 AM PDT	6:57 PM PDT
Mon 16		3:31 AM PDT / -0.05 ft	8:30 AM PDT / 2.70 ft	3:29 PM PDT / 0.28 ft	8:10 PM PDT / 3.30 ft	6:36 AM PDT	6:56 PM PDT
Tue 17		4:09 AM PDT / -0.06 ft	9:03 AM PDT / 2.92 ft	4:16 PM PDT / 0.17 ft	8:57 PM PDT / 3.30 ft	6:36 AM PDT	6:55 PM PDT
Wed 18		4:46 AM PDT / -0.03 ft	9:35 AM PDT / 3.09 ft	5:00 PM PDT / 0.10 ft	9:42 PM PDT / 3.22 ft	6:37 AM PDT	6:53 PM PDT
Thu 19		5:20 AM PDT / 0.02 ft	10:08 AM PDT / 3.20 ft	5:43 PM PDT / 0.05 ft	10:26 PM PDT / 3.04 ft	6:38 AM PDT	6:52 PM PDT
Fri 20		5:52 AM PDT / 0.10 ft	10:40 AM PDT / 3.24 ft	6:25 PM PDT / 0.04 ft	11:09 PM PDT / 2.80 ft	6:38 AM PDT	6:50 PM PDT
Sat 21		6:24 AM PDT / 0.19 ft	11:12 AM PDT / 3.20 ft	7:08 PM PDT / 0.06 ft	11:53 PM PDT / 2.53 ft	6:39 AM PDT	6:49 PM PDT
Sun 22		6:54 AM PDT / 0.29 ft	11:45 AM PDT / 3.10 ft	7:55 PM PDT / 0.11 ft		6:40 AM PDT	6:48 PM PDT
Mon 23	12:42 AM PDT / 2.24 ft	7:25 AM PDT / 0.39 ft	12:20 PM PDT / 2.94 ft	8:47 PM PDT / 0.17 ft		6:40 AM PDT	6:46 PM PDT

New Moon

First Quarter

Full Moon

Tue 24	1:43 AM PDT / 1.98 ft	7:57 AM PDT / 0.49 ft	1:00 PM PDT / 2.75 ft	9:53 PM PDT / 0.23 ft		6:41 AM PDT	6:45 PM PDT
Wed 25	3:13 AM PDT / 1.80 ft	8:37 AM PDT / 0.57 ft	1:53 PM PDT / 2.56 ft	11:18 PM PDT / 0.26 ft		6:42 AM PDT	6:43 PM PDT
Thu 26	5:30 AM PDT / 1.82 ft	10:00 AM PDT / 0.64 ft	3:13 PM PDT / 2.41 ft			6:42 AM PDT	6:42 PM PDT
Fri 27		12:44 AM PDT / 0.24 ft	6:50 AM PDT / 1.97 ft	12:21 PM PDT / 0.64 ft	4:47 PM PDT / 2.39 ft	6:43 AM PDT	6:41 PM PDT
Sat 28		1:47 AM PDT / 0.21 ft	7:24 AM PDT / 2.13 ft	1:43 PM PDT / 0.58 ft	6:01 PM PDT / 2.47 ft	6:44 AM PDT	6:39 PM PDT
Sun 29		2:31 AM PDT / 0.17 ft	7:49 AM PDT / 2.28 ft	2:32 PM PDT / 0.49 ft	6:55 PM PDT / 2.59 ft	6:45 AM PDT	6:38 PM PDT
Mon 30		3:05 AM PDT / 0.15 ft	8:10 AM PDT / 2.44 ft	3:10 PM PDT / 0.40 ft	7:38 PM PDT / 2.69 ft	6:45 AM PDT	6:37 PM PDT

Last Quarter

Oct-13

Tue 1		3:34 AM PDT / 0.13 ft	8:30 AM PDT / 2.60 ft	3:43 PM PDT / 0.31 ft	8:17 PM PDT / 2.77 ft	6:46 AM PDT	6:35 PM PDT
Wed 2		4:01 AM PDT / 0.13 ft	8:52 AM PDT / 2.78 ft	4:16 PM PDT / 0.22 ft	8:53 PM PDT / 2.81 ft	6:47 AM PDT	6:34 PM PDT
Thu 3		4:27 AM PDT / 0.14 ft	9:14 AM PDT / 2.94 ft	4:50 PM PDT / 0.14 ft	9:30 PM PDT / 2.80 ft	6:47 AM PDT	6:33 PM PDT
Fri 4		4:53 AM PDT / 0.16 ft	9:40 AM PDT / 3.10 ft	5:25 PM PDT / 0.07 ft	10:08 PM PDT / 2.73 ft	6:48 AM PDT	6:31 PM PDT
Sat 5		5:20 AM PDT / 0.20 ft	10:07 AM PDT / 3.21 ft	6:03 PM PDT / 0.02 ft	10:49 PM PDT / 2.61 ft	6:49 AM PDT	6:30 PM PDT
Sun 6		5:50 AM PDT / 0.25 ft	10:38 AM PDT / 3.28 ft	6:45 PM PDT / -0.00 ft	11:34 PM PDT / 2.44 ft	6:50 AM PDT	6:29 PM PDT
Mon 7		6:22 AM PDT / 0.32 ft	11:13 AM PDT / 3.28 ft	7:33 PM PDT / -0.03 ft		6:50 AM PDT	6:27 PM PDT
Tue 8	12:27 AM PDT / 2.23 ft	6:57 AM PDT / 0.40 ft	11:53 AM PDT / 3.21 ft	8:29 PM PDT / 0.03 ft		6:51 AM PDT	6:26 PM PDT
Wed 9	1:34 AM PDT / 2.04 ft	7:40 AM PDT / 0.48 ft	12:42 PM PDT / 3.07 ft	9:38 PM PDT / 0.06 ft		6:52 AM PDT	6:25 PM PDT
Thu 10	3:03 AM PDT / 1.94 ft	8:42 AM PDT / 0.56 ft	1:47 PM PDT / 2.89 ft	10:57 PM PDT / 0.08 ft		6:53 AM PDT	6:23 PM PDT
Fri 11	4:44 AM PDT / 2.01 ft	10:26 AM PDT / 0.60 ft	3:14 PM PDT / 2.73 ft			6:53 AM PDT	6:22 PM PDT
Sat 12		12:17 AM PDT / 0.08 ft	5:58 AM PDT / 2.22 ft	12:21 PM PDT / 0.55 ft	4:48 PM PDT / 2.69 ft	6:54 AM PDT	6:21 PM PDT
Sun 13		1:23 AM PDT / 0.06 ft	6:46 AM PDT / 2.47 ft	1:42 PM PDT / 0.44 ft	6:07 PM PDT / 2.74 ft	6:55 AM PDT	6:20 PM PDT
Mon 14		2:15 AM PDT / 0.05 ft	7:25 AM PDT / 2.73 ft	2:41 PM PDT / 0.31 ft	7:11 PM PDT / 2.81 ft	6:56 AM PDT	6:18 PM PDT
Tue 15		2:59 AM PDT / 0.05 ft	8:00 AM PDT / 2.96 ft	3:30 PM PDT / 0.18 ft	8:05 PM PDT / 2.84 ft	6:56 AM PDT	6:17 PM PDT
Wed 16		3:38 AM PDT / 0.08 ft	8:32 AM PDT / 3.16 ft	4:14 PM PDT / 0.07 ft	8:53 PM PDT / 2.82 ft	6:57 AM PDT	6:16 PM PDT
Thu 17		4:13 AM PDT / 0.12 ft	9:03 AM PDT / 3.30 ft	4:55 PM PDT / -0.00 ft	9:37 PM PDT / 2.74 ft	6:58 AM PDT	6:15 PM PDT
Fri 18		4:45 AM PDT / 0.18 ft	9:33 AM PDT / 3.37 ft	5:34 PM PDT / -0.04 ft	10:20 PM PDT / 2.61 ft	6:59 AM PDT	6:14 PM PDT
Sat 19		5:16 AM PDT / 0.25 ft	10:03 AM PDT / 3.37 ft	6:12 PM PDT / -0.05 ft	11:02 PM PDT / 2.45 ft	7:00 AM PDT	6:12 PM PDT
Sun 20		5:46 AM PDT / 0.32 ft	10:33 AM PDT / 3.30 ft	6:51 PM PDT / -0.03 ft	11:45 PM PDT / 2.28 ft	7:01 AM PDT	6:11 PM PDT
Mon 21		6:15 AM PDT / 0.39 ft	11:03 AM PDT / 3.18 ft	7:32 PM PDT / 0.02 ft		7:01 AM PDT	6:10 PM PDT
Tue 22	12:33 AM PDT / 2.10 ft	6:44 AM PDT / 0.47 ft	11:35 AM PDT / 3.01 ft	8:17 PM PDT / 0.07 ft		7:02 AM PDT	6:09 PM PDT
Wed 23	1:30 AM PDT / 1.94 ft	7:16 AM PDT / 0.54 ft	12:10 PM PDT / 2.80 ft	9:10 PM PDT / 0.14 ft		7:03 AM PDT	6:08 PM PDT
Thu 24	2:48 AM PDT / 1.85 ft	7:55 AM PDT / 0.60 ft	12:54 PM PDT / 2.58 ft	10:14 PM PDT / 0.19 ft		7:04 AM PDT	6:07 PM PDT
Fri 25	4:34 AM PDT / 1.88 ft	9:12 AM PDT / 0.66 ft	1:55 PM PDT / 2.36 ft	11:27 PM PDT / 0.22 ft		7:05 AM PDT	6:06 PM PDT
Sat 26	5:51 AM PDT / 2.02 ft	11:35 AM PDT / 0.66 ft	3:28 PM PDT / 2.20 ft			7:05 AM PDT	6:05 PM PDT
Sun 27		12:33 AM PDT / 0.22 ft	6:29 AM PDT / 2.18 ft	1:13 PM PDT / 0.58 ft	5:02 PM PDT / 2.17 ft	7:06 AM PDT	6:04 PM PDT
Mon 28		1:25 AM PDT / 0.22 ft	6:56 AM PDT / 2.36 ft	2:08 PM PDT / 0.48 ft	6:13 PM PDT / 2.22 ft	7:07 AM PDT	6:03 PM PDT
Tue 29		2:05 AM PDT / 0.21 ft	7:19 AM PDT / 2.55 ft	2:49 PM PDT / 0.36 ft	7:07 PM PDT / 2.30 ft	7:08 AM PDT	6:02 PM PDT
Wed 30		2:39 AM PDT / 0.21 ft	7:42 AM PDT / 2.76 ft	3:25 PM PDT / 0.24 ft	7:53 PM PDT / 2.38 ft	7:09 AM PDT	6:01 PM PDT
Thu 31		3:10 AM PDT / 0.22 ft	8:06 AM PDT / 2.98 ft	3:59 PM PDT / 0.12 ft	8:36 PM PDT / 2.45 ft	7:10 AM PDT	6:00 PM PDT

First Quarter

Full Moon

Last Quarter

Nov-13

Fri 1		3:41 AM PDT / 0.23 ft	8:33 AM PDT / 3.19 ft	4:35 PM PDT / 0.01 ft	9:18 PM PDT / 2.47 ft	7:11 AM PDT	5:59 PM PDT
Sat 2		4:12 AM PDT / 0.25 ft	9:02 AM PDT / 3.37 ft	5:13 PM PDT / -0.08 ft	10:02 PM PDT / 2.46 ft	7:11 AM PDT	5:58 PM PDT
Sun 3		3:45 AM PST / 0.28 ft	8:35 AM PST / 3.51 ft	4:54 PM PST / -0.14 ft	9:47 PM PST / 2.41 ft	6:12 AM PST	4:57 PM PST
Mon 4		4:20 AM PST / 0.32 ft	9:11 AM PST / 3.57 ft	5:38 PM PST / -0.16 ft	10:37 PM PST / 2.31 ft	6:13 AM PST	4:56 PM PST
Tue 5		4:59 AM PST / 0.38 ft	9:51 AM PST / 3.54 ft	6:26 PM PST / -0.16 ft	11:33 PM PST / 2.21 ft	6:14 AM PST	4:55 PM PST
Wed 6		5:43 AM PST / 0.44 ft	10:36 AM PST / 3.41 ft	7:20 PM PST / -0.12 ft		6:15 AM PST	4:54 PM PST
Thu 7	12:38 AM PST / 2.13 ft	6:37 AM PST / 0.50 ft	11:28 AM PST / 3.18 ft	8:21 PM PST / -0.06 ft		6:16 AM PST	4:54 PM PST
Fri 8	1:54 AM PST / 2.13 ft	7:52 AM PST / 0.55 ft	12:33 PM PST / 2.89 ft	9:28 PM PST / -0.00 ft		6:17 AM PST	4:53 PM PST
Sat 9	3:12 AM PST / 2.24 ft	9:34 AM PST / 0.56 ft	1:55 PM PST / 2.61 ft	10:37 PM PST / 0.05 ft		6:18 AM PST	4:52 PM PST
Sun 10	4:17 AM PST / 2.44 ft	11:18 AM PST / 0.49 ft	3:29 PM PST / 2.42 ft	11:41 PM PST / 0.09 ft		6:19 AM PST	4:51 PM PST
Mon 11	5:08 AM PST / 2.68 ft	12:39 PM PST / 0.36 ft	4:54 PM PST / 2.36 ft			6:20 AM PST	4:51 PM PST
Tue 12		12:36 AM PST / 0.13 ft	5:51 AM PST / 2.92 ft	1:39 PM PST / 0.22 ft	6:05 PM PST / 2.36 ft	6:20 AM PST	4:50 PM PST
Wed 13		1:23 AM PST / 0.17 ft	6:28 AM PST / 3.12 ft	2:28 PM PST / 0.10 ft	7:03 PM PST / 2.36 ft	6:21 AM PST	4:49 PM PST
Thu 14		2:04 AM PST / 0.22 ft	7:02 AM PST / 3.27 ft	3:11 PM PST / -0.00 ft	7:54 PM PST / 2.35 ft	6:22 AM PST	4:49 PM PST
Fri 15		2:41 AM PST / 0.27 ft	7:35 AM PST / 3.37 ft	3:50 PM PST / -0.06 ft	8:39 PM PST / 2.32 ft	6:23 AM PST	4:48 PM PST
Sat 16		3:14 AM PST / 0.31 ft	8:05 AM PST / 3.41 ft	4:27 PM PST / -0.10 ft	9:20 PM PST / 2.27 ft	6:24 AM PST	4:48 PM PST
Sun 17		3:46 AM PST / 0.36 ft	8:35 AM PST / 3.39 ft	5:02 PM PST / -0.10 ft	10:00 PM PST / 2.20 ft	6:25 AM PST	4:47 PM PST
Mon 18		4:16 AM PST / 0.40 ft	9:05 AM PST / 3.33 ft	5:37 PM PST / -0.09 ft	10:41 PM PST / 2.12 ft	6:26 AM PST	4:47 PM PST
Tue 19		4:46 AM PST / 0.45 ft	9:35 AM PST / 3.22 ft	6:14 PM PST / -0.06 ft	11:23 PM PST / 2.04 ft	6:27 AM PST	4:46 PM PST
Wed 20		5:18 AM PST / 0.49 ft	10:06 AM PST / 3.07 ft	6:52 PM PST / -0.01 ft		6:28 AM PST	4:46 PM PST
Thu 21	12:12 AM PST / 1.97 ft	5:53 AM PST / 0.54 ft	10:40 AM PST / 2.88 ft	7:34 PM PST / 0.05 ft		6:29 AM PST	4:45 PM PST
Fri 22	1:08 AM PST / 1.94 ft	6:36 AM PST / 0.58 ft	11:17 AM PST / 2.66 ft	8:20 PM PST / 0.11 ft		6:30 AM PST	4:45 PM PST
Sat 23	2:14 AM PST / 1.96 ft	7:40 AM PST / 0.62 ft	12:03 PM PST / 2.41 ft	9:11 PM PST / 0.16 ft		6:31 AM PST	4:45 PM PST
Sun 24	3:20 AM PST / 2.05 ft	9:23 AM PST / 0.63 ft	1:08 PM PST / 2.15 ft	10:06 PM PST / 0.21 ft		6:32 AM PST	4:44 PM PST
Mon 25	4:11 AM PST / 2.19 ft	11:16 AM PST / 0.57 ft	2:40 PM PST / 1.96 ft	11:01 PM PST / 0.25 ft		6:32 AM PST	4:44 PM PST
Tue 26	4:49 AM PST / 2.38 ft	12:32 PM PST / 0.46 ft	4:16 PM PST / 1.88 ft	11:51 PM PST / 0.27 ft		6:34 AM PST	4:44 PM PST
Wed 27	5:21 AM PST / 2.59 ft	1:22 PM PST / 0.33 ft	5:33 PM PST / 1.92 ft			6:34 AM PST	4:43 PM PST
Thu 28		12:36 AM PST / 0.29 ft	5:52 AM PST / 2.83 ft	2:04 PM PST / 0.19 ft	6:33 PM PST / 2.01 ft	6:35 AM PST	4:43 PM PST
Fri 29		1:17 AM PST / 0.31 ft	6:24 AM PST / 3.09 ft	2:43 PM PST / 0.05 ft	7:24 PM PST / 2.11 ft	6:36 AM PST	4:43 PM PST
Sat 30		1:57 AM PST / 0.32 ft	6:57 AM PST / 3.34 ft	3:22 PM PST / -0.08 ft	8:12 PM PST / 2.19 ft	6:37 AM PST	4:43 PM PST

New Moon

First Quarter

Full Moon

Last Quarter

Dec-13

Sun 1		2:38 AM PST / 0.33 ft	7:34 AM PST / 3.55 ft	4:03 PM PST / -0.18 ft	8:58 PM PST / 2.26 ft		6:38 AM PST	4:43 PM PST
Mon 2		3:19 AM PST / 0.34 ft	8:13 AM PST / 3.71 ft	4:45 PM PST / -0.25 ft	9:45 PM PST / 2.29 ft	New Moon	6:39 AM PST	4:43 PM PST
Tue 3		4:02 AM PST / 0.35 ft	8:55 AM PST / 3.77 ft	5:30 PM PST / -0.28 ft	10:34 PM PST / 2.30 ft		6:40 AM PST	4:43 PM PST
Wed 4		4:48 AM PST / 0.37 ft	9:39 AM PST / 3.71 ft	6:16 PM PST / -0.27 ft	11:26 PM PST / 2.30 ft		6:41 AM PST	4:43 PM PST
Thu 5		5:40 AM PST / 0.41 ft	10:27 AM PST / 3.53 ft	7:06 PM PST / -0.22 ft			6:41 AM PST	4:43 PM PST
Fri 6	12:21 AM PST / 2.32 ft	6:39 AM PST / 0.44 ft	11:20 AM PST / 3.24 ft	7:58 PM PST / -0.14 ft			6:42 AM PST	4:43 PM PST
Sat 7	1:21 AM PST / 2.36 ft	7:51 AM PST / 0.47 ft	12:20 PM PST / 2.86 ft	8:53 PM PST / -0.04 ft			6:43 AM PST	4:43 PM PST
Sun 8	2:25 AM PST / 2.46 ft	9:21 AM PST / 0.47 ft	1:34 PM PST / 2.47 ft	9:51 PM PST / 0.06 ft			6:44 AM PST	4:43 PM PST
Mon 9	3:27 AM PST / 2.61 ft	10:59 AM PST / 0.40 ft	3:04 PM PST / 2.15 ft	10:52 PM PST / 0.16 ft		First Quarter	6:44 AM PST	4:43 PM PST
Tue 10	4:24 AM PST / 2.78 ft	12:25 PM PST / 0.29 ft	4:39 PM PST / 1.99 ft	11:51 PM PST / 0.24 ft			6:45 AM PST	4:43 PM PST
Wed 11	5:14 AM PST / 2.96 ft	1:32 PM PST / 0.17 ft	6:01 PM PST / 1.96 ft				6:46 AM PST	4:44 PM PST
Thu 12		12:46 AM PST / 0.30 ft	5:58 AM PST / 3.11 ft	2:24 PM PST / 0.05 ft	7:07 PM PST / 2.00 ft		6:47 AM PST	4:44 PM PST
Fri 13		1:33 AM PST / 0.34 ft	6:37 AM PST / 3.23 ft	3:08 PM PST / -0.03 ft	8:00 PM PST / 2.04 ft		6:47 AM PST	4:44 PM PST
Sat 14		2:16 AM PST / 0.38 ft	7:13 AM PST / 3.30 ft	3:46 PM PST / -0.09 ft	8:43 PM PST / 2.08 ft		6:48 AM PST	4:44 PM PST
Sun 15		2:53 AM PST / 0.40 ft	7:46 AM PST / 3.33 ft	4:20 PM PST / -0.12 ft	9:22 PM PST / 2.09 ft		6:49 AM PST	4:45 PM PST
Mon 16		3:27 AM PST / 0.42 ft	8:17 AM PST / 3.33 ft	4:53 PM PST / -0.13 ft	9:57 PM PST / 2.10 ft		6:49 AM PST	4:45 PM PST
Tue 17		3:59 AM PST / 0.43 ft	8:48 AM PST / 3.30 ft	5:25 PM PST / -0.12 ft	10:30 PM PST / 2.09 ft	Full Moon	6:50 AM PST	4:45 PM PST
Wed 18		4:32 AM PST / 0.45 ft	9:18 AM PST / 3.23 ft	5:56 PM PST / -0.10 ft	11:05 PM PST / 2.08 ft		6:50 AM PST	4:46 PM PST
Thu 19		5:05 AM PST / 0.47 ft	9:49 AM PST / 3.11 ft	6:28 PM PST / -0.06 ft	11:41 PM PST / 2.07 ft		6:51 AM PST	4:46 PM PST
Fri 20		5:42 AM PST / 0.49 ft	10:21 AM PST / 2.94 ft	7:00 PM PST / -0.01 ft			6:52 AM PST	4:47 PM PST
Sat 21	12:20 AM PST / 2.08 ft	6:23 AM PST / 0.51 ft	10:55 AM PST / 2.72 ft	7:34 PM PST / 0.05 ft			6:52 AM PST	4:47 PM PST
Sun 22	1:01 AM PST / 2.10 ft	7:15 AM PST / 0.54 ft	11:33 AM PST / 2.46 ft	8:09 PM PST / 0.12 ft			6:53 AM PST	4:48 PM PST
Mon 23	1:47 AM PST / 2.15 ft	8:24 AM PST / 0.55 ft	12:19 PM PST / 2.16 ft	8:48 PM PST / 0.19 ft			6:53 AM PST	4:48 PM PST
Tue 24	2:37 AM PST / 2.24 ft	9:58 AM PST / 0.52 ft	1:28 PM PST / 1.87 ft	9:33 PM PST / 0.26 ft			6:53 AM PST	4:49 PM PST
Wed 25	3:27 AM PST / 2.39 ft	11:36 AM PST / 0.44 ft	3:11 PM PST / 1.66 ft	10:27 PM PST / 0.32 ft		Last Quarter	6:54 AM PST	4:49 PM PST
Thu 26	4:15 AM PST / 2.59 ft	12:49 PM PST / 0.31 ft	5:00 PM PST / 1.62 ft	11:27 PM PST / 0.37 ft			6:54 AM PST	4:50 PM PST
Fri 27	5:01 AM PST / 2.83 ft	1:43 PM PST / 0.16 ft	6:20 PM PST / 1.73 ft				6:55 AM PST	4:51 PM PST
Sat 28		12:27 AM PST / 0.39 ft	5:46 AM PST / 3.10 ft	2:28 PM PST / 0.01 ft	7:19 PM PST / 1.88 ft		6:55 AM PST	4:51 PM PST
Sun 29		1:23 AM PST / 0.39 ft	6:30 AM PST / 3.37 ft	3:10 PM PST / -0.13 ft	8:08 PM PST / 2.04 ft		6:55 AM PST	4:52 PM PST
Mon 30		2:15 AM PST / 0.37 ft	7:15 AM PST / 3.61 ft	3:52 PM PST / -0.24 ft	8:52 PM PST / 2.19 ft		6:55 AM PST	4:53 PM PST
Tue 31		3:04 AM PST / 0.35 ft	7:59 AM PST / 3.78 ft	4:33 PM PST / -0.31 ft	9:34 PM PST / 2.35 ft		6:56 AM PST	4:53 PM PST

APPENDIX B

Chronology

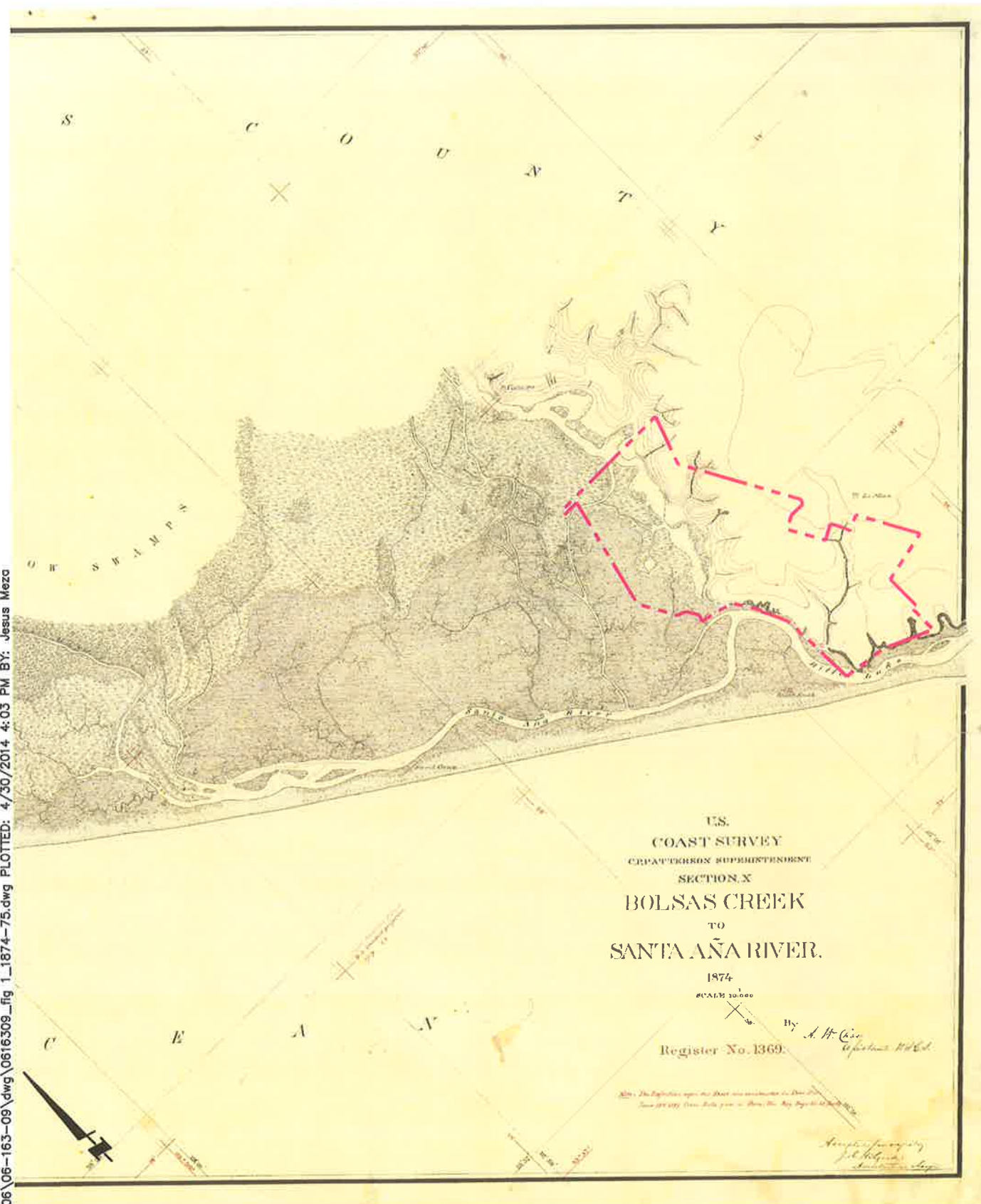
Chronology

Year	Notes
1874/75	US Coast Survey maps No Santa Ana River delta Santa Ana River contained by sand bar between "Las Bolsas" and "La Mesa" NBR protected from ocean waves by sand bar Sand bar alters river channel near coast causing river to outlet to the south at Newport Bay Fluvial (Santa Ana River) erosion along western and southern edge of NBR Erosion gullies on west/south-tilted mesa
1896	USGS Santa Ana Sheet Survey 1894 Little change from 1874 Santa Ana River along western and southern edge of mesa River contained by sand bar as in 1874/75 No development on the mesa
1901	USGS Santa Ana Sheet 1894 survey Culture revised 1900 Little change from 1874 Railroad tracks on sand bar to pier at Newport Beach No development on the mesa A few roads on mesa east of NBR
1916	Soil Map – Base map USGS Survey sheets Santa Ana River Channelized, no longer erosion along western edge of NBR, still erosion potential along southwest/southern edge of mesa, outlet to ocean at Newport Bay Drainage of wetlands Evidence of gully erosion on mesa Additional roads east of NBR Additional rail line on sand bar No on site development
1927	Aerial photographs Fairchild collection 2-lane Coast Highway located at base of site bluffs inland of Santa Ana River, evidence of bluff disturbance due to road construction Trails (some erosion) on mesa to lower elevations Jetties visible at mouth of Santa Ana River River flow directly to ocean west of NBR Highway and train bridges over river

- 1927 (con't.) Tidal/river flow into old fluvial channels that flow from river to Newport Bay
Evidence of active gully erosion on mesa and bluff instability
Evidence of agricultural activity
- 1928 **Aerial photographs Fairchild collection**
Evidence of active drainage from farm land east of NBR into large NW trending gully the drains toward coast
Mouth of river nearly closed due to sand
Evidence of fluvial erosion north of coast highway
Coast Highway road cuts into bluff at a number of locations
No evidence of development on mesa or ocean wave erosion
- 1931 **Aerial photographs Fairchild collection**
Improvement of Coast Highway, appears wider but only 2-lane paved, new road cuts and bluff instability
Narrow road along southwestern edge of NBR north of Coast Highway
Narrow road along toe of bluff north of Coast Highway, road cuts minimal to none
Additional more visible "trails" on mesa
Structures on sand bar ocean side of coast highway
- 1932/35 **USGS Newport Beach Quad**
1932 survey
Santa Ana Channel improvements, river opens to ocean
Significant loss of wetlands, drainage ditches connect to Santa Ana River channel
Sand bar from mouth of Santa Ana River to outlet at Newport Beach Harbor
More roads on mesa, some structures
Narrow roads/trails from mesa to wetlands/roads
Levees stop short of coast highway allow flow (river/tidal) into channels western and southern edge of NBR
Road toe of bluff north of coast highway
No structures on NBR
No evidence of ocean wave erosion
Sand bar >10' above MSL
Coast Highway (south end of site) above 10-foot contour
- 1938 **Aerial photographs Fairchild collection**
1938 flood, damage to Coast Highway, bluff erosion
Bluff inland of Coast Highway appears "white" for nearly entire length at NBR
No evidence of ocean wave erosion, sand bar stable
Evidence of agricultural activity on mesa, no structures
- 1941 **Prado Dam and Flood Control Basin**
Earthen dam constructed across the Santa Ana River at the Chino Hills
The dam authorized in 1936

- 1943 West Newport Oil Field discovered, start development
at NBR soon after discovery
- 1949/51 **USGS Newport Beach Quadrangle**
Survey 1932, culture and drainage revised from aerial photographs taken in 1947,
contour revision and field check 1949
BM elevations 9-11 feet, south side of NBR, 16 feet at Santa Ana river crossing
15, 16, 17, 18 streets visible east of NBR
West Newport Oil Field oil wells and roads shown
Development includes roads, well pads, and storage tanks
Roads along toe of slope entire site, 2 or 3 roads from base of slope to top of mesa
Sewage Disposal plant in wetlands
Flow from river/ocean into old river channels
- 1965 **USGS Newport Beach Quadrangle**
Planimetry by photogrammetric methods from aerial photographs taken 1963
Topography by planetable surveys 1932. Revised 1965
BM elevations 9 and 10 feet along south side of NBR
Additional wells/ graded pads, support roads, water and oil storage tanks
One structure near bluff above coast highway
Sewage disposal site removed
Trains removed from sand bar
- 1974 **USGS Orthophotoquad**
Coast Highway 6 lanes
Additional oil field grading
Conversion of agricultural land to industrial east of NBR
appears to have reduced surface flow into several of the larger gullies
- 1981/65 **USGS Newport Beach Quadrangle**
Five additional oil field structures, additional wells/roads
- 1993 **Aerial photographs**
Improved road along southwestern edge of NBR north of Coast Highway
Improved road(s) from lower section to mesa
Extensive oil field road/pad development, vegetation removal
- 1995/2013 **Google Aerial Images**
Oil field vegetation allowed to slowly return
Tidal/river flow into wetlands and old SA channel controlled by levee gates at
near coast highway
Flow into gullies from properties to the east reduced or
controlled due to development
- 2012 **USGS Newport Beach and USGS Newport Beach OE S**

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PARTIAL 1874 MAP
FIGURE 1 - U.S. COAST SURVEY "SANTA ANA RIVER AND NEWPORT BAY"



PARTIAL 1875 MAP

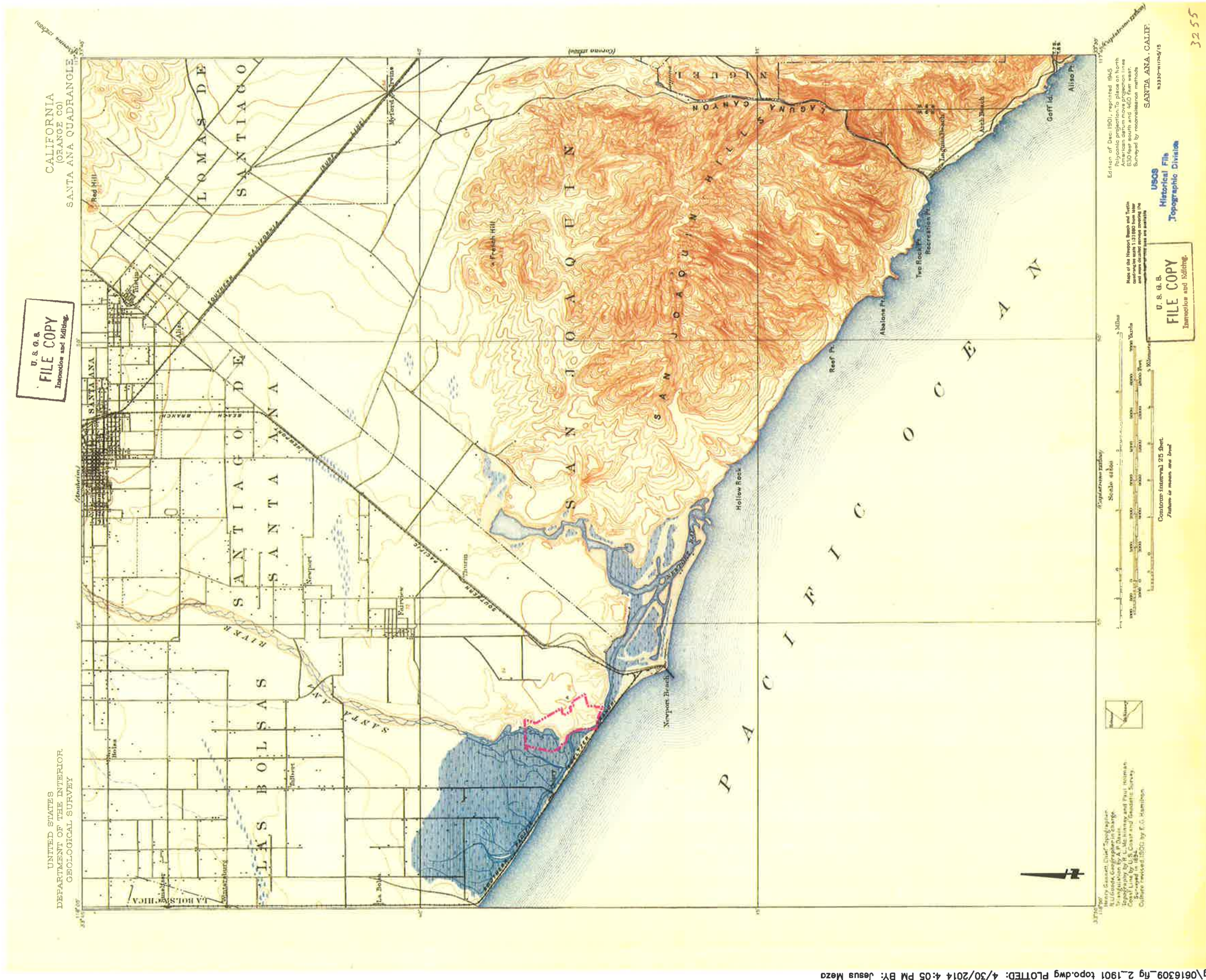
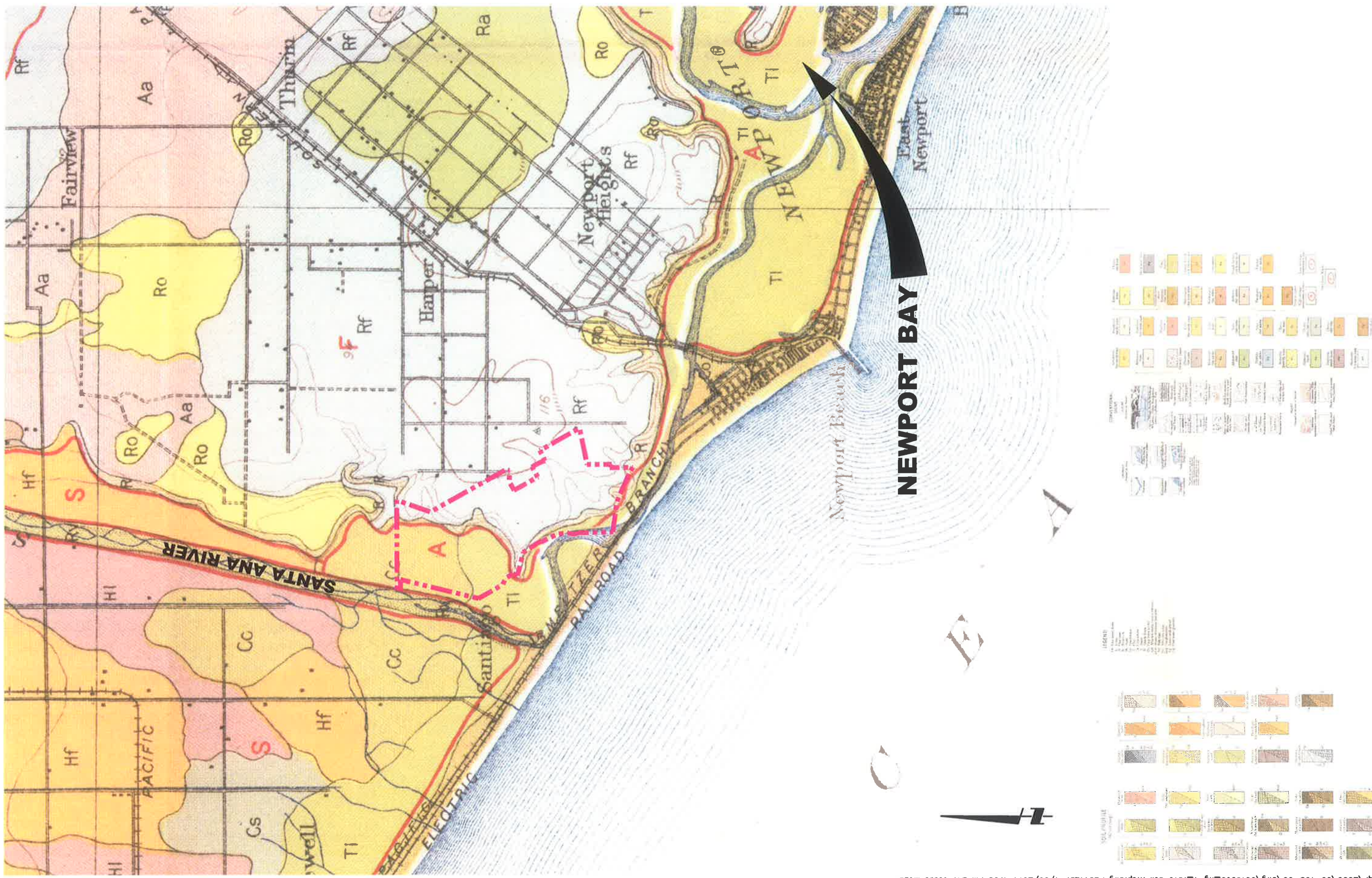


FIGURE 2 - SANTA ANA QUADRANGLE - 1901



FIGURE 3 - AERIAL PHOTOGRAPHY - 1927



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FIGURE 4- PARTIAL ANAHEIM SHEET SOIL MAP-1916



FIGURE 5 - 1927 AERIAL PHOTOGRAPH

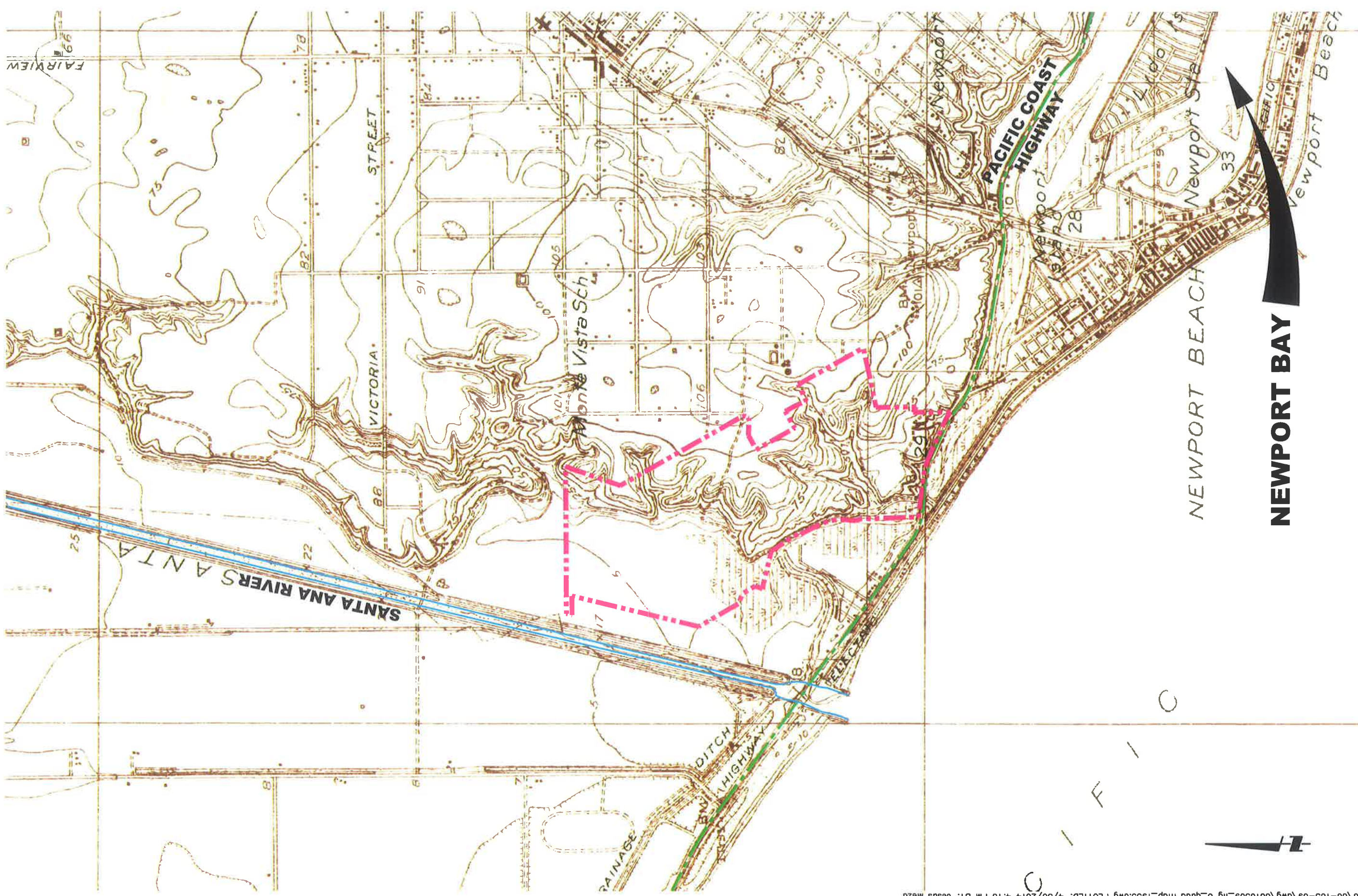


FIGURE 6

NEWPORT BEACH QUADRANGLE MAP - 1932



FIGURE 7 - AERIAL PHOTOGRAPHY - 1938

DRAWING: q:\2006\06-163-09\dwg\0616309_fig 8_view of santa ana river from coast to prado dam.dwg PLOTTED: 4/30/2014 4:12 PM BY: Jesus Meza

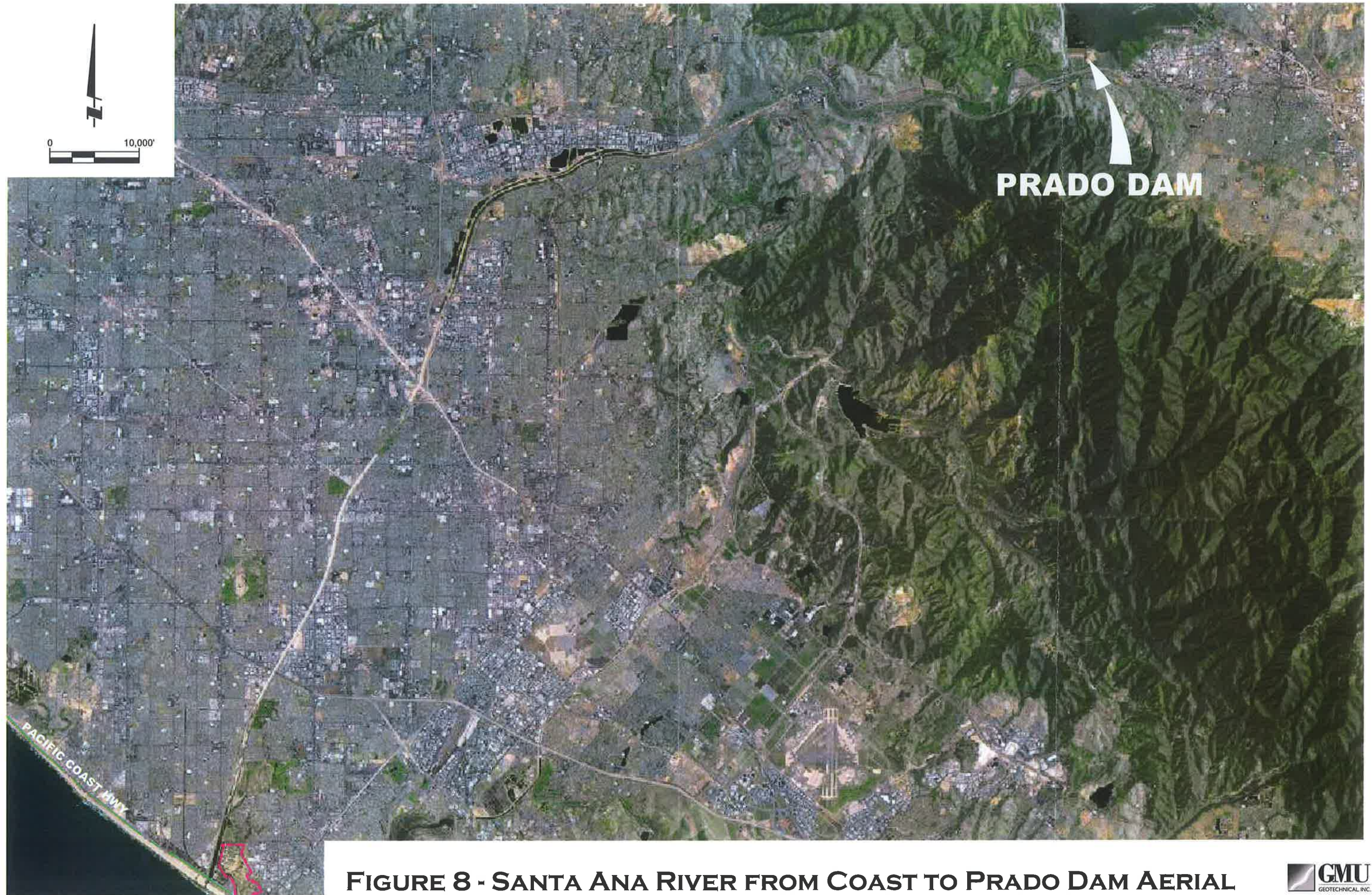


FIGURE 8 - SANTA ANA RIVER FROM COAST TO PRADO DAM AERIAL



FIGURE 9 - GOOGLE EARTH AERIAL IMAGE APRIL 16, 2003



FIGURE 10 - AERIAL PHOTOGRAPHY 1928



FIGURE 1 1 - AERIAL PHOTOGRAPHY 1931



FIGURE 12 - COSTA MESA QUADRANGLE 1974



FIGURE 13 - AERIAL PHOTOGRAPHY 1993



FIGURE 14 - AERIAL IMAGERY 2013

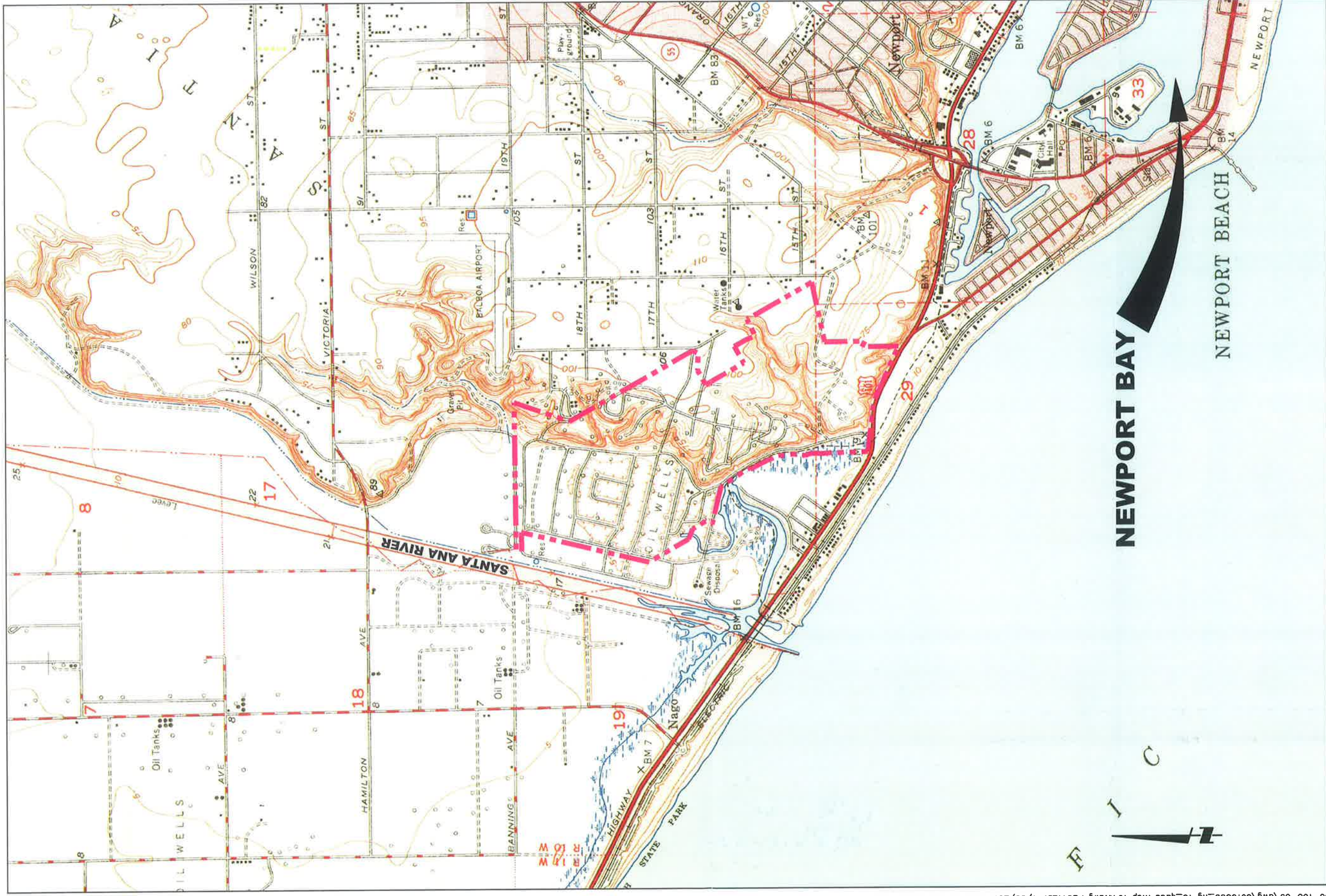


FIGURE 15 - NEWPORT BEACH QUADRANGLE 1949

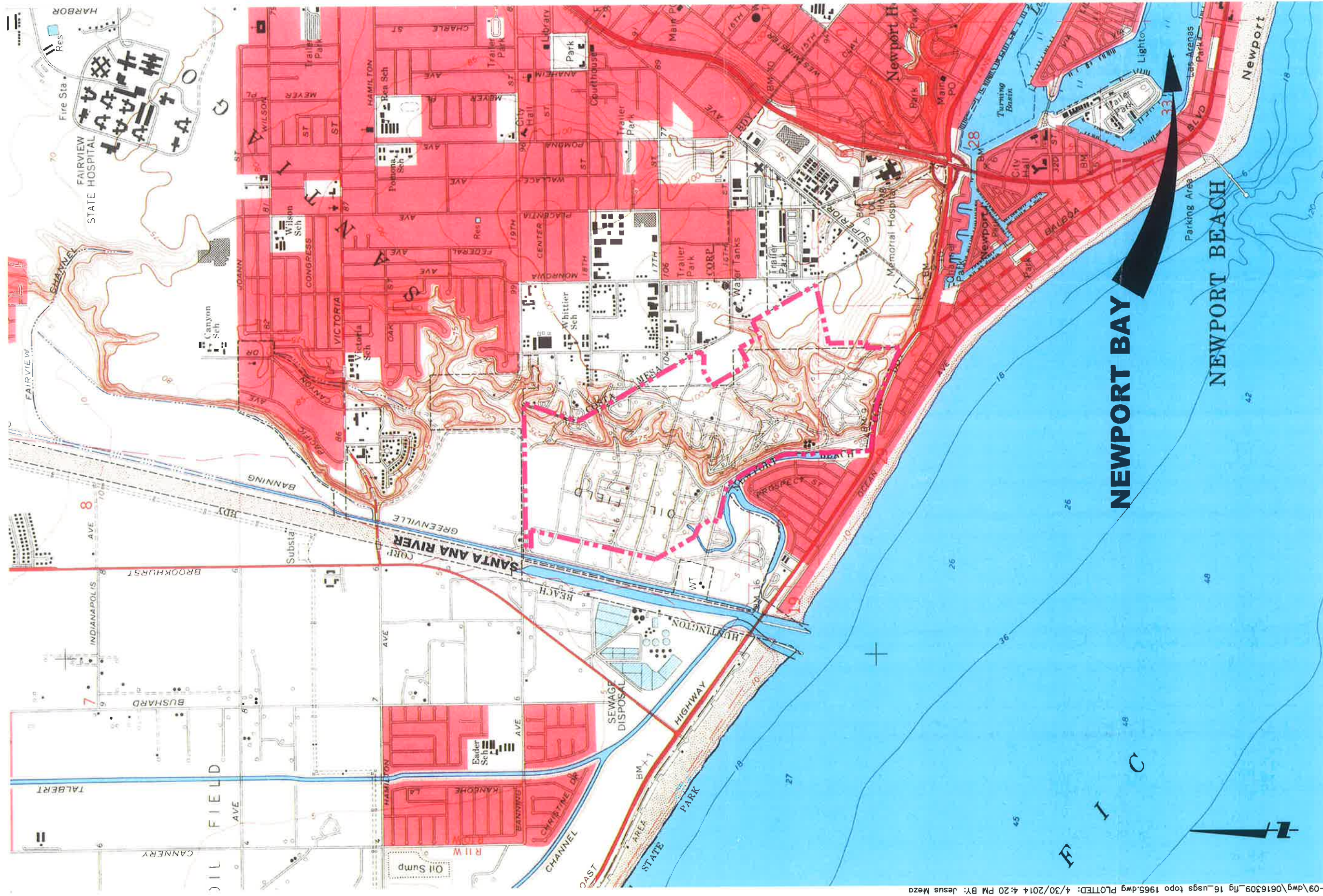
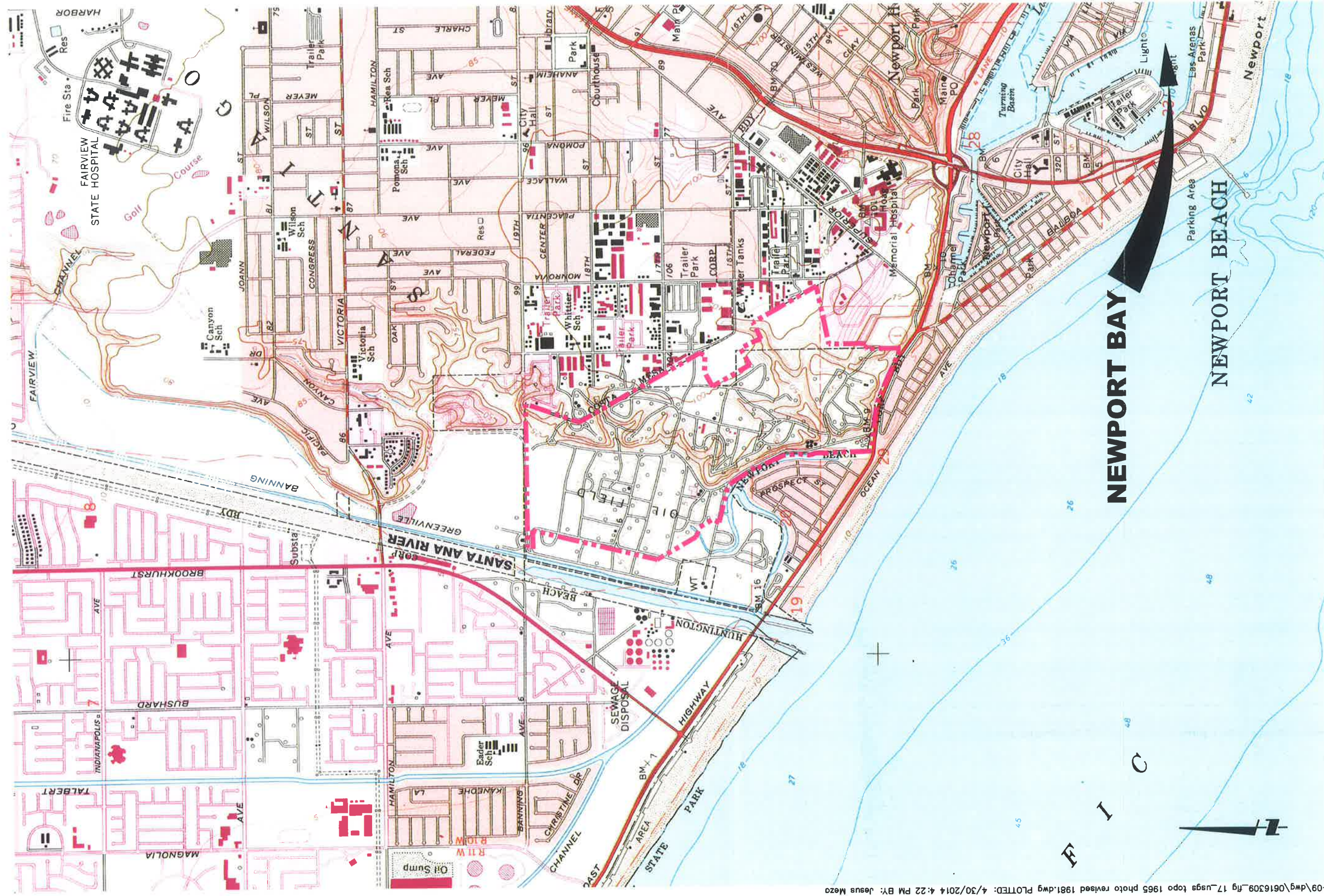
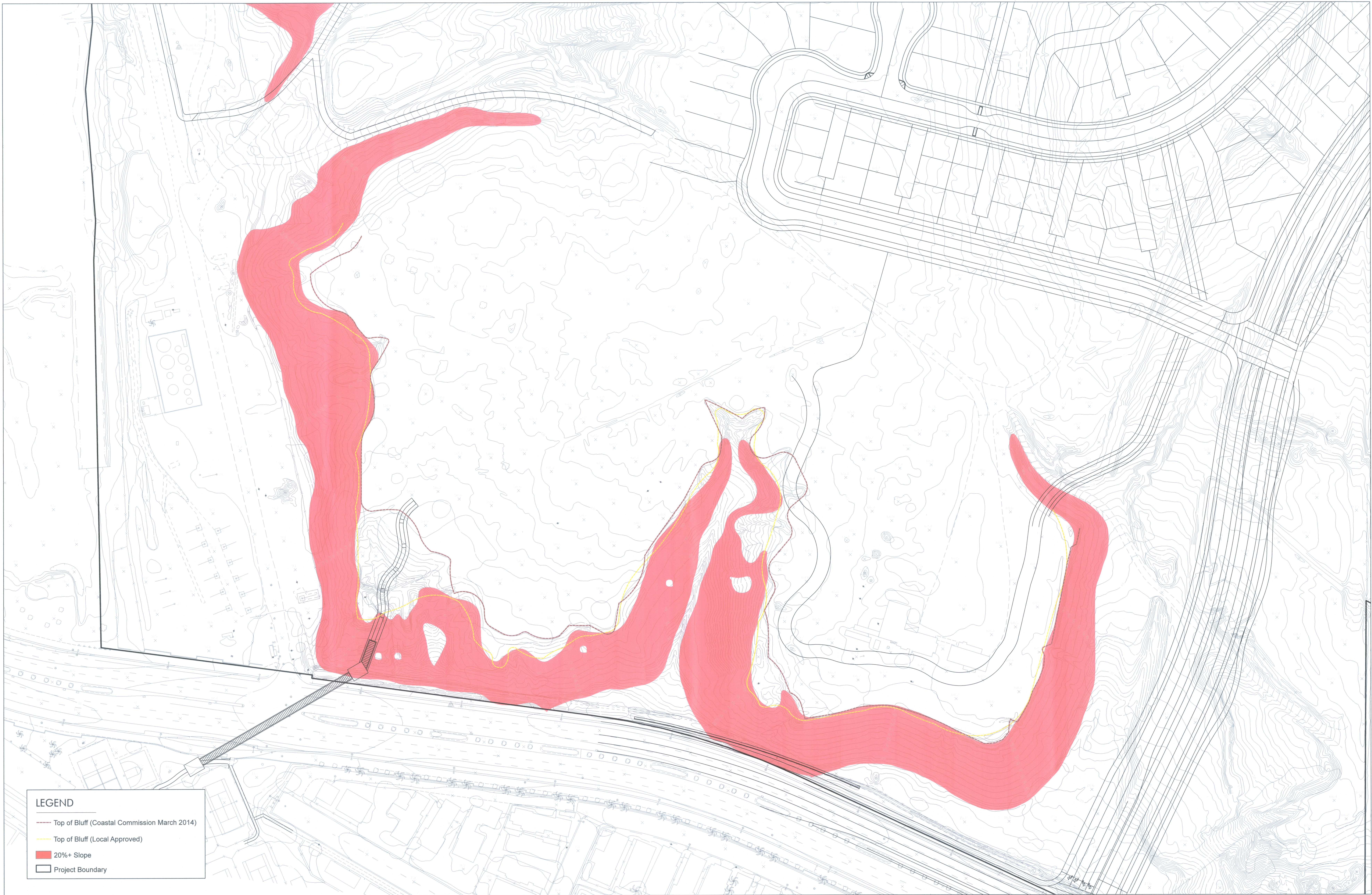
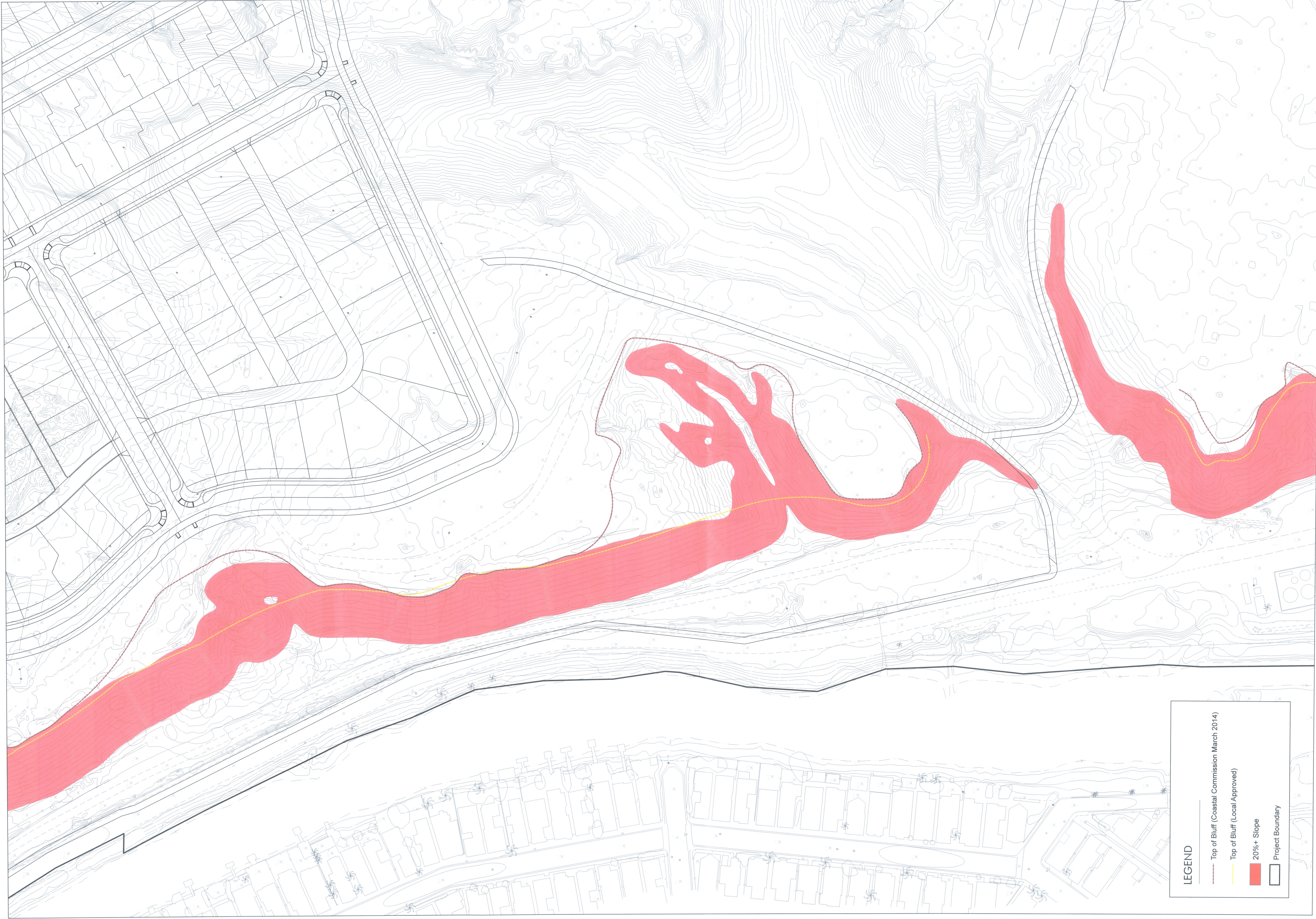


FIGURE 16 - NEWPORT BEACH QUADRANGLE 1965



**FIGURE 17 - NEWPORT BEACH QUADRANGLE 1965
PHOTO REVISED 1981**





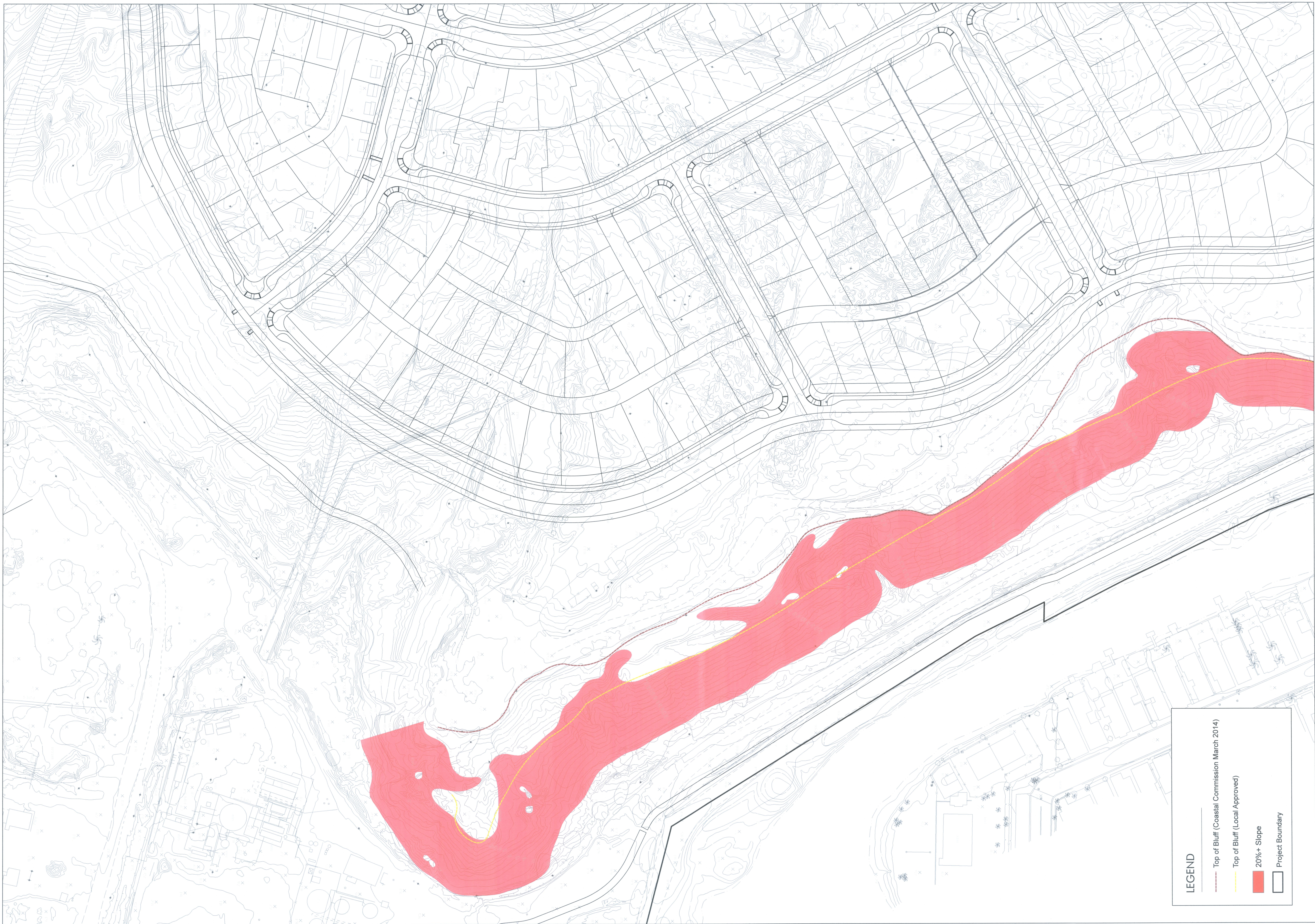
LEGEND

Top of Bluff (Coastal Commission March 2014)

Top of Bluff (Local Approved)

20%+ Slope

Project Boundary



Slope Analysis / Bluff Delineation - Sheet 2

Slope Analysis / Bluff Delineation - Sheet 1

