April 19, 2019
G5019

Mr. Eamon O'Marah
Managing Partner
HARBINGER DEVELOPMENT
103 Central Street
Wellesley, MA 02482

SUBJECT: **Geotechnical Feasibility Study -DRAFT-**
RE: Mar Vista Hotel, Hostel & Stables
Daly City, California

Dear Mr. O'Marah:

Cotton, Shires and Associates, Inc. (CSA) is pleased to provide Harbinger Development the results of our geotechnical feasibility study of the five parcels located at 2116 Olympic Way in Daly City California (Figure 1). This work was performed in accordance with our proposal dated March 6, 2019 and revised on March 7, 2019. The five parcels that are the focus of our study include APNs: 002-011-040, 002-011-050, 002-001-120, 002-011-130 and 002-011-110.

Based on a review of the November 14, 2018 Pre-Application Submittal prepared by Harbinger Development, the proposed development on APN: 002-011-040 and 002-011-050, referred to as the Mar Vista property will consist of the following: 1) an 85-room hotel with an additional 4,485 square feet of public space (restaurant, bar & café lobby); 2) a 36-bed hostel with an additional 1,778 square feet of shared space; 3) a 10- to 12-horse stable facility; 4) 65 parking stalls; and 5) associated driveways and hardscape. We understand that the adjacent parcels APN: 002-001-120, 002-011-130 and 002-011-110, referred to as the Olympic Way Retreat, will consist of a public and private event center.

In the following letter-report, we discuss the purpose and scope of our geotechnical services, the site conditions, the regional geology, the geologic hazards that exist at the site, our conclusions and recommendations, and the limitations of our services.

PURPOSE AND SCOPE OF WORK

The purpose of our geotechnical feasibility study was to: 1) characterize the surficial geologic conditions at the site; 2) identify any geologic hazards that could affect the proposed development of the site; and 3) form conclusions as to the feasibility of the proposed development.

The specific scope of work performed for our feasibility study included the following tasks:

1) Review of proposed development documents and plans provided to us;
2) Review of published geologic maps and reports pertinent files in CSA's archives;
3) Review of historical aerial photographs of the site;
4) Reconnaissance level surficial evaluation of the site;
5) Engineering geologic analysis; and
6) Preparation of this report and associated figures.

REGIONAL GEOLOGY

The site is located in the Coast Ranges geomorphic province. In general, the Coast Ranges consist of northwest-southeast trending valleys and ridges initially controlled by folds and faults along the convergent plate margin associated with past subduction of the Farallon tectonic plate beneath the North American plate. More recently, the plate margin has been dissected by a series of subparallel strike-slip faults associated with the San Andreas fault system. The subject site is underlain by relatively young bedrock materials of the Colma Formation and the Merced Formation (Bonilla, 1998). The Merced Formation is underlain at depth by much older rocks of the Franciscan Complex. The Thornton Beach Monitoring Well, located immediately south of the subject properties, encountered 1,410 feet of Merced Formation sandstone and claystone, but did not encounter Franciscan Complex bedrock (Luhdorff and Scalmanini, 2004). The regional geology is depicted on the attached Figure 2, Regional Geologic Map.

SITE CONDITIONS

The subject site is located at the top of a coastal bluff. The relatively level property sits approximately 210 feet above the base of the bluff, which is at Elevation 12'. The site is bound to the west by a very steep west-facing slope that defines the headscarp of large landslide. Olympic Way bounds the property to the east and undeveloped parcels abut the site to the north and south. The Mar Vista properties were developed as early as 1943 and the development has been in roughly its current configuration since at least 1955. The Olympic Way Retreat properties also contained some infrastructure as early as 1943; however, these properties have been undeveloped since at least 1965.

The Thornton Beach Landslide, characterized by a very large, down-dropped and back-rotated landslide block, is located immediately downslope from the subject properties, and has been recognized as large landslide complex for over 100 years. The landslide extends along the coastline for a distance of approximately 4,000 feet, and has an average width of approximately 450 feet downslope of the Mar Vista property. The landslide block contains a lower bluff face, approximately 100 feet in height, with precipitously steep slopes up to approximately 35- to 45-degree inclinations. This lower bluff face is exposed to coastal wave attack. An upper bluff face rises above the landslide block, and is characterized by a 120-foot high, very steep bluff face. Coastal bluff average long-term retreat rates for this portion of the coastline have been documented to be approximately 1 foot per year. We note that this long-term average bluff retreat rate was likely calculated for the top of the lower bluff face.

GEOLOGIC HAZARDS

Landslides

Landsliding presents the most significant geologic hazard to the subject site. The potential for headward (landward) advancement upslope from the large Thornton Beach Landslide appears to be the most likely landslide mechanism to impact the subject site. The Thornton Beach Landslide is a deep rotational slump type landslide that is thought to have developed as recently as 400 years ago (Liebhardt, 2002). The Thornton Beach Landslide is depicted on our Engineering Geologic Map of the site as Ols2 (Figure 3). In addition to the Thornton Beach Landslide, a complex of several large landslides is located to the north of the subject site. We have grouped these slides together and refer to them as the Olympic Club Landslide (Ols1 on Figure 3). The Olympic Club Landslide appears to have advanced southward over time. During our site reconnaissance we observed relatively small (6 to 8 foot tall) scarps at the southern end of the Olympic Club Landslide. The most recent landslide affecting the area occurred in the early 1970s along the southern end of the Thornton Beach Landslide. This landslide is known as the Lynvale Court Landslide, named after the residential cul-de-sac that it truncated, eventually forcing the demolition of six houses.

In addition to the large deep-seated landslides, numerous shallow landslides are located along the steep upper bluff face, and along the lower bluff face.

The mechanism that will eventually cause headward migration of the Thornton Beach Landslide is the removal of buttressing material at the toe of the landslide due to coastal erosion of the lower bluff face by wave action associated with high surf and winter storms. The bluff subject to this type of erosion is depicted on our Engineering Geologic Map. The bluff retreat rate for this lower bluff has been estimated to be 13 inches per year (Griggs, 2005). Over a 75 year design life of a structure this would equate to over 80 feet of retreat of this lower bluff.

No evidence of recent activity of the Thornton Beach Landslide was observed during our reconnaissance, or in our review of the historical aerial photographs. No landslide activity has been documented for the large landslide mass in at least 100 years. Numerous smaller landslides are evident along the toe and the headscarp in the historical aerial photograph record, and in the field.

Seismic Setting

The site is situated in an area of high seismicity. The nearest controlling active fault is the San Andreas fault, located approximately 5,000 feet southwest of the site. Intense ground shaking should be anticipated during the design life of any structure located on the site; however, the risk of surface rupture at the site is very low.

CONCLUSIONS AND RECOMMENDATIONS

Geomorphic Analysis

In order to evaluate the impact of headward advancement upslope from the Thornton Beach Landslide on the subject properties, we developed Engineering Geologic Cross Section A-A' (Figure 4). Utilizing the subsurface data available from the Thornton Beach Monitoring Well, and following previous analysis done of the slide by Bonilla (1960), we attempted to correlate geologic units described in the monitoring well log with geologic units observed in the field within the displaced landslide blocks. Based on our analysis, there appear to be two major events of rotational slumping of the large Thornton Beach Landslide block that are preserved in the field today. The geomorphic expression of these events include the north-south oriented ridges that form closed depressions on their landward side, and variably dipping bedrock units across discrete landslide blocks. The width of the most recent rotational slump block (approximately 150 to 200 feet) can serve as an approximate analog for the potential width of a future event. Based on this analysis we determined that a likely width of a future failure could be approximately 150 to 200 feet from the current headscarp/top of bluff. Once we developed this width we plotted an arcuate failure surface on our Engineering Geologic Map to determine if a new headscarp 150 to 200 feet inland could produce a reasonable landslide geometry and if that geometry was similar to what we see in the existing landslide. This estimated future headward expansion is shown on both the Engineering Geologic Map (Figure 3) and on Engineering Geologic Cross Section A-A' (Figure 4). It should be noted that the northern limit of the estimated future headward expansion was shifted inland to account for the potential influence of the southward expansion of the Olympic Club Landslide.

Slope Stability Analysis

It is important to note that no slope stability analysis was performed as part of this study. Slope stability analysis was performed by Liebhardt in 2002 as part of his Master's Thesis utilizing laboratory testing data from nearby sites. When removing 20 feet of buttressing material at the toe of the landslide Liebhardt derived a factor of safety of 0.71 at a point 200 feet inland of the existing headscarp. A factor of safety is a way to quantify the stability of a slope. A value of 1.0 is threshold for slope failure, values less than 1.0 indicate that a slope is failing. Values greater than 1.0 indicate the slope is marginally stable. The standard of practice is to design for a static safety factor of over 1.5.

Preliminary Building Setback

Based on this study and the previous slope stability analysis, it is our opinion that the line depicted on our Engineering Geologic Map is a preliminary estimate of a likely failure line, but should not be used to guide setback criteria at this time. This line is our best estimate of an appropriate setback from the limit of future landward advancement of the headscarp of the landslide. **This line does not represent a factor of safety of 1.5**. The only way to develop a building setback line for use in design is to perform a detailed site investigation including detailed mapping, subsurface exploration, laboratory testing and slope stability analysis. Such an investigation could generate a factor of safety line of 1.5 that shifts the potential building envelope farther from the bluff or closer to the bluff.

Coastal Commission Considerations

Based on our understanding of the 2003 California Coastal Commission Memorandum "Establishing development setbacks from coastal bluffs" a slope stability analysis establishing a factor of safety of 1.5 will be required prior to Coastal Commission approval of a proposed development. Our understanding of the California Coastal Act is that mitigation measures that would improve the slope stability of the site will not be allowed for new construction. In addition to the 1.5 factor of safety setback line, the Coastal Commission requires that an additional buffer be added to the setback to account for the anticipated bluff retreat over the life of the development, typically 75 years. At the subject site the established bluff retreat rate is 13 inches per year, and was likely calculated for the top of the lower bluff face. However, it is likely that the upper bluff would be determined to be the jurisdictional 'top of the coastal bluff'. A separate retreat rate analysis of the upper bluff could be performed and could reduce the incremental long-term retreat rate, and thereby, potentially reduce the setback

Geotechnical Feasibility

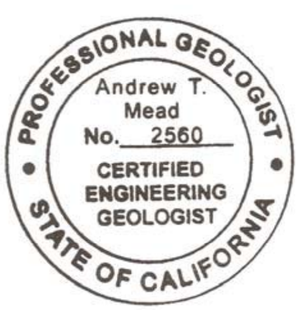
Based on preliminary geologic mapping and evaluation of aerial photographs, it appears that the western half of the property may fall within the limits of a no-build zone, and possibly more. Available information, and our experience with coastal bluffs in this area, suggest that the area within 150 to 200 feet of the top of the headscarp/bluff has a significant risk of future landslides. Appropriate setbacks would need to be identified based upon a detailed geologic and geotechnical investigation.

LIMITATIONS

Our services consist of professional opinions and recommendations made in accordance with generally accepted engineering geology and geotechnical engineering principles and practices. No warranty, expressed or implied, or merchantability of fitness, is made or intended in connection with our work, by the proposal for consulting or other services, or by the furnishing of oral or written reports or findings.

We trust that this provides you with the information that you need at this time. If you have any questions, or need additional information, please call.

Respectfully submitted,



COTTON, SHIRES AND ASSOCIATES, INC.

Andrew T. Mead
Principal Engineering Geologist EG 2560

AM:JW:st
Attachment: References, List of Aerial Photographs Reviewed, Figures

REFERENCES

California Coastal Commission, 2003, Establishing Development Setbacks From Coastal Bluffs, Memorandum

California Geological Survey, 2002, Note 36, California Geomorphic Provinces.

California Geological Survey, 2000, Earthquake Zones of Required Investigation, San Francisco South Quadrangle..

Bonilla, M. G., 1960, Landslides in the San Francisco South Quadrangle, California, U.S. Geologic Survey, OFR 60-15.

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Gilpin Geosciences, Inc., 2007, Engineering Geologic Evaluation Vista Grande Basin Alternatives Thornton State Beach/Fort Funston Daly City/San Francisco.

Johnson, M. J., 2005, "Establishing Development Setbacks From Coastal Bluffs" in California and the World Ocean – Proceedings of the Conference, p. 396-416.

Liebhardt, M. D., 2002, The Thornton Beach State Park Deep Rotational Landslide Daly City, California, Thesis.

McGuire, T., 2009, Stratigraphic Investigation of the North Westside Basin of San Francisco and Northern San Mateo County, Thesis.

Luhdorff and Scalmanini Consulting Engineers, 2004, Update on the Conceptualization of the Lake-Aquifer System West Ground-Water Basin, San Francisco and San Mateo Counties.

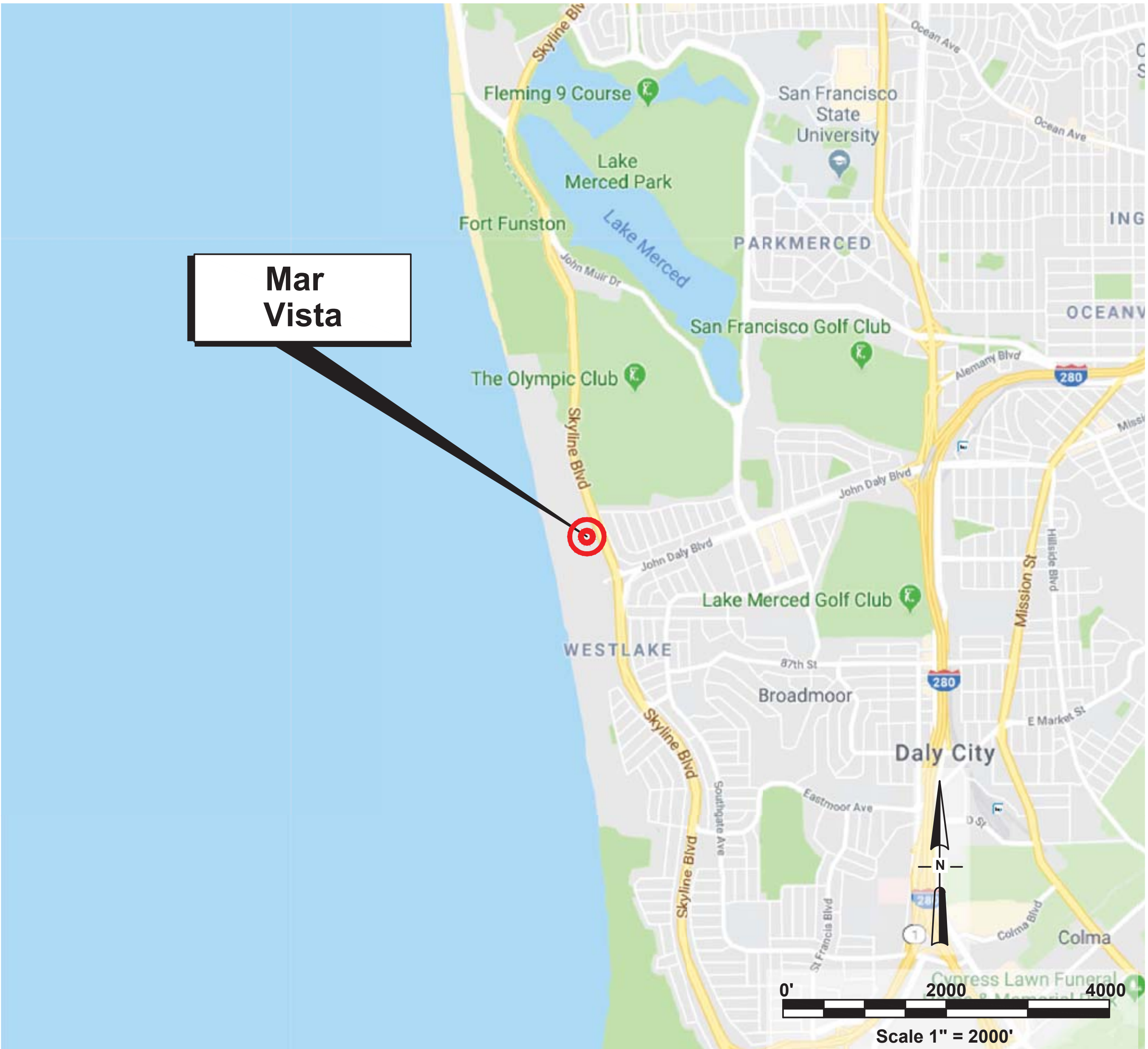
San Francisco Public Utilities Commission, 2018, 2017 Annual Groundwater Monitoring Report Westside Basin, San Francisco and San Mateo Counties, California.

Griggs, G, Weber, J, Lajoie, K. R., Mathieson, S., 2005, "San Francisco to Ano Nuevo" in Living With the Changing California Coast, p. 228-234.

Aerial Photographs Reviewed (Pacific Aerial Surveys)

Date	Flight Number	Line	Photo	Number of Photos
10/17/2005	9200	20	1/2	2
		21	1/2	2
		22	1/2	2
3/10/2005	9010	64	1/2	2
		65	1/2	2
		66	1/2	2
8/17/2001	7091	2	15-17	3
8/15/2000	6600	2	8-10	3
6/23/1997	5434	2	11-13	3
9/7/1995	4916	2	8-10	3
8/8/1995	4905	1	5-7	3
6/10/1994	4661	1	1-10	3
8/27/1993	4515	2	8-11	4
10/30/1991	4168	1	6-8	3
10/30/1991	4146	1	4/5	2
11/3/1993	4130	7	35/36	2
7/2/1991	4075	2	10-12	3
6/21/1989	3593	1A	1/2	2
6/19/1989	3556	1	7-10	4
5/4/1988	3293	1	8/9	2
3/24/1987	3048	1	2/3	2
3/24/1987	3047	1	1/2	2
10/1/1986	2944	1	7-9	3
10/14/1985	2670	1	9-12	4
10/10/1985	2664	1	1	1
4/23/1985	2600	06	16-17	2
5/11/1983	2265	01	8-10	3
7/13/1981	2050	5	29/30	2
6/19/1981	2020	1	9/12	4
5/30/1979	1705	1	10-13	4
5/11/1979	1700	05	24/25	2
5/27/1977	1356	01	7-9	3
		02	10-13	4
12/16/1975	1215	05	23/24	2
4/28/1975	1188	01	7-11	5
5/11/1972	1045	02	12,14&15	3 frame 13 out of stock

Date	Flight Number	Line	Photo	Number of Photos
9/8/1970	965	04	26/27	2
10/29/1969	933	02	8-11	4
4/9/1968	844	08	34-36	3
2/20/1967	784	20	05/06	2
4/14/1966	710	04	27/28	2
7/9/1963	550	03	23-25	3
		04	24/25	2
4/23/1958	279	01	12&15	2 frames out of stock
		02	14/15 & 18	3 frames out of stock
5/10/1955	170	02	11-14	4
7/28/1948	17	Frame out of stock		
7/29/1946	9	10	1-3	3
3/21/1938	8	1	09-13	5
		2	10-13	3
1935	248	07	12-13	2
		08	8/9	2



Reference: Google Maps, 2019.

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CONSULTING ENGINEERS AND GEOLOGISTS

SITE LOCATION MAP MAR VISTA DALY CITY, CALIFORNIA		
GEO/ENG BY AM	SCALE 1"=2000'	PROJECT NO. G5019
APPROVED BY JW	DATE April 2019	FIGURE NO. 1

Reference: Preliminary Geologic Map of the San Francisco South 7.5' Quadrangle and Part of the Hunters Point 7.5' Quadrangle, San Francisco Bay Area, California, M.G Bonilla, USGS OFR 98-354, 1998.

EXPLANATION

Qaf - Artificial Fill
Ql - Landslide Deposits
Qd - Dune Sand
Qc - Colma Formation
QTm - Merced Formation

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REGIONAL GEOLOGIC MAP
MAR VISTA
DALY CITY, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
AM	1"=2000'	G5019
APPROVED BY	DATE	FIGURE NO.
JW	April 2019	2

Qd
Estimated Next Likely Headward Expansion of Landslide
A'
Mar Vista and Olympic Way Retreat Properties
Qc
Af
QTm
Thornton Beach Monitoring Well
Olympic Club Landslide
Ols_1
Thornton Beach Landslide
Ols_2
Als
Qb
Lynvale Court Landslide
A
North
0 75 150 300
(feet)
EXPLANATION
Earth Materials
Af Artificial Fill
Als Active Landslide
Ols Old Landslide, Subscript 1 Indicates the Olympic Club Landslide, Subscript 2 indicates the Thornton Beach Landslide
Qb Beach Sand
Qd Dune Sands
Qc Colma Formation
QTm Merced Formation
Map Symbols
56 Bedrock Orientation of Both In Place Bedrock and Blocks Displaced by Landslides
Geologic Contact, Dashed Where Approximate
Landslide, Arrows Indicate Direction of Movement
Coastal Bluff Subject to Erosion Due to Wave Impact
A' A Engineering Geologic Cross Section Location
Thornton Beach Monitoring Well Approximate Boring Location, Drilled by Others, 2003.
DRAFT
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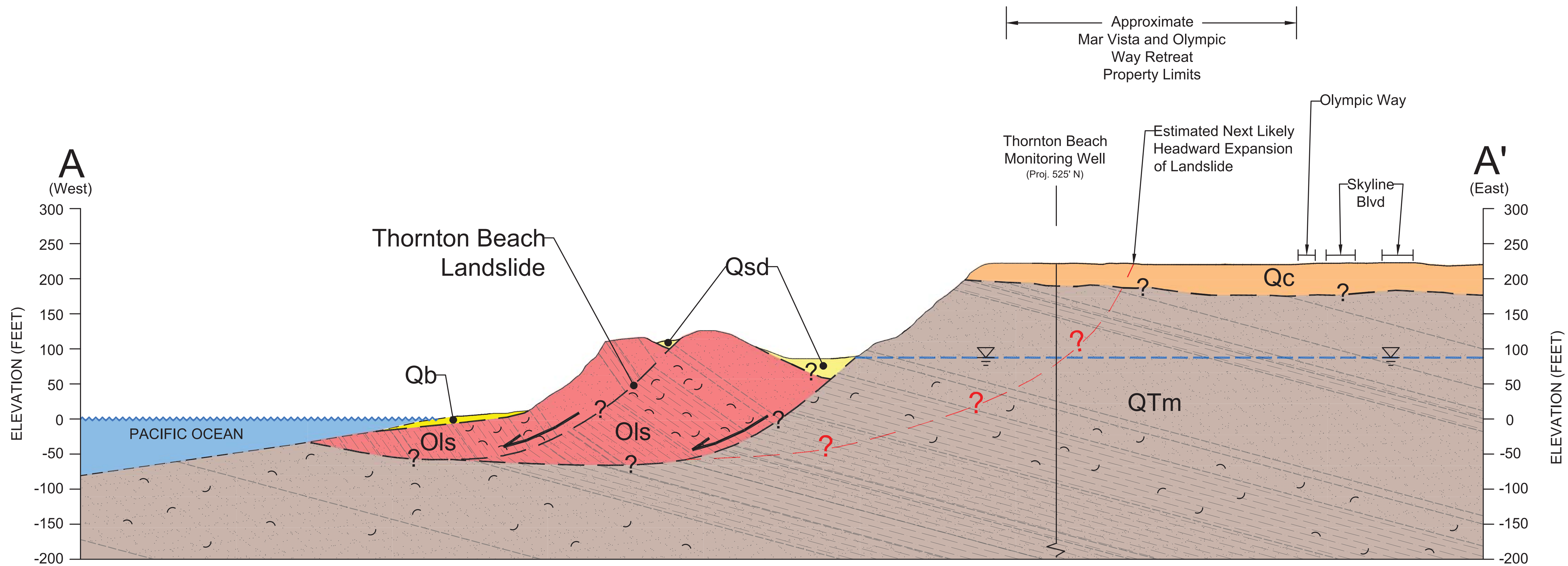
ENGINEERING GEOLOGIC MAP
MAR VISTA
DALY CITY, CALIFORNIA
GEO/ENG BY AM
SCALE 1"=150'
PROJECT NO. G5019
APPROVED BY JW
DATE April 2019
FIGURE NO. 3



EXPLANATION

Earth Materials

Qb	Beach Sand
Qsd	Slope Debris / Graben Fill
Ols	Old Landslide Deposit (Thornton Beach Landslide)
Qc	Colma Formation
QTm	Merced Formation

Symbols

Shells

Clay

Sand

Geologic Contact, Dashed Where Approximate, Queried Where Uncertain

Groundwater Surface Average level in Thornton Beach Monitoring Well 225 (2003-2017)

DRAFT

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ENGINEERING GEOLOGIC CROSS SECTION A-A'
MAR VISTA
DALY CITY, CALIFORNIA

GEO/ENG BY	SCALE	PROJECT NO.
AM	1"=150'	G5019
APPROVED BY	DATE	FIGURE NO.
JW	April 2019	4

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PRELIMINARY BUILDING SETBACK MAP
MAR VISTA
DALY CITY, CALIFORNIA

GEO/ENG BY AM	SCALE 1"=60'	PROJECT NO. G5019
APPROVED BY JW	DATE April 2019	FIGURE NO. 5