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TECHNICAL MEMORANDUM

To: Cam Boyd, Chief Operating Officer
Coastal Community Builders
330 James Way, Suite 270
Pismo beach, CA 93449

From: Ben Snyder, M.S., P.E., Senior Restoration Engineer
Jessica Ha, Assistant Staff Restoration Engineer

Date: July 12, 2023

Re: **Coastal Flood Risk Evaluation for 197 West Grand Avenue, Grover Beach, San Luis Obispo County, California / SWCA Project No. 81984**

EXECUTIVE SUMMARY

SWCA Environmental Consultants (SWCA) evaluated flood risk for the property at 197 West Grand Avenue, Grover Beach, San Luis Obispo County, California, to determine a suitable ground elevation to mitigate coastal flood risk. The parcel elevation should be no lower than the sum of the existing 100-year coastal flood elevation and the projected increase in local sea level. The most up-to-date guidance from federal and state governments was used and a hydraulic model was developed to simulate a wide range of coastal and riverine flood scenarios. The design life of the proposed structure is roughly 75 years; therefore, sea level rise projections for the Year 2100 were used.

Per the Federal Emergency Management Agency (FEMA) flood insurance study for the coastal flood transect nearest to the subject property (Transect 72), the 100-year water surface elevation is 15.2 feet NAVD88. The projected sea level rise is 6.7 feet for the year 2100, assuming high emissions, for the medium-to-high risk category. The sum of sea level rise and 100-year coastal flood is 21.9 feet NAVD88. The topographic survey showed that the existing ground surface is between 19 and 21 feet NAVD88. The development should have a ground floor elevation of at least 22 feet NAVD88 to mitigate coastal flood risk and the effects of climate change for the rest of this century. SWCA's assumptions, methods, and results are provided in the following sections.

BACKGROUND AND OBJECTIVES

Coastal Community Builders (CCB) is proposing a redevelopment project at 197 West Grand Avenue, Grover Beach, San Luis Obispo County, California. Because the subject property is in the coastal zone, the City of Grover Beach (City) requested engineering documentation of coastal flood risk at the subject property. SWCA evaluated flood risk due to sea level rise, storm surge, astronomical tides, wind, waves, and wave runup. An additional source of flood risk, Meadow Creek, was identified during the analysis and evaluated. The creek flows from north to south directly adjacent to the subject property (Figure 1).

Figure 1. Location map showing subject property in relation to the Pacific Ocean and Meadow Creek.

Additional site information was provided to SWCA by CCB, including a property boundary and topographic survey, which are included as Appendix A.

METHODS

Flood risk for the subject property was analyzed using FEMA flood insurance studies and rate maps, State of California projections for sea level rise, and hydraulic modeling of the site. Assumptions and methods related to each task are documented in the following sections.

FEMA Flood Insurance Study

A flood insurance study for San Luis Obispo County and incorporated areas was published by FEMA in May 2017 (FEMA 2017). The study showed that the 100-year water surface elevation, considering tides, storm surge, and wind effects, is 15.2 feet NAVD88 at the transect closest to the subject property (Transect 72). The flood insurance study also reported that the 100-year peak discharge for Meadow Creek is 3,500 cubic feet per second.

State of California Sea-Level Rise Guidance

The State of California Sea-Level Rise Guidance provided probabilistic projections for the height of sea-level rise in feet (California Ocean Protection Council 2018). These probabilistic projections are recommended projections for use in low, medium-high, and extreme risk aversion decisions. An example of a low-risk aversion project would be a coastal trail. An extreme-risk aversion project would be an airport or wastewater treatment facility. Residential developments tend to be in the medium-high risk category. The State of California further refines projections based on assumptions of low or high future emissions. The study was released in 2018, and global carbon dioxide (CO_2) emissions have continued to rise since its publication. Therefore, the "high emissions" scenario was used for this analysis. CCB

directed SWCA to assume that the design life of the structure will extend until at least Year 2100 (CCB 2023). Referring to Table 1 for the Year 2100 high emissions medium-to-high risk aversion, the projected sea level rise is 6.7 feet.

Table 1. Sea Level Rise Projections for Port San Luis, California

		Probabilistic Projections (in feet) (based on Kopp et al. 2014)					H++ scenario (Sweet et al. 2017) *Single scenario
		MEDIAN	LIKELY RANGE		1-IN-20 CHANCE	1-IN-200 CHANCE	
		50% probability sea-level rise meets or exceeds...	66% probability sea-level rise is between...		5% probability sea-level rise meets or exceeds...	0.5% probability sea-level rise meets or exceeds...	
				Low Risk Aversion		Medium - High Risk Aversion	Extreme Risk Aversion
High emissions	2030	0.3	0.2 -	0.5	0.5	0.7	1.0
	2040	0.5	0.3 -	0.7	0.8	1.2	1.6
	2050	0.7	0.5 -	1.0	1.2	1.8	2.6
Low emissions	2060	0.8	0.4 -	1.1	1.4	2.2	
High emissions	2060	1.0	0.6 -	1.3	1.7	2.5	3.7
Low emissions	2070	0.9	0.5 -	1.3	1.7	2.9	
High emissions	2070	1.2	0.8 -	1.7	2.2	3.3	5.0
Low emissions	2080	1.0	0.6 -	1.6	2.1	3.6	
High emissions	2080	1.5	1.0 -	2.1	2.8	4.3	6.4
Low emissions	2090	1.1	0.6 -	1.8	2.5	4.5	
High emissions	2090	1.8	1.1 -	2.6	3.4	5.3	8.0
Low emissions	2100	1.3	0.7 -	2.1	2.9	5.4	
High emissions	2100	2.1	1.3 -	3.1	4.1	6.7	9.9
Low emissions	2110*	1.4	0.8 -	2.2	3.1	5.9	
High emissions	2110*	2.3	1.5 -	3.2	4.2	7.0	11.6
Low emissions	2120	1.5	0.8 -	2.4	3.5	7.0	
High emissions	2120	2.6	1.8 -	3.7	4.9	8.2	13.8
Low emissions	2130	1.6	0.9 -	2.7	4.0	8.0	
High emissions	2130	2.9	2.0 -	4.3	5.7	9.6	16.2
Low emissions	2140	1.7	0.9 -	3.0	4.5	9.2	
High emissions	2140	3.2	2.1 -	4.8	6.4	11.1	18.7
Low emissions	2150	1.9	0.8 -	3.3	5.1	10.5	
High emissions	2150	3.6	2.3 -	5.4	7.3	12.6	21.5

*Most of the available climate model experiments do not extend beyond 2100. The resulting reduction in model availability causes a small dip in projections between 2100 and 2110, as well as a shift in uncertainty estimates (see Kopp et al. 2014). Use of 2110 projections should be done with caution and with acknowledgement of increased uncertainty around these projections.

Hydraulic Modeling

Hydraulic modeling was performed to evaluate a range of existing and future coastal and riverine flooding scenarios, including coincident flooding of Meadow Creek with an extreme high tide event. A digital elevation model (DEM) with 1-meter resolution was retrieved from the U.S. Geological Survey (USGS). The DEM was re-projected to NAD83 California Zone 5, converted to units of U.S. feet, and imported to the U.S. Army Corps of Engineer's hydraulic modeling software program (HEC-RAS Version 6.3.1). A rectilinear mesh was created for the study area using 100-foot grid cells. The mesh was refined by adding additional computation points within the known areas of concentrated flow. The terrain was modified to raise the subject parcel to a height of 22 feet NAVD88 in the proposed conditions scenario.

Maps illustrating distribution of water depths for various scenarios are presented in the following figures. Figure 2 illustrates that the subject property is not inundated by a 100-year flood event under existing conditions. Figure 3 illustrates that the subject property would be inundated by a 100-year flood event under future conditions, without mitigating flood risk by raising the property. Figure 4 illustrates that the property would not be inundated by a 100-year flood event in Year 2100 if raised to 22 feet NAVD88.

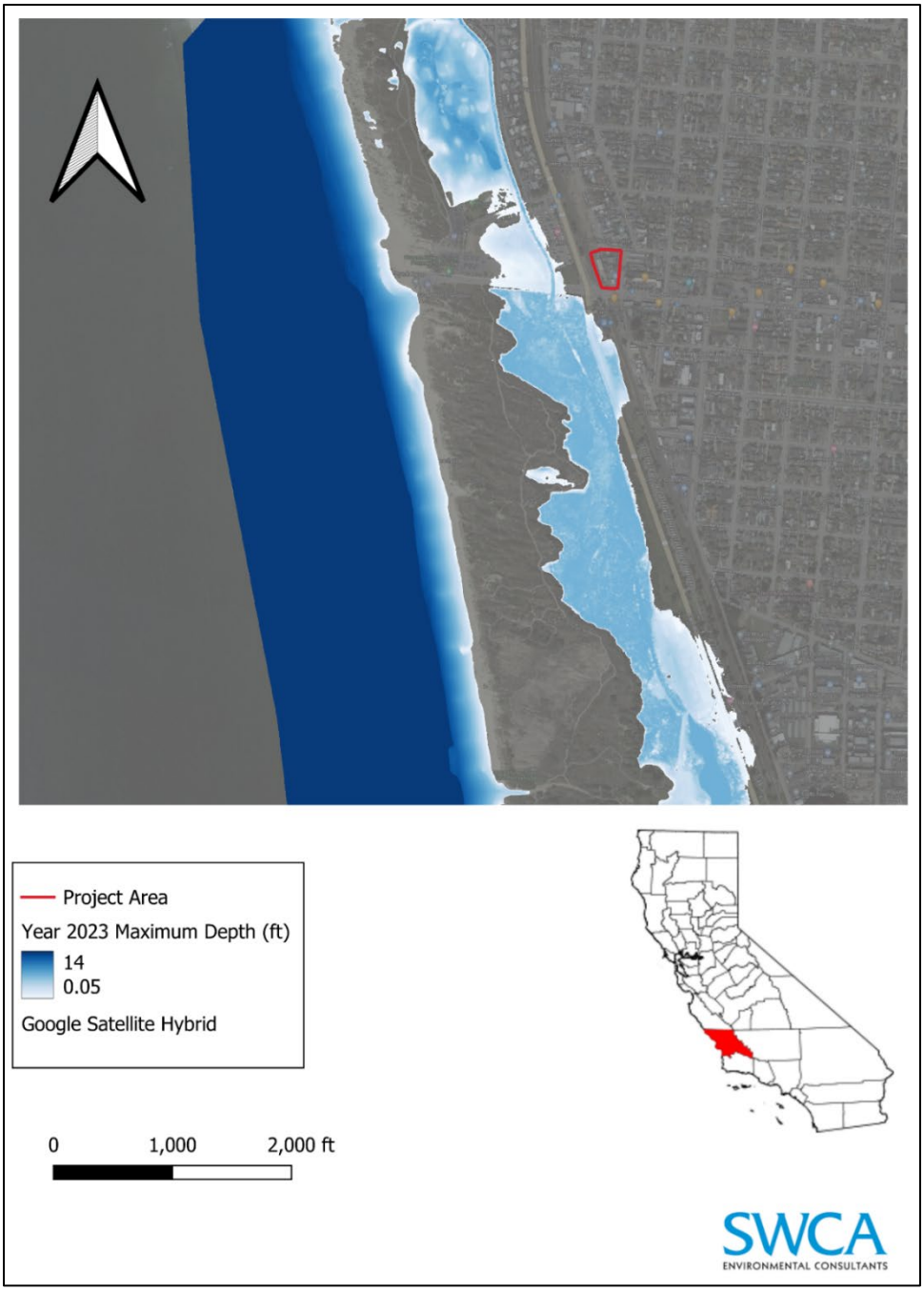

Figure 2. Existing conditions, 100-year flood depth, showing subject parcel to not be inundated.

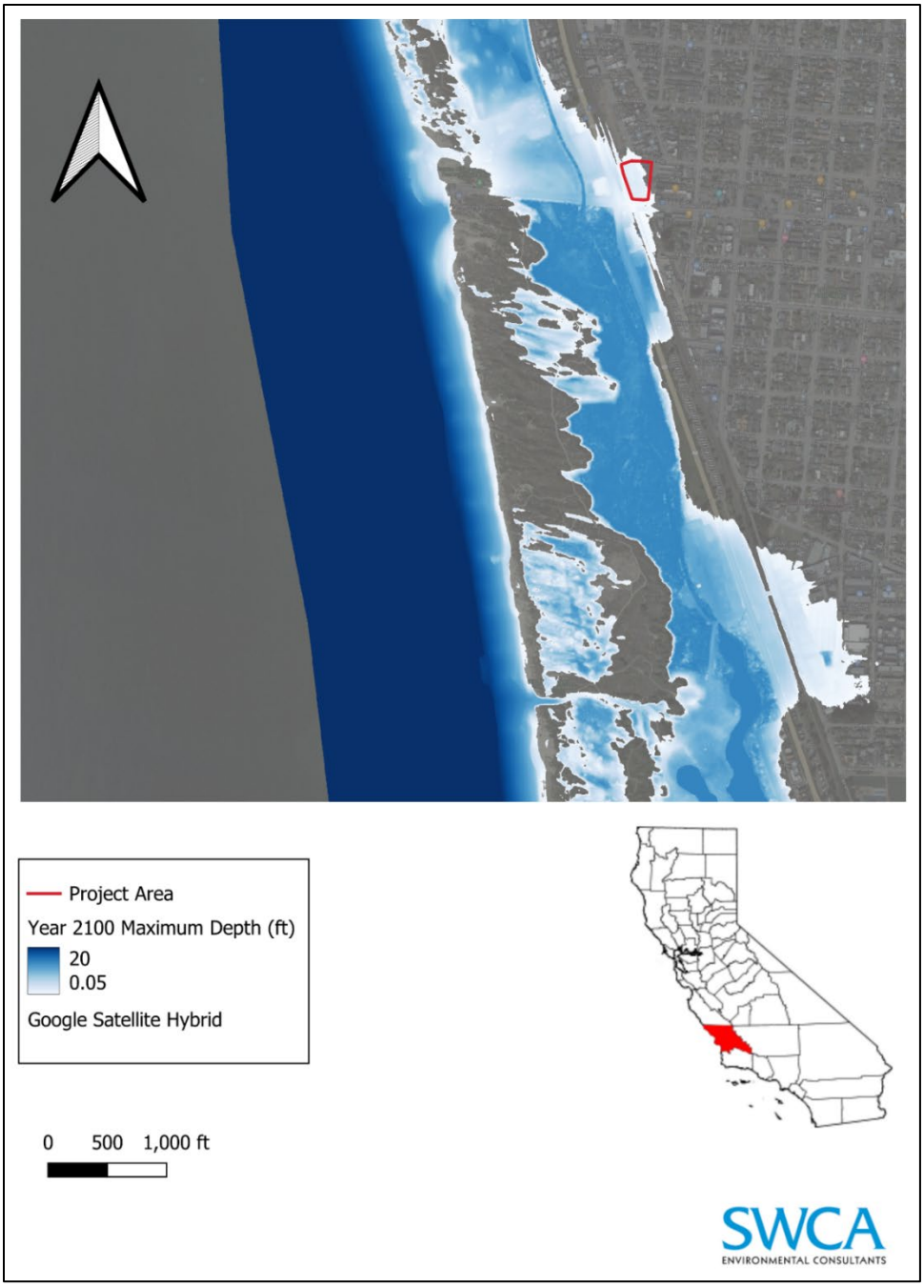

Figure 3. Existing conditions, Year 2100 sea level rise, 100-year flood event, showing subject property to be inundated.

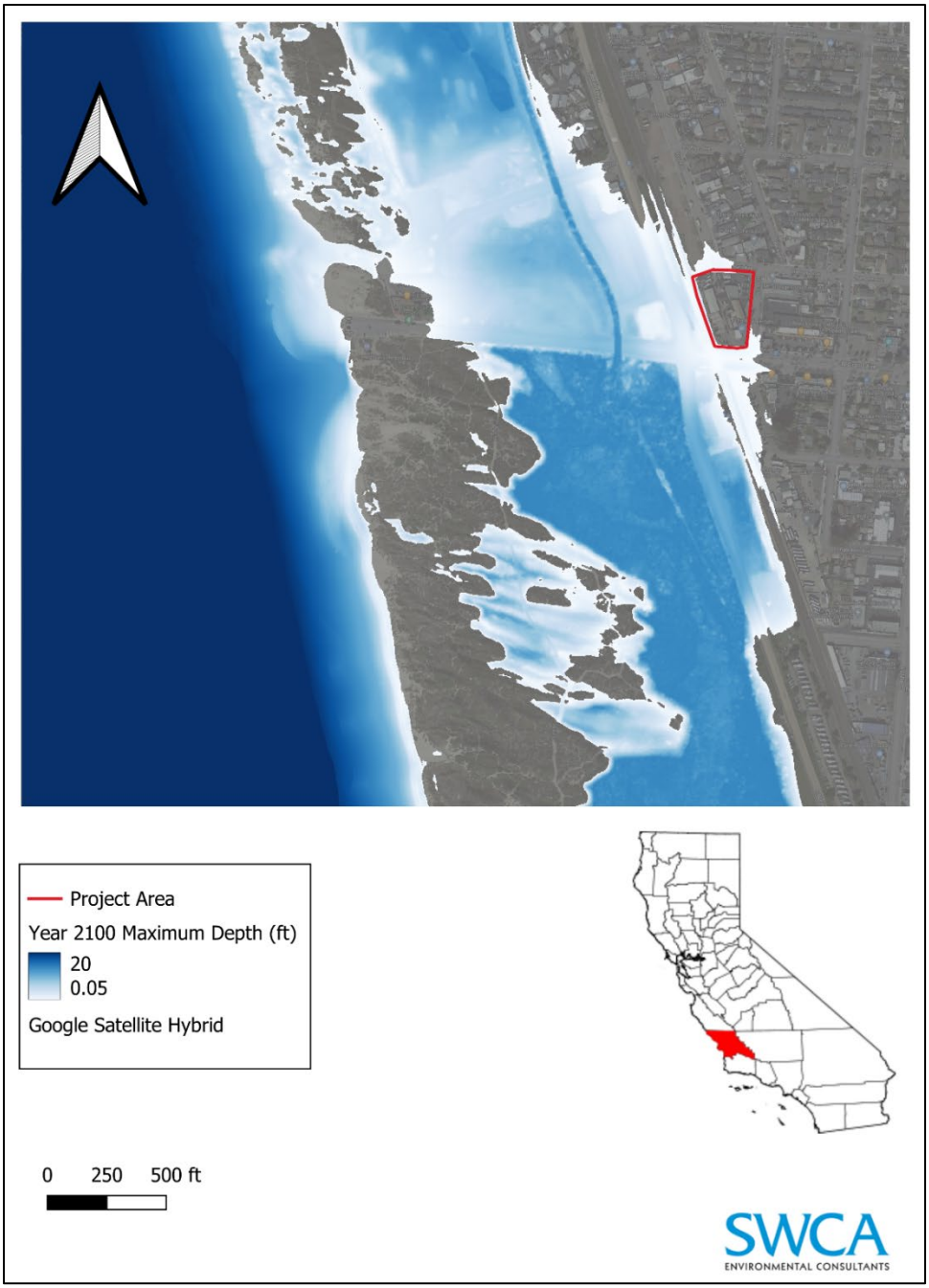

Figure 4. Proposed conditions, Year 2100 sea level rise, 100-year flood event, showing subject property to not be inundated when raised to 22 feet NAVD88.

CONCLUSION

This engineering evaluation of coastal and riverine flood risk for the property at 197 West Grand Avenue has identified 22 feet NAVD88 as a suitable elevation to mitigate flood risk due to future sea level rise.

REFERENCES

California Ocean Protection Council. 2018. *State of California Sea-Level Rise Guidance: 2018 Update*. Available at: http://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3_Exhibit-A_OPC_SLR_Guidance-rd3.pdf. Accessed July 2023.

Coastal Community Builders. 2023. Personal communication. Email from Cam Boyd to Ben Snyder, P.E. June 8.

Federal Emergency Management Agency (FEMA). 2017. *Flood Insurance Study: San Luis Obispo County, CA*. FIS No. 06079CV001C. Available at: https://msc.fema.gov/portal/home. Accessed July 2023.

APPENDIX A

Additional Site Information