6. Sector Results

This Chapter describes the results of the vulnerability assessment and potential physical and fiscal impacts associated with inaction in the face of rising sea levels and coastal hazards in Carpinteria.

This Chapter provides detailed results of the potential risks to multiple sectors for the various sea level rise elevations and coastal hazards. This includes a geospatial analysis of each resource and infrastructure sector and an evaluation of the potential costs and economic losses assuming no action is taken to prevent or minimize erosion, flooding, or inundation. Please refer to Chapter 1, *Sector Profiles*, for information of additional resource and service elements vulnerable to coastal hazards.

Based on the unique characteristics of the City's coastline and watersheds, input from City staff, the Coastal Land Use Plan (CLUP)/General Plan Update Committee, and the public, the sectors listed below were chosen specifically to support policy development. The sectors analyzed include:

- Land Use and Structures;
- Roads, Parking, and Public Transportation;
- Camping and Visitor Accommodations;
- Coastal Access and Trails;
- Hazardous Materials Sites, and Oil and Gas Wells;
- Stormwater, Wastewater, and Water Supply Infrastructure;
- Community Facilities and Critical Services;
- Environmentally Sensitive Habitat Areas (ESHA);
- Social Vulnerabilities; and
- Housing.

The 2018 Ocean Protection Council (OPC) *State of California Sea-Level Rise Guidance* requires consideration of the H++ scenario for critical facilities. The identified sectors with vulnerable critical facilities include Section 6.2, *Roads, Parking, and Public Transportation,* and Section 6.6, *Infrastructure*. No modeling data is available for the H++ scenario, which provides another measure of uncertainty in that all vulnerable sectors with impacts occurring with 5 feet of sea level rise by 2100 could occur as early as 2070. It is also noted that coastal hazarding modeling indicates that existing fluvial flood hazards appear to be a larger threat to the City when compared to coastal hazards, even with approximately 5 feet of sea level rise. While analysis in this Report focuses upon coastal hazards, a discussion of fluvial flooding hazards is contained within Appendix C.

6.1 Land Use and Structures

Analysis of land uses is based on County Assessor parcel data including structures. Land use types are classified as either residential, commercial, industrial, open space, or public facilities. Parcels, land area, structures, and structure area at risk are quantified to the extent feasible. Since residential land uses are particularly vulnerable, this Report examines vulnerabilities to residential structures by type (e.g., condominiums, apartments, multi-family and single-family residences). The following assumptions support understanding and interpretation of the land use analysis.

- Parcels may contain multiple non-dwelling structures (e.g., garages and sheds). Some parcels may be vacant and contain no structures. Not all structures are affected by hazards; this comprises 9 percent of the total tally (i.e., the parcel is affected, and the structure is not). Parcels where less than 1 percent of the parcel area is in the hazard zone and where the structure(s) is unaffected by the hazard zone are not included in the structures count (typically parcels that abut stream channels). See Definitions for more information on dwellings.
- Large apartment complexes have multiple units per structure and can have multiple structures per parcel.
- Condominiums typically have multiple units, and therefore multiple parcels per structure. Commonly held condominium parcels (parking and landscaped areas) are not included in the tally.
- Multiple units may exist on one lot (e.g., mobile home parks).
- Multi-family complexes can contain either multiple lots per structure or multiple structures per lot.
- An additional 15 large residential apartments encompassed within 2 complexes are projected to become islands from combined coastal hazards and approximately 5 feet of sea level rise. These units would not be directly vulnerable to coastal hazards and are not included in the analyses.
- Economic analyses rely on County Assessor parcels located within the City limits and include all lots that intersect a coastal hazard flood zone (details on the types and extent of the hazard zones can be found in Figure 5-1, Figure 5-2, Figure 5-3, and Figure 5-4).

The total land area of parcels at risk to coastal hazards with up to 5 feet of sea level rise is 380 acres, encompasses approximately 23 percent of the land area in the City, and 23 percent of all parcels in the City. All structures within these parcels are included for study, and this includes 630 individual structures with a combined area of 28 acres or 1,222,608 square feet. The land use designation for these structures is as follows: 16 Commercial (5 percent), 13 Facilities (4 percent), 11 Industrial (6 percent), 1 Mixed Use (<1 percent), 11 Recreation (1 percent), and 579 Residential (83 percent). Of this total, 106 (17 percent) structures are

coded as an outbuilding[1], which includes garages, car ports, or storage sheds (Table 6-1, Figure 6-1, and Figure 6-3). A total of 1,090 housing units were identified as potentially at risk with up to 5 feet of sea level rise, including up to 218 short-term vacation rentals located primarily in the Beach Neighborhood (City of Carpinteria [City] 2018).

Table 6-1. Vulnerable Land Uses and Structures[2]

Sea Level Rise	Residential	Commercial and Mixed Use	Industrial	Open Space & Recreational	Public Facilities
	(Parcel acres) / (# of Parcels) (Structure sq. ft) / (# of Structures)				
Existing	2.99/79 44,365/19	<0.1/1 0/0	0.15/1 3/1	39.18/42 0/0	0.36/3 0/0
~1 ft	7.00/164 171,147/146	<0.1/1 0/0	0.04/3 1,010/0	13.46/4 5,043/5	0.14/1 0/0
~2 ft	10.29/234 246,526/116	0.23/3 52/2	0.17/2 3,683/1	19.25/5 4,982/4	3.45/3 348/1
~5 ft	24.51/292 430,438/298	5.62/16 29,557/14	4.67/4 62,955/9	33.93/8 3,809/2	5.52/2 51,448/12
Total	**44.80/769** **892,477/579**	**5.85/20** **29,609/16**	**5.02/10** **67,651/11**	**105.82/59** **13,834/11**	**9.48/9** **51,796/13**

Note: All counts and sums are non-cumulative across sea level rise elevations, and categories do not include land in the public right-of-way (e.g., roadways and rail corridors), commonly held residential parcel areas (e.g., trailer park drives, and apartment parking and landscaped areas), flood control channels, and vacant land. The one affected agricultural field is not included. The one affected mixed-use structure is attributed as a commercial land use.

Land Uses at Risk

Figure 6-1 illustrates the increased total exposure (to coastal erosion, coastal flooding and tidal inundation) to parcels and structures over time, according to land use. The majority of vulnerable parcels and structures are residential. Open space and recreational uses are the second most vulnerable land use.

[1] This is a conservative number as it only includes clear outbuildings. Many people rent out space in converted garages, so the actual number may be larger.

[2] 15 additional large residential apartments encompassed within 2 complexes are projected to become islands from combined coastal hazards and approximately 5 feet of sea level rise.

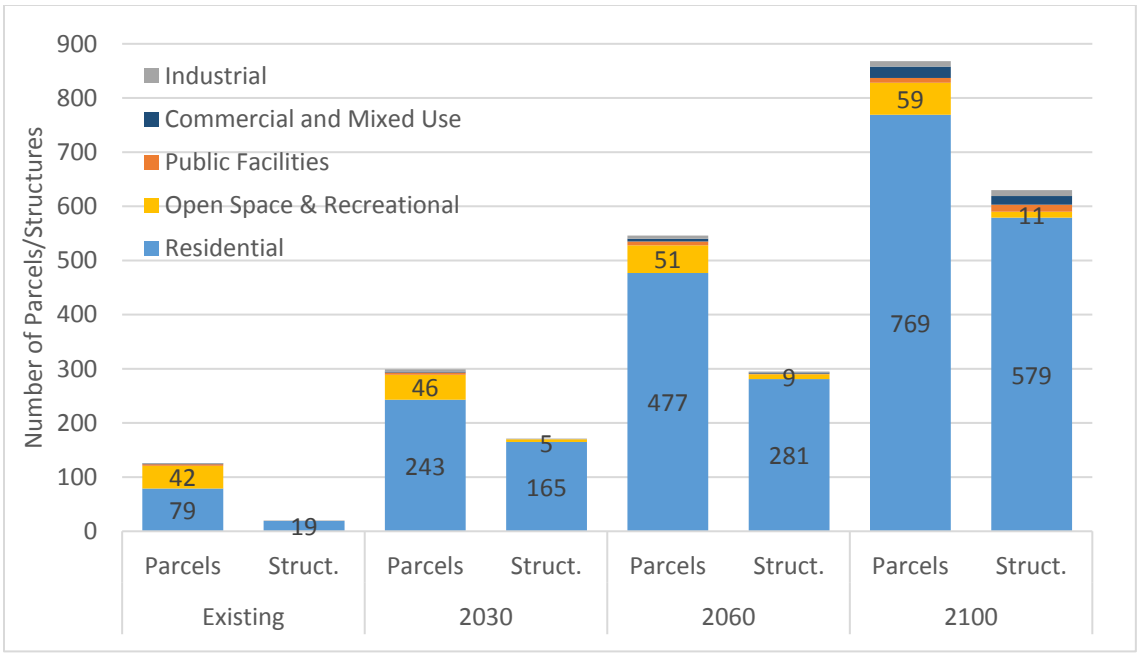


Figure 6-1. *Number of Vulnerable Land Use Parcels and Structures*

Figure 6-2 illustrates the increase in vulnerable land area (measured in acreage) over time, according to property land use. Open space and recreational land uses constitute the majority of the vulnerable land area, as measured by acreage. A significant amount of residential land area is also at risk of coastal hazards, especially with greater elevations of sea level rise.

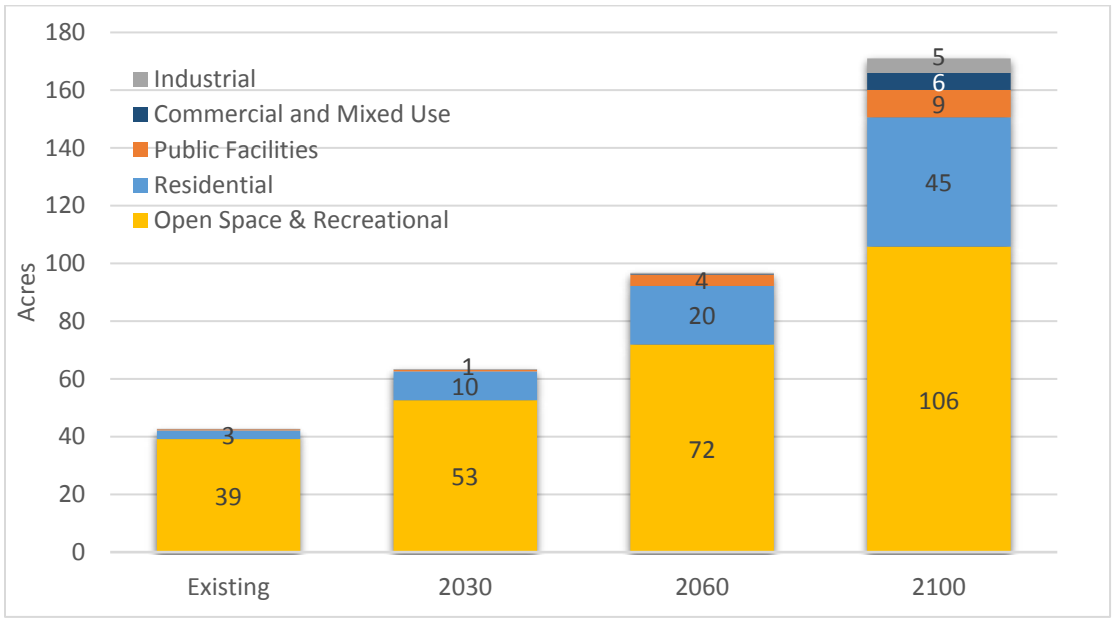
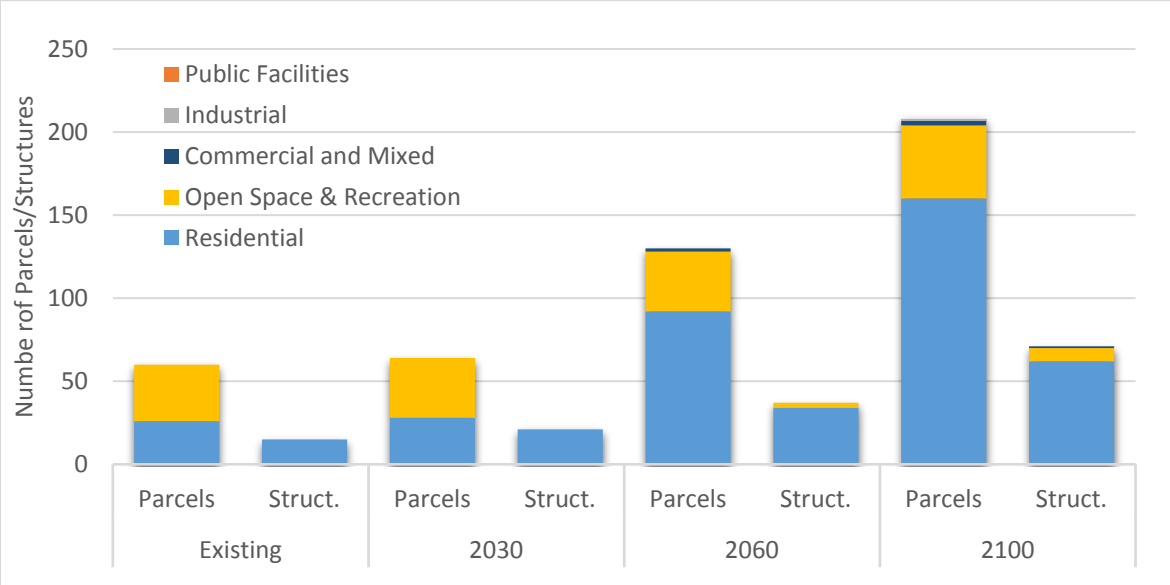


Figure 6-2. *Acres of Vulnerable Land Uses*

Coastal Erosion Impacts to Land Uses and Structures

Figure 6-3 illustrates the number of land use parcels and structures that become vulnerable to coastal erosion with sea level rise. Nearly all vulnerable parcels and structures are either residential, or open space and recreation. Under existing conditions, 60 parcels and 15 structures are at risk to coastal erosion, which escalates with up to 5 feet of sea level rise, to 208 parcels and 71 structures potentially vulnerable to coastal erosion.

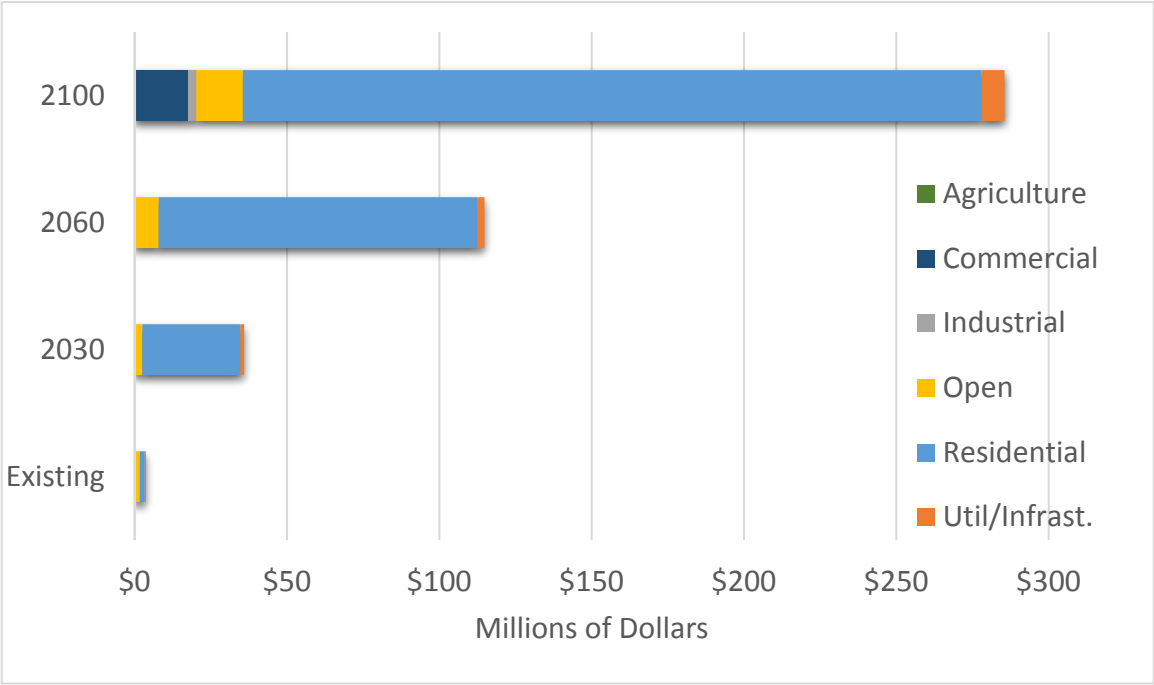


Sea Level Rise	Parcel/ Structure	Residential	Open Space & Recreation	Commercial & Mixed	Industrial	Public Facilities	Total
Existing	Parcels	26	34	0	0	0	**60**
	Structures	15	0	0	0	0	**15**
~1 ft	Parcels	28	36	0	0	0	**64**
	Structures	21	0	0	0	0	**21**
~2 ft	Parcels	92	36	2	0	0	**130**
	Structures	34	3	0	0	0	**37**
~5 ft	Parcels	160	44	3	1	0	**208**
	Structures	62	8	1	0	0	**71**

Note: The number of parcels and structures are cumulative across all time horizons.

Figure 6-3. *Number of Land Use Parcels and Structures Vulnerable to Coastal Erosion During a 1% Annual Chance Storm*

As shown in Figure 6-4, $3.7 million (in 2017 dollars) of property in the City is currently at risk to potential erosion losses should a 1 percent annual chance storm occur without any sea level rise or adaptation strategies implemented. This exposure significantly increases with sea level rise, to $35.9 million with 1 foot of sea level rise, $114.8 million with 2 feet of



sea level rise, and $285.5 million with 5 feet of sea level rise. Residential property most vulnerable to erosion includes beachfront residences, including condominiums and apartments. Approximately 55 short-term vacation rental units are located along the south side of Sandyland Road, and an additional 115 units are located along the north side of the street.

Erosion Losses	Existing	~ 1 ft	~2 ft	~5 ft
Agriculture	$0	$0	$0	$400,000
Commercial	$0	$0	$0	$17,100,000
Industrial	$0	$0	$0	$2,700,000
Open	$1,700,000	$2,500,000	$7,900,000	$15,300,000
Residential	$1,600,000	$32,200,000	$104,500,000	$242,400,000
Utility/ Infrastructure	$400,000	$1,200,000	$2,400,000	$7,600,000
Grand Total	**$3,700,000**	**$35,900,000**	**$114,800,000**	**$285,500,000**

Figure 6-4. *Estimated Value of Property Loss Due to Coastal Erosion from a 1% Annual Chance Storm (2017 dollars)*

Utilities and infrastructure are a category that includes losses and damages to parcels owned by railroad companies, oil, gas and electric companies, water pumps, water and sewer pipes, and roads. Open land, finally, includes open land that has not been developed. As such, these losses to erosion do not include losses to structural improvements. See also Section 6.6, *Infrastructure*.

Revenue Implications to the City

Currently, the City receives approximately $2.3 million in Transient Occupancy Tax (TOT), from hotels, motels, and short-term vacation rentals, with an estimated $400,000 of annual TOT from vacation rentals. Damages to other visitor serving land uses may also affect tourism spending and associated sales tax revenues in the City.

Structures within the Carpinteria Bluffs could become vulnerable to cliff erosion with approximately 5 feet of sea level rise.

This Report estimates the potential property tax loss due to land and structure losses from erosion in 2017 and in 2030 with 1 foot of sea level rise (Table 6-2). Currently, erosion hazards are not expected to result in a loss of property tax revenues; however, losses could be $231,000 (assuming 2017 property tax values). For potential flooding losses, this report assumes that property would be repaired, and property tax rates would not change. Property taxes were not estimated for 2060 and 2100 due to uncertainty about future housing prices and inflation.

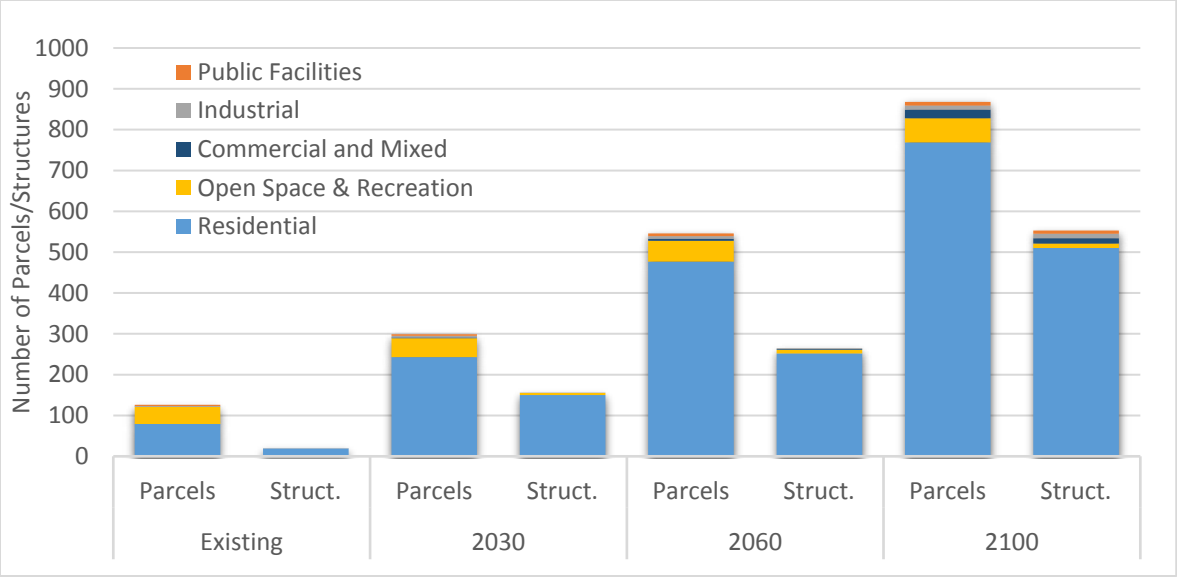
Table 6-2. Estimated Loss in Property Tax from Erosion

	2017	2030
2017 Property Tax Values	$0	$231,000

Coastal Flooding Impacts to Land Uses and Structures, and Infrastructure

Figure 6-5 depicts the number of parcels and structures vulnerable to coastal flooding during a 1 percent annual chance storm. Residential land uses comprise the strong majority, by number, of vulnerable structures and parcels. Open space and commercial and mixed-use uses are also vulnerable to coastal storm damage. The majority of land uses susceptible to coastal storm damage are within the Beach Neighborhood and Downtown.

Estimates of property loss from coastal flooding reflect the vulnerability of damaged property to severe coastal flooding without consideration of coastal erosion damages (Figure 6-6). Increased potential coastal flooding damages is expected with increased sea level rise due to an expanded flood zone and increased flood depths.

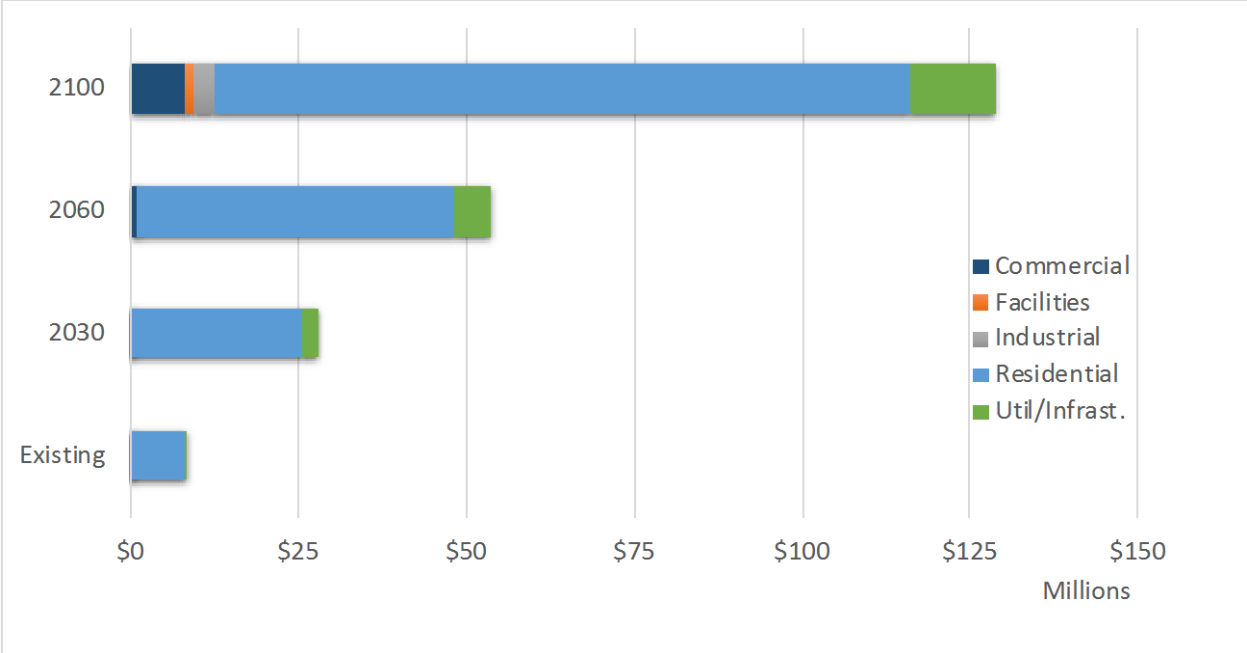


Sea Level Rise	Parcel/ Structure	Residential	Open Space & Recreation	Commercial & Mixed	Industrial	Public Facilities	Total
Existing	Parcels	79	42	1	1	3	**126**
	Struct.	19	0	0	1	0	**20**
~1 ft	Parcels	243	46	2	4	4	**299**
	Struct.	150	5	0	1	0	**156**
~2 ft	Parcels	477	51	5	6	7	**546**
	Struct.	252	9	2	2	0	**265**
~5 ft	Parcels	769	59	21	10	9	**868**
	Struct.	510	11	13	11	8	**553**

Note: Counts of parcels and structures are cumulative across all time horizons.

Figure 6-5. *Number of Land Use Parcels and Structures Vulnerable to Coastal Flooding During a 1% Annual Chance Storm*

Currently $8.5 million of property is at risk to coastal flooding, increasing to $28 million with 1 foot of sea level rise, $53.8 million with 2 feet of sea level rise, and $128.8 million with 5 feet of sea level rise. Residential land uses comprise the majority of property value estimates. Commercial assets that become vulnerable by 2100 with 5 feet of sea level rise include the multi-story office buildings within the Carpinteria Bluffs. With 5 feet of sea level rise, community and public facilities also become vulnerable to coastal flooding, including churches, medical facilities, fire and police stations, post offices, and schools.



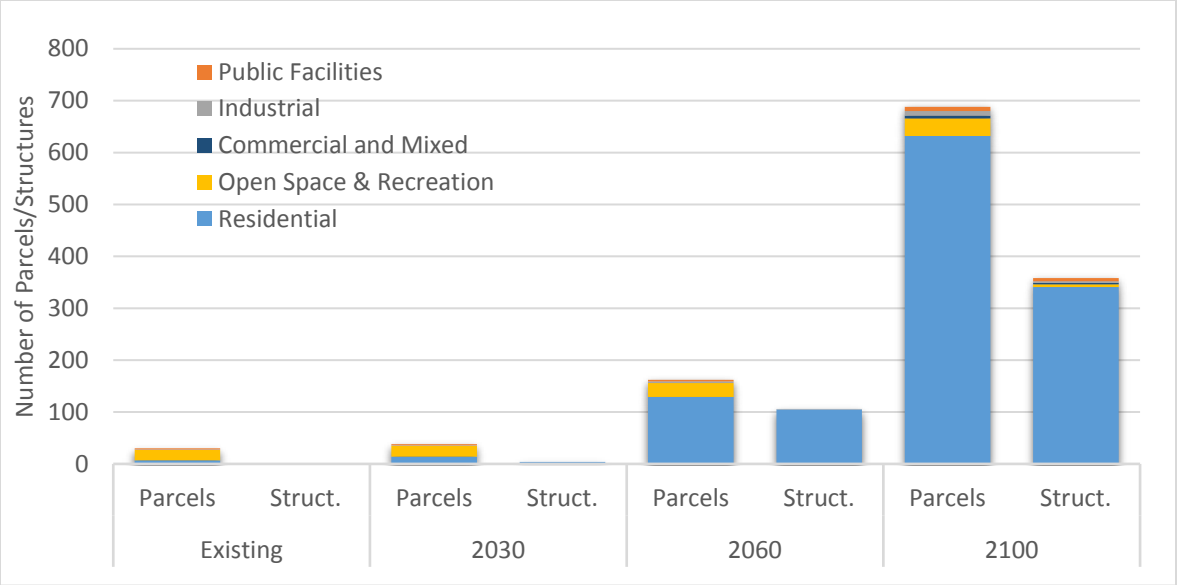
Coastal Damages	Existing	~1 ft	~2 ft	~5 ft
Commercial	$0	$0	$1,000,000	$8,000,000
Facilities	$0	$0	$0	$1,300,000
Industrial	$0	$0	$0	$3,200,000
Residential	$8,200,000	$25,500,000	$47,300,000	$103,600,000
Utility/ Infrastructure	$300,000	$2,500,000	$5,500,000	$12,700,000
Grand Total	**$8,500,000**	**$28,000,000**	**$53,800,000**	**$128,800,000**

Note: Estimates of losses are cumulative across all time horizons.

Figure 6-6. *Estimated Value of Property Loss to Coastal Flooding from a 1% Annual Chance Storm (2017 dollars)*

Tidal Inundation Impacts to Land Uses and Structures

Figure 6-7 depicts the number of parcels and structures according to land use at risk to tidal inundation. Mostly open space land uses would be affected by tidal inundation with up to 2 feet of sea level rise. With more than 2 feet of sea level rise, residential parcels and condominium/apartment structures, particularly in the Beach Neighborhood, start to become exposed to tidal inundation. The dramatic increase in property loss value between 2 feet and 5 feet of sea level rise is due to typically high value of shoreline property.

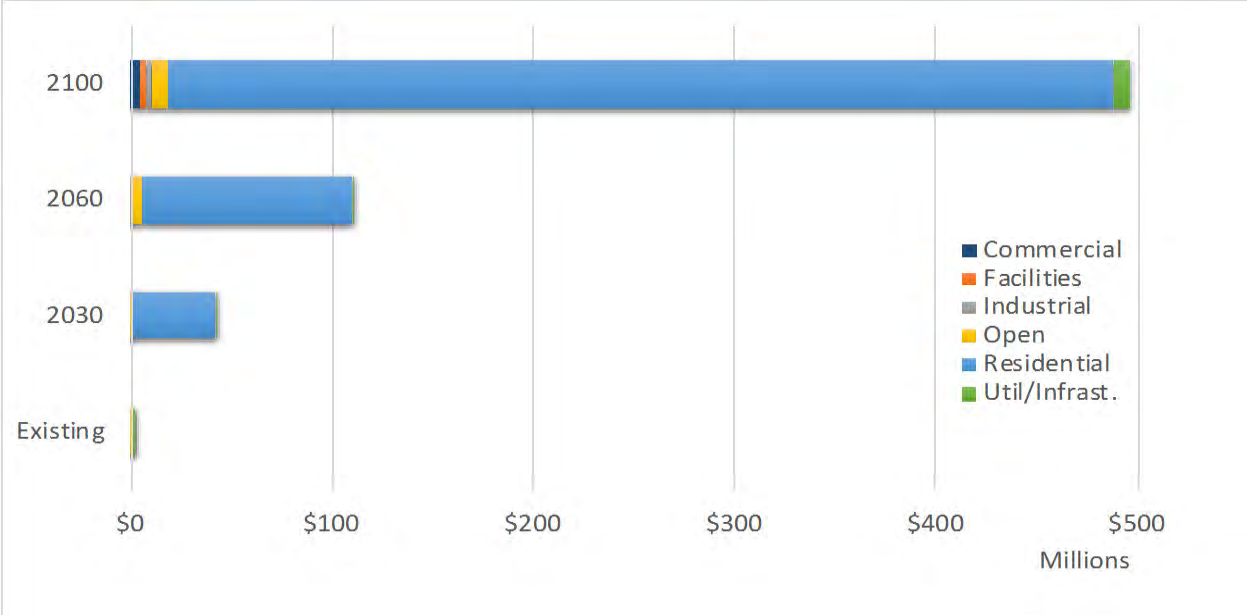


Sea Level Rise	Parcel/ Structure	Residential	Open Space & Recreation	Commercial & Mixed	Industrial	Public Facilities	Total
Existing	Parcels	7	20	0	1	2	**30**
	Struct.	0	0	0	0	0	**0**
~1 ft	Parcels	14	21	0	1	2	**38**
	Struct.	4	0	0	0	0	**4**
~2 ft	Parcels	129	27	0	3	3	**162**
	Struct.	105	0	0	1	0	**106**
~5 ft	Parcels	632	34	5	9	8	**688**
	Struct.	510	11	13	11	8	**553**

Note: Estimates of losses are cumulative across all time horizons.

Figure 6-7. *Number of Land Use Parcels and Structures Vulnerable to Monthly Tidal Inundation*

Figure 6-8 presents estimates of property at risk to tidal inundation. Since there are no current methods to evaluate the cost of potential damages associated with tidal inundation, estimates represent the total value of the property at risk rather than actual damages or losses due to tidal inundation.



Tidal Exposure	Existing	~1 ft	~2 ft	~5 ft
Commercial	$200,000	$0	$0	$4,100,000
Facilities	$0	$0	$0	$3,800,000
Industrial	$0	$300,000	$500,000	$2,600,000
Open	$300,000	$300,000	$5,300,000	$8,200,000
Residential	$200,000	$41,400,000	$103,900,000	$469,800,000
Utility/Infrastructure	$100,000	$100,000	$1,800,000	$8,200,000
Grand Total	**$800,000**	**$42,100,000**	**$111,500,000**	**$496,700,000**

Note: Estimates of losses are cumulative across all time horizons. These numbers only estimate property at risk to tidal flooding, not estimated damages.

Figure 6-8. *Estimated Value of Property Vulnerable to Tidal Inundation (2017 dollars)*

The Carpinteria Salt Marsh during a king tide in 2013. The Carpinteria Salt Marsh is hydraulically connected to the ocean and increases in tidal elevation may result in flooding of adjacent development. Photo credit: Bill Dewey for Heal the Ocean

Currently, only $800,000 in property value is at risk to tidal inundation. $200,000 of this is in commercial damages resulting from a drainage ditch that flows from Carpinteria Salt Marsh into a commercial area on the west side of town. Tidal exposure is projected to rise gradually to $42.1 million with 1 foot of sea level rise and then increase to $111.5 million with 5 feet of sea level rise. By 2100, however, sea levels may inundate a much greater number of structures, increasing the total exposure to $496.7 million in land, structures, and infrastructure, covering almost the entirety of the Beach Neighborhood. Significant, non-residential vulnerabilities include the multi-story office building on Carpinteria Avenue, the Carpinteria Business Park on Carpinteria Avenue, the Aliso Elementary School at Carpinteria Avenue and 7th Street, and the St. Joseph's Catholic Church building on 7th Street.

Residential Property Vulnerabilities

Vulnerable residential dwellings exposed to coastal wave flooding within Carpinteria could increase from 86 today, to 237 with 1 foot of sea level rise, and up to 1,090 with 5 feet of sea level rise.

Residential properties represent approximately 90 percent of all structural vulnerabilities in the City. All vulnerable residential properties are in the Beach, Downtown/Old Town, and Concha Loma Neighborhoods. Residential land use parcels may contain multiple structures, and apartments/condominiums can overlay multiple parcels. Table 6-3 below highlights these differences and identifies the number of dwellings in each of the residential unit types.

Table 6-3. Residential Land Uses Affected by Coastal Hazards

Type	Large Apartments (5+ units)[1]	Condominiums and Mixed Use[2]	Mobile Homes[3]	Multi-family (2-4 units)[4]	Single-family	Total
Parcels	25	426	83	74	166	**774**
Structures	46	75	154	110	194	**579**
Dwelling Units	210	426	154	152	148	**1090**

Notes: All parcels can contain multiple non-dwelling structures (e.g., garages and sheds). Some parcels may be vacant and contain no structures. Not all structures are affected by hazards, this comprises 9% of the total tally (i.e., the parcel is affected, and the structure is not). Parcels where less than 1% of the parcel area in the hazard zone and where the structure(s) is unaffected by the hazard zone are not included in the structures count (typically parcels that abut stream channels). See definitions section for more information on dwellings.
[1]Large apartments have multiple units per structure and can have multiple structures per parcel.
[2]Condominiums have multiple parcels per structure. Commonly held condominium parcels (parking and landscaped areas) are not included in the tally.
[3]Multiple homes may exist on one lot (e.g., mobile home parks).
[4]Multi-family can contain either multiple lots per structure or multiple structures per lot.

To facilitate a better understanding of the impacts to residential land uses, the analysis identifies the residential dwelling units projected to be affected by varying levels of sea level rise (Table 6-4).

Table 6-4. Vulnerable Residential Dwelling by Categories[3]

Sea Level Rise	Large Apartments (5+ units)	Condominiums and Mixed Use	Mobile Homes	Multi-family (2-4 units)	Single-family	Total
	Number of dwellings					
Existing	0	73	0	11	2	86
~1 ft	49	63	63	32	30	237
~2 ft	64	217	21	28	33	363
~5 ft	97	73	70	81	83	404
Total	**210**	**426**	**154**	**152**	**148**	**1090**

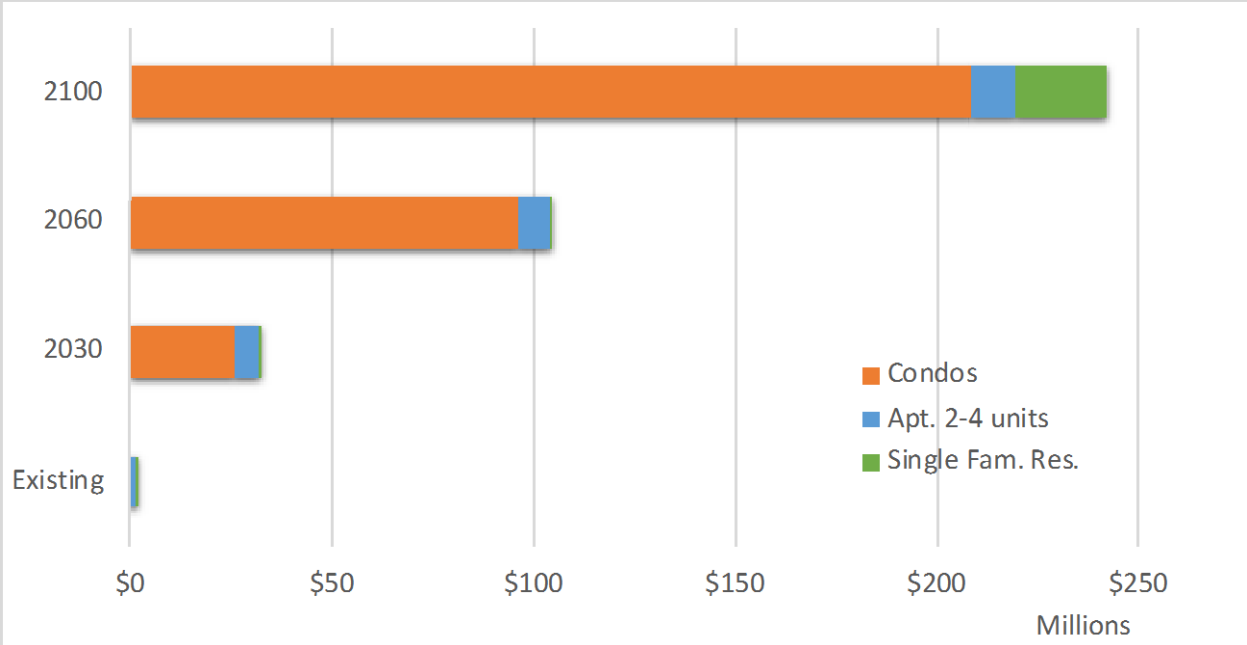
Note: All counts and sums are non-cumulative across time horizon years. Number of dwelling units assigned to each structure is an estimation based on assessor's data information.

Coastal Erosion Damages to Residential Parcels and Structures

Figure 6-9 presents the current market value of residential property subject to erosion from coastal storms. This analysis does not account for any future appreciation in residential property prices. Currently, $1.6 million (in 2017 dollars) in residential property is vulnerable to coastal erosion during a 1 percent annual chance storm. The estimated property values in Figure 6-10 increase substantially over time, topping out at $242 million

[3] Please note that there are an additional 15 large residential apartments encompassed within 2 complexes which are projected to become islands from combined coastal hazards and approximately 5 feet of sea level rise.

in vulnerable residential property with 5 feet of sea level rise. The majority of this property value occurs in the Beach Neighborhood condominium and apartment buildings. Single-family residences in the Concha Loma Neighborhood also become exposed with 5 feet of sea level rise.



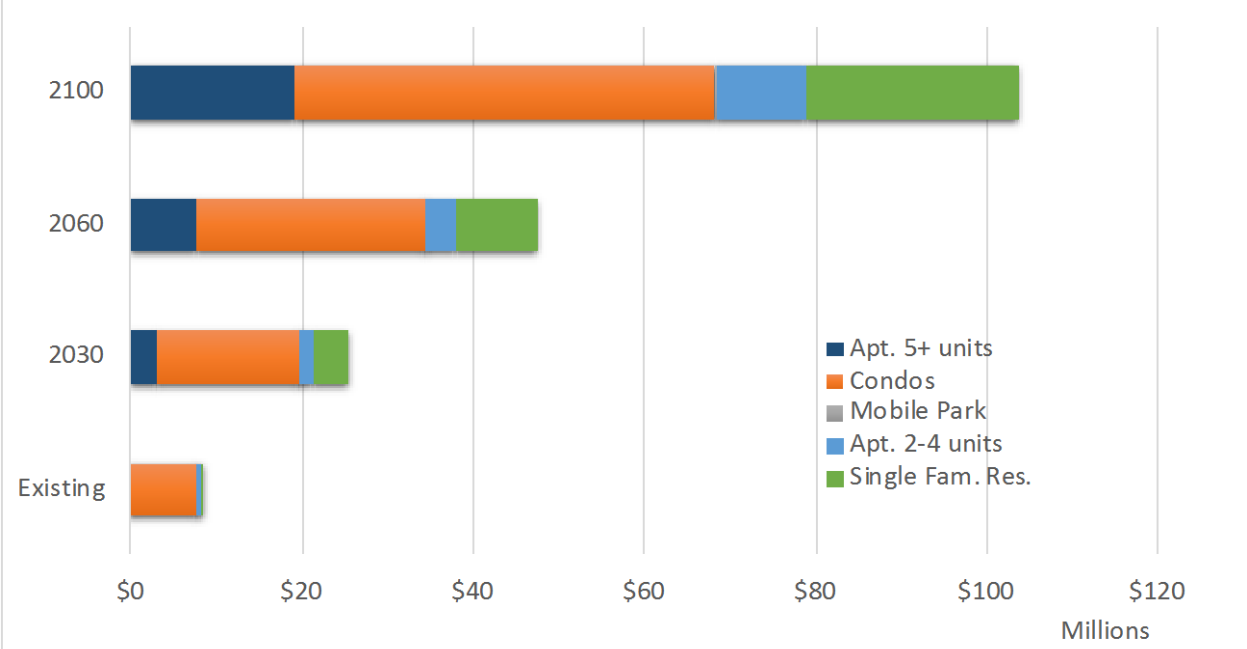
Erosion Losses	Existing	~1 ft	~2 ft	~5 ft
Condominiums	$200,000	$25,900,000	$96,100,000	$208,500,000
Apartments, 2-4 units	$1,000,000	$6,000,000	$7,700,000	$11,000,000
Single Family Residence	$300,000	$300,000	$600,000	$22,900,000
Grand Total	**$1,600,000**	**$32,200,000**	**$104,500,000**	**$242,400,000**

Note: Estimates of losses are cumulative across all time horizons.

Figure 6-9 *Estimated Value of Infrastructure Vulnerable to Coastal Erosion from a 1% Annual Chance Storm (2017 dollars)*

Coastal Flooding Damages to Residential Parcels and Structures

Figure 6-10 presents the current market value of residential property subject to coastal storm flooding. Unlike coastal erosion, coastal storm flooding can impact low-elevation parcels, even if they are not directly adjacent to the shoreline. Such flooding also does not impact second- or third-story residences.



Coastal Damages	Existing	~1 ft	~2 ft	~5 ft
Apartments, 5+ units	$0	$3,000,000	$7,700,000	$19,200,000
Condominiums	$7,700,000	$16,600,000	$26,600,000	$49,000,000
Mobile Park	$0	$0	$0	$300,000
Apartments, 2-4 units	$400,000	$1,700,000	$3,700,000	$10,500,000
Single Family Residence	$200,000	$4,200,000	$9,400,000	$24,700,000
Grand Total	**$8,200,000**	**$25,500,000**	**$47,300,000**	**$103,600,000**

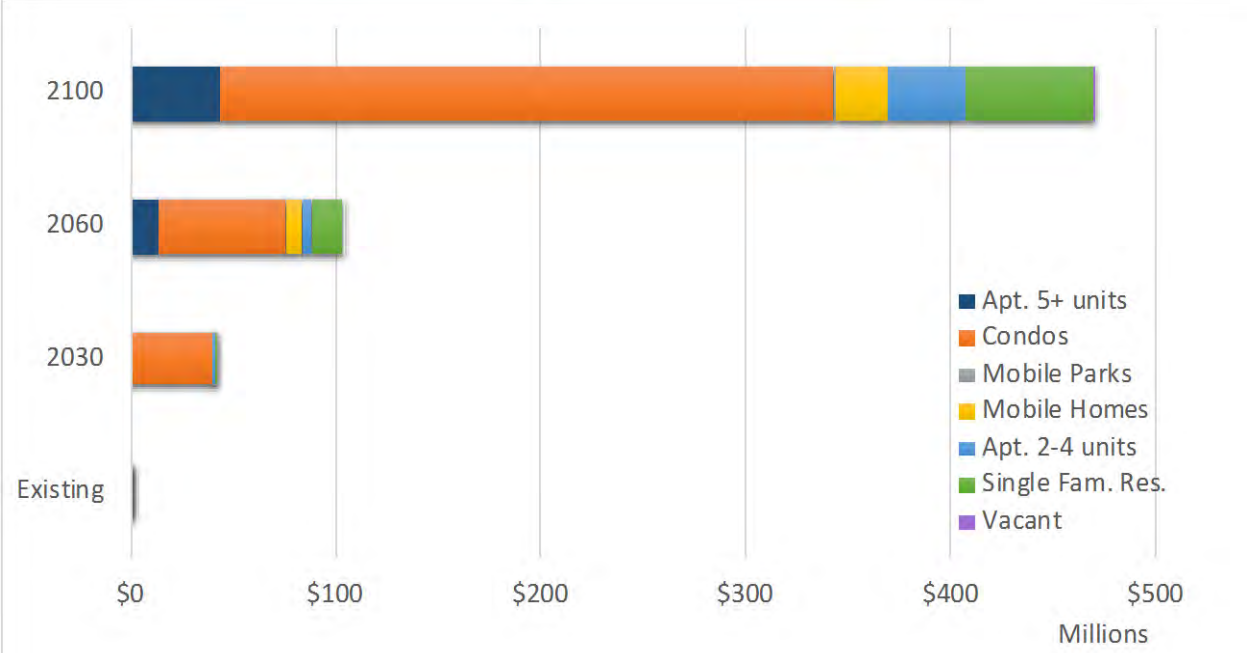
Note: Estimates of losses are cumulative across all time horizons.

Figure 6-10. *Estimated Value of Property Vulnerable to Coastal Flooding from a 1% Annual Chance Storm (2017 dollars)*

Under existing conditions, this Report estimates $8.2 million in potential damages and losses to residential property due to a 1 percent annual chance storm. This figure could increase dramatically with 5 feet of sea level rise to over $100 million. While ground floor residences in the Beach Neighborhood, including large condominium and apartment complexes, constitute the largest vulnerability by market value, large apartment buildings (5 units or more) on Holly, Ash, and Elm Avenues, along with single-family residences on Dorrance Way and 3rd Street are also impacted as early as 2030 or 2060.

Tidal Inundation Exposure to Residential Parcels and Structures

Figure 6-11 considers the value of property that is vulnerable to tidal inundation. This Report estimates the land and structural value exposed to tidal inundation with sea level rise and does not estimate the value of potential losses and damages due to insufficient data.



Tidal Exposure	Existing	~1 ft	~2 ft	~5 ft
Apartments, 5+ units	$0	$0	$13,100,000	$43,100,000
Condominiums	$0	$40,600,000	$62,700,000	$300,100,000
Mobile Parks	$0	$0	$200,000	$700,000
Mobile Homes	$0	$0	$7,300,000	$25,900,000
Apartments, 2-4 units	$100,000	$200,000	$5,300,000	$37,100,000
Single Family Residence	$100,000	$600,000	$15,200,000	$62,400,000
Vacant Residential	$0	$0	$0	$600,000
Grand Total	**$200,000**	**$41,400,000**	**$103,900,000**	**$469,800,000**

Note: Estimates of losses are cumulative across all time horizons.

Figure 6-11. *Estimated Value of Property Vulnerable to Tidal Inundation (2017 dollars)*

The condominiums and apartments along Sandyland Road, constitute the majority of residential property value exposed to tidal inundation, including up to 170 short-term vacation rentals. Unlike coastal flooding, tidal inundation does not only impact the ground

floor. With 2 or more feet of sea level rise, however, single-family residences and large apartment buildings (5 units or more) along Holly, Ash, and Elm Avenues, 3rd Street, and Dorrance Way also become exposed to tidal inundation and mobile homes along Ash Avenue become increasingly inundated by tides.

6.2 Roads, Parking, and Public Transportation

Much of the western portion of the City, including the Union Pacific Railroad (UPRR) and Amtrak corridor, portions of U.S. Highway 101 (U.S. 101), local roads, and bikeways lie at low elevations behind a generally unarmored one-mile long coast and are vulnerable to flooding and damage associated with sea level rise; in contrast, the eastern two miles of City shoreline is fronted by steep coastal bluffs which are potentially vulnerable to accelerated cliff erosion from sea level rise. This coastal bluff area supports the UPRR and the Carpinteria Bluffs Trail, as well as local roads. To identify roads and parking areas potentially vulnerable to sea level rise hazards, 50.3 miles of roadways and 16 surface parking areas within the City are evaluated. To identify public transportation facilities potentially vulnerable to sea level rise hazards, 4.1 miles of bike routes, approximately 7.0 miles of bus routes, 50 bus stops, 3.6 miles of railroad line, and 1 train station within the City are evaluated. Impacts are described based on modeled results showing the extents of hazards under existing conditions (based on 2010) and with approximately 1 foot, approximately 2 feet, and approximately 5 feet of sea level rise. All modeled results estimate the extent of vulnerabilities assuming no adaptive measures are taken.

Coastal Erosion

Currently, no roadways, bikeways, or bus routes within the City are vulnerable to coastal erosion. However, if a large storm event were to occur, some small portions of Union Pacific Railroad (UPRR) along Bluffs II and III would be vulnerable to cliff failure and damage from storm-based erosion**.** With approximately 1 foot of sea level rise, UPRR would continue to be vulnerable to erosion from a large singular storm event. Modeling results show road ends at Ash, Holly, Elm, and Linden Avenues in the Beach Neighborhood become exposed to potential beach and dune erosion with approximately 2 feet of sea level rise (both long-term and storm-based erosion); such road ends would be exposed to wave uprush through gaps in the existing homes that would erode the beach and dunes fronting these road end, damaging

Sand from Carpinteria City Beach abuts Ash Avenue, which serves as a buffer from wave attack and runup damaging and eroding the roadway. With approximately 2 feet of sea level rise, erosion of this sand buffer could result in damage to this roadway, as well as at Linden, Holly, and Elm Avenues, which also terminate at the sandy beach.

or eroding road paving, sidewalks, bike lanes, and parking. The roadway network would potentially become significantly more vulnerable to erosion with approximately 5 feet of sea level rise, with the model showing a total of 0.7 mile of roadway at risk of damage from erosion. Seaward segments of Ash, Holly, Elm, and Linden Avenues in the Beach Neighborhood could erode landward approximately 220 feet to inland of Sandyland Road, as well as 1,331 linear feet of Sandyland Road. Approximately 382 linear feet of 4th Street within the State Park east of Carpinteria Creek would also be subject to erosion. However, as noted above, the model may at least initially over-project the extent of beach and dune erosion to these roadways as paved surfaces and development in this area would erode at a slower rate; damage these roads, particularly Sandyland Road, would be strongly linked to management and adaptation measures undertaken for beach front homes. Therefore, the accuracy of modeling damage to roads from beach and dune erosion is strongly dependent on actions to protect or adapt structures such as the beachfront homes that line Sandyland Road.

Further, infrastructure along the Carpinteria Bluffs could be extremely vulnerable to cliff erosion with potentially 1.4 miles of UPRR, with approximately 5 feet of sea level rise. The model shows that erosion of the bluffs in the eastern portion of the City would not expose any roadways to damage until approximately 5 feet of sea level rise, at which point, it could affect over 1,336 feet of 4th Street within the State Park if no adaptive actions are taken. It is noted however, that 700 feet of the rail line in the Carpinteria Bluffs area is protected by a 500-foot long seawall and a 200-foot long rock revetment which would substantially slow cliff erosion and retreat in these areas. Further, UPRR typically responds to cliff erosion and track failure with emergency coastal armoring, which if continued over time, would protect the tracks and trails within most of the Carpinteria Bluffs, which lie landward to the tracks. However, this response could lead to armoring of much of the shoreline of eastern Carpinteria, with secondary impacts to sand supply, coastal access and habitats.

Roads will not become significantly vulnerable to erosion until approximately 5 feet of sea level rise at which point 0.7-mile of roadway ($1 million) becomes vulnerable to erosion during a 1 percent annual chance storm. The increasing vulnerability of UPRR, however, is much more gradual in nature. By 2100, 1.4 miles of railroad ($2.5 million) may be exposed to coastal erosion along the Carpinteria Bluffs (Table 6-5).

Table 6-5. Length and Replacement Costs of Roads and Railroad due to Coastal Erosion during a 1% Annual Chance Storm

Erosion	Roads	Roads	Railroads	Railroads
Existing	< 0.1-mile	$0	0.1-mile	$130,000
~1 ft	< 0.1-mile	$0	0.4-mile	$760,000
~2 ft	0.1-mile	$90,000	0.8-mile	$1,510,000
~5 ft	0.7-mile	$1,050,000	1.4 miles	$2,550,000

Note: All linear totals and losses are cumulative across horizon years.

Coastal Storm Flooding

The area extent of flooding of the transportation network during a 1 percent annual chance storm increases with increased sea level rise elevation. Coastal storm flooding is episodic in nature, and roadways, and the railroad, could be flooded temporarily following a storm, leading to damage, closures, and circulation issues. The model shows that no significant amount of roadways, bikeways, or bus routes are currently at risk of flooding; although, coastal flooding could temporarily inundate the 7th Street and Carpinteria Avenue bridge crossings over Franklin Creek during a large storm event. With approximately 1 foot of sea level rise, storm flooding could inundate many roadways within the Beach Neighborhood, including Ash, Holly, Elm, Linden, 3rd Street, and 4th Street. The UPRR tracks, which are elevated in places up to four feet above adjacent roadways would act as a levee between Elm Avenue and Ash Avenue that would protect landward development within the Downtown with up to approximately 2 feet of sea level rise; although, flooding of lower lying areas along Linden and by Amtrak station inland of the railroad could occur. With approximately 2 feet of sea level rise, 2.0 miles of roadway, including segments of every roadway located within the Beach Neighborhood become subject to coastal flooding from wave run-up. In addition, some road segments immediately north of UPRR, including about 300 feet of 5th Street could be flooded.

The UPRR tracks near Ash Avenue are raised about four feet above the roadway and could protect landward infrastructure from flooding with up to approximately 2 feet of sea level rise.

With approximately 5 feet of sea level rise, 4.8 miles of roadway segments could be at risk of flooding, including 100 percent of roadways within the Beach Neighborhood, and some roadway segments north of the Carpinteria Salt Marsh (south of U.S. 101) including Carpinteria Avenue, 7th, 8th, and 9th Streets, Reynolds, Santa Ynez, and Holly Avenues. Some of the road lengths at risk include a 1,497-foot segment of U.S. 101 and the on-ramp to Carpinteria Avenue at exit 87B. Further, the actual area of flooding has the potential to be greater under all scenarios, as precipitation runoff down Santa Monica, Franklin, and Carpinteria Creeks could further exacerbate the extent and depth of flooding on roadways under all scenarios. With 5 feet of sea level rise, 4.8 miles of roads ($7.1 million) and 1.5 miles of railroad lines ($2.6 million) may be vulnerable to coastal flooding along the Carpinteria Bluffs and near the Carpinteria Salt Marsh (Table 6-6).

Table 6-6. Length and Replacement Costs of Roads and Railroad due to Coastal Flooding during a 1% Annual Chance Storm

Sea Level Rise	Roads	Roads	Railroads	Railroads
Existing	0.1-mile	$120,000	0.1-mile	$180,000
~1 ft	1.1 miles	$1,690,000	0.4-mile	$810,000
~2 ft	2.0 miles	$2,970,000	0.9-mile	$1,560,000
~5 ft	4.8 miles	$7,090,000	1.5 miles	$2,630,000

Note: All linear totals and losses are cumulative across horizon years.

Tidal Inundation

The Carpinteria Salt Marsh is an open tidal system where the creek watershed and tidal processes are directly connected. With approximately 5 feet of sea level rise, the Carpinteria Salt Marsh could be completely submerged by regular monthly tides and could result in the flooding of adjacent and nearby roadways.

Tidal inundation is projected monthly flooding due to rising tides under non-storm conditions and would extend further inland as sea levels rise. Tidal inundation is of concern as it would occur during monthly peak high tides with potential for frequently repeated damage and ongoing cleanup or maintenance costs. Tidal inundation could result in the flooding of roadways and infrastructure at low elevations, resulting in road closures and damage, leaving some areas periodically inaccessible. This type of hazard would occur along many of the same roadway segments that are also subject to coastal flooding under a large storm event, particularly in the Beach Neighborhood and north of the Carpinteria Salt Marsh; however, the area and depth of flooding is lesser under this non-storm scenario that would occur on a monthly basis. Currently, no transportation infrastructure is affected by tidal inundation due to regular monthly high tides or periodic Extreme Monthly High Water (EMHW) tides. With approximately 1 foot of sea level rise, a 600 foot segment of Ash Avenue south of the railroad may be periodically inundated due to the low elevation and configuration of storm drain infrastructure along this roadway segment. With approximately 2 feet of sea level rise, several roads within the Beach Neighborhood including a total of 2,485 linear feet along Ash, Holly, Elm, and Linden Avenues could become periodically inundated under EMHW tide conditions. With approximately 5 feet of sea level rise, the area exposed to tidal inundation increases significantly, where a total of 3.0 miles of roads could be inundated, including all roadways within the Beach Neighborhood, and roadways north of

the Salt Marsh but south of U.S. Highway 101, including 4th, 5th. 7th, 8th, and 9th Streets, Carpinteria Avenue, Estero, Pear, and Plum Streets.

Tidal inundation is a chronic threat. As such, it is much more amenable to removal costs rather than total losses or replacement costs. The recurring nature of this threat makes the indirect losses to redirected traffic more significant. With 5 feet of sea level rise, 3.0 miles of roads ($4.5 million) may be exposed or at risk to tidal inundation, while less than 0.1-mile of railroad lines may be exposed, although these appear to be co-located with bridges, so damages may not be as severe (Table 6-7).

Table 6-7. Length and Replacement Costs of Roads and Railroad due to Monthly Tidal Inundation

Tidal	Roads	Roads	Railroads	Railroads
Existing	< 0.1-mile	$20,000	< 0.1-mile	$30,000
~1 ft	< 0.1-mile	$50,000	< 0.1-mile	$30,000
~2 ft	0.8-mile	$1,220,000	< 0.1-mile	$30,000
~5 ft	3.0 miles	$4,480,000	< 0.1-mile	$40,000

Note: All linear totals and losses are cumulative across horizon years.

H++ Scenario

Although no modeling data for the H++ scenario is currently available, it can be assumed that damage to the transportation network described above could be experienced even sooner than the planning horizon years used for this analysis (2030, 2060, and 2100) if the H++ scenario were to occur. Further, **approximately 10 feet of sea level rise by 2100** under the H++ scenario could impact a substantially greater portion of the transportation network if no adaptive measures are taken, as well as potentially causing more severe damage to the facilities already forecasted to be impacted. Coastal erosion could occur at an accelerated rate and retreat further inland; coastal flooding and tidal inundation hazards could also extend further inland, affecting a greater area north of the Carpinteria Salt Marsh and within the Downtown north of the railroad. Such impacts could also occur more frequently as with higher sea levels, less intense storm and non-peak monthly high tides could cause repeated more frequent damage. Under this scenario, impacts to the transportation network would increase in magnitude. In particular, it should be noted that flooding of U.S. 101 north of the Salt Marsh, flooding of UPRR within the Downtown, and erosion of UPRR along the Bluffs could be even more detrimental. U.S. 101 and UPRR are considered critical facilities serving the local and regional transportation network. These facilities have a limited potential for adaptation, are costly to repair, adapt or relocate, where repeated or substantial damage to or destruction of such facilities could result in significant and widespread economic and socioeconomic impacts. The need for adaptation planning to ensure the long-term protection of these facilities becomes even more important under this scenario.

Roadways

Currently, roadways are generally not exposed any coastal hazards, apart from storm-based flooding of a low-lying portion of Sandyland Road within the State Park, and potential flooding of bridge crossings over Carpinteria Creek and Franklin Creek (however, the model may be over-projecting these results as the elevations of the bridges are not taken into account). Storm-based flooding begins to significantly affect roadways within the Beach Neighborhood with approximately 1 foot or more of sea level rise. With approximately 2 or more feet of sea level rise, roadways in the Beach Neighborhood begin to be significantly impacted by periodic tidal inundation, and erosion of sand within the City Beach could start to expose north-south oriented roadways to damage from erosion. Approximately 4.8 miles of roadway, or 14.9 percent of the total road network within Carpinteria, would be affected by at least one type of coastal hazard with approximately 5 feet of sea level rise (Table 6-8); many roadway segments in the Beach Neighborhood would be affected by multiple hazards. Specific roadway segments impacted by coastal erosion, coastal flooding and tidal inundation are described below (Table 6-9).

Table 6-8. Cumulative Length of Total Potential Road Damage due to Coastal Hazards

SLR Elevation	Coastal Erosion		Coastal Flooding		Tidal Inundation	
	Length	%	Length	%	%	%
Existing	~0 mile	< 0.1%	<0.1 mile	< 0.1%	~0 mile	< 0.1%
~1 foot	< 0.1 mile	< 0.1%	1.1 miles	2.2%	< 0.1 mile	< 0.1%
~2 feet	0.1 mile	0.3%	2.0 miles	6.2%	0.8 mile	2.5%
~5 feet	0.7 mile	1.4%	4.8 miles	14.9%	3.0 miles	9.3%

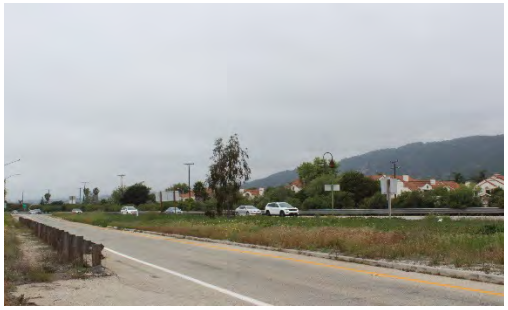
Note: All linear totals and losses are cumulative across planning horizons. % indicates the percentage of the Carpinteria roadway network affected out of 50.3 miles of roadway within the City.

Table 6-9. Cumulative Length and Location of Potential Road Loss due to Coastal Hazards

Road	Existing				~1 foot by 2030				~2 feet by 2060				~5 feet by 2100			
	BDE	CE	CF	TI	BDE	CE	CF	TI	BDE	CE	CF	TI	BDE	CE	CF	TI
U.S. Highway 101	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1,497 ft	--
Carpinteria Avenue	--	--	--	--	--	--	--	--	--	--	204 ft	--	--	--	4,314 ft	2,145 ft
Via Real	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Linden Avenue	--	--	--	--	--	--	105 ft	--	76 ft	--	735 ft	173 ft	206 ft	--	934 ft	778 ft
Ash Avenue	--	--	--	--	--	--	1,415 ft	419 ft	62 ft	--	1,601 ft	1,148 ft	243 ft	--	1,794 ft	1,810 ft
Holly Avenue	--	--	--	--	--	--	1,065 ft	--	47 ft	--	1,281 ft	924 ft	200 ft	--	1,714 ft	1,536 ft
Elm Avenue	--	--	--	--	--	--	460 ft	--	54 ft	--	702 ft	240 ft	195 ft	--	1,100 ft	934 ft
3rd Street	--	--	--	--	--	--	524 ft	--	--	--	870 ft	504 ft	--	--	1,270 ft	1,270 ft
4th Street	--	--	--	80 ft	--	--	658 ft	85 ft	148 ft	--	1,203 ft	820 ft	382 ft	1,336 ft	3,800 ft	1,105 ft
7th Street	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1,572 ft	920 ft
Sandyland Road	--	--	128 ft	--	--	--	1,810 ft	--	--	--	2,369 ft	440 ft	1,331 ft	--	2,505 ft	2,505 ft

Note: All linear totals and losses are cumulative across planning horizons. Coastal hazards (e.g., coastal flooding and tidal inundation) may account for losses in the same area. Note that model does not account for existing structures such as homes along Sandyland Road or limited areas of seawalls and rock revetments which may reduce erosion or affect severity of coastal flooding and tidal inundation.
BDE = Beach & Dune Erosion
CE = Cliff Erosion
CF = Coastal Flooding
TI = Tidal Inundation

- **U.S. 101** would not be affected by any coastal hazard until approximately 5 feet of sea level rise. With approximately 5 feet of sea level rise, a nearly 1,500-foot section north of the Carpinteria Salt Marsh could be flooded during a large coastal storm event. This model does not take into account creek runoff, and the combined extent of flooding from a 1 percent annual chance storm and approximately 5 feet of sea level rise could be greater when combined with increased rainfall and creek runoff from Santa Monica, Franklin, and Carpinteria Creeks. As noted above, under the H++ scenario, damage would occur earlier than 2100 and may be more frequent and severe.



U.S. 101 and Exit 87B (pictured above) could be exposed to flooding during a storm when combined with approximately 5 feet of sea level rise or more.

- **Carpinteria Avenue** would be vulnerable to coastal hazards with approximately 2 or more feet of sea level rise. With approximately 2 feet of sea level rise, 204 linear feet of roadway in western Carpinteria north of the Carpinteria Salt Marsh and west of Plum Street could be flooded during a large storm. With approximately 5 feet of sea level rise, large sections of Carpinteria Avenue west of Santa Ynez Avenue/ 7th Street and north and northeast of the Carpinteria Salt Marsh become at risk to coastal flooding (4,314 linear feet) and tidal inundation (2,145 linear feet).
- **Linden Avenue** becomes exposed to damage from coastal flooding with approximately 1 foot of sea level rise (105 linear feet). With approximately 2 feet of sea level rise, the segment south of the railroad also becomes vulnerable to beach and dune erosion (76 linear feet), coastal flooding (735 linear feet), and tidal inundation (173 linear feet). With approximately 5 feet of sea level rise, the entire segment of Linden Avenue south of the railroad is exposed to tidal inundation and coastal flooding hazards.

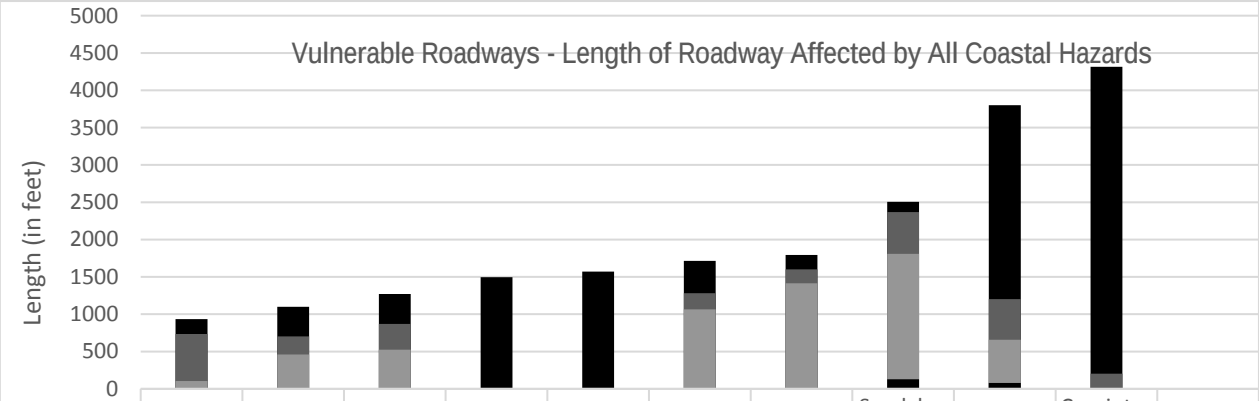
With 5 feet of sea level rise, Linden Avenue south of UPRR could be exposed to erosion, flooding from a coastal storm and extremely high tides.

- A large section of **Ash Avenue** becomes vulnerable to coastal flooding (1,415 linear feet) and tidal inundation (419 linear feet) with approximately 1 foot of sea level rise. With greater sea level rise, Ash Avenue becomes increasingly vulnerable to all coastal hazards. With approximately 5 feet of sea level rise, the entire segment of Ash Avenue becomes exposed to coastal flooding and tidal inundation, and the segment south of Sandyland Road could be damaged by erosion.

- A large section of **Holly Avenue** south of the railroad becomes vulnerable to coastal flooding with approximately 1 foot of sea level rise (1,065 linear feet). With approximately 2 or more feet of sea level rise, Holly Avenue also becomes increasingly vulnerable to dune erosion, coastal flooding, and tidal inundation. With approximately 5 feet of sea level rise, the entire segment of Holly Avenue south of the railroad is exposed to coastal flooding and tidal inundation hazards, and in addition, coastal flooding and tidal inundation impacts could extend approximately 400 feet north of the railroad.
- The section of **Elm Avenue** closest to the coast becomes vulnerable to coastal flooding with approximately 1 foot of sea level rise (460 linear feet). With approximately 2 feet or more of sea level rise, Elm Avenue could be exposed to erosion. With approximately 5 feet of sea level rise, the entire segment of Elm Avenue becomes exposed to coastal flooding and tidal inundation hazards.
- Sections of **3rd Street** become vulnerable to coastal flooding with approximately 1 foot or more of sea level rise (524 linear feet), increasing in length with approximately 2 and approximately 5 feet of sea level rise (870 linear feet and 1,270 linear feet, respectively). With approximately 2 and approximately 5 feet of sea level rise, 3rd Street also becomes exposed to tidal inundation (504 linear feet and 1,270 linear feet). With approximately 5 feet of sea level rise, the entire segment of 3rd Street becomes exposed to coastal flooding and tidal inundation.
- Currently, the model shows that the 80-foot segment of **4th Street** crossing Carpinteria Creek is exposed to tidal inundation with an EMHW tide and will continue to be exposed to periodic tidal inundation under all sea level rise scenarios. In addition to tidal inundation, 4th Street within the State Park becomes vulnerable to coastal flooding with approximately 1 foot of sea level rise (658 linear feet). With approximately 2 feet of sea level rise, a 148-foot segment of 4th Street north of Carpinteria State Beach could also be impacted by dune erosion, in addition to coastal flooding impacts (1,203 linear feet) and tidal inundation (802 linear feet). Coastal hazard impacts increase with approximately 5 feet of sea level rise. A 1,300-foot section of 4th Street within the State Park and leading to the Carpinteria Bluffs Trail becomes vulnerable to cliff erosion with approximately 5 feet of sea level rise. This section is also vulnerable to coastal flooding and tidal inundation with approximately 5 feet of sea level rise.
- **7th Street** isn't affected by coastal hazards until approximately 5 feet of sea level rise, at which point the entire segment between Santa Ynez Avenue and Holly Avenue could be vulnerable to coastal flooding (1,572 linear feet) and regular tidal inundation (920 linear feet).
- A 128-foot long segment of **Sandyland Road** within the State Park is currently exposed to coastal flooding if a large storm were to occur. With approximately 1 foot of sea level rise, the 1,810-foot segment of Sandyland Road within the Beach Neighborhood becomes vulnerable to coastal flooding. This amount nearly doubles with approximately 2 feet of

sea level rise, where the entire length of the road is subject to coastal flooding (2,369 linear feet), with added vulnerabilities to tidal inundation within the State Park (404 linear feet).

- **Via Real** is not vulnerable to coastal hazards with projected sea level rise; however, Via Real has flooded from rainfall runoff in past storm events and would continue to be subject to this type of flooding.



	Linden	Elm	3rd St	U.S. 101	7th St	Holly	Ash	Sandyland	4th St	Carpinteria	Via Real
~5 feet	934	1,100	1,270	1,497	1,572	1,714	1,794	2,505	3,800	4,314	0
~2 feet	735	702	870	0	0	1,281	1,601	2,369	1,203	204	0
~1 foot	105	460	524	0	0	1,065	1,415	1,810	658	0	0
Existing	0	0	0	0	0	0	0	128	80	0	0

Parking

The model indicates that paid parking facilities within the State Park, as well as public parking along Ash, Holly, Elm, and Linden Avenues often used to access the beach, are currently vulnerable to coastal flooding during a 1 percent annual chance storm and that flooding could become more extensive as sea levels rise. With approximately 5 feet of sea level rise, 12 parking lots or facilities, and roughly 75 percent of public and semi-public parking facilities south of U.S. 101 would become vulnerable to at least one coastal hazard when combined.

Table 6-10. Number of Parking Facilities Potentially Impacted due to Coastal Hazards

SLR Elevation	Coastal Erosion	Coastal Flooding	Tidal Inundation
Existing	0 lots	6 lots	0 lots
~1 foot	1 lot	8 lots	0 lots
~2 feet	7 lots	8 lots	1 lot
~5 feet	10 lots	12 lots	8 lots

Note: All totals and losses are cumulative along planning horizons. Note that model does not account for existing structures such as homes along Sandyland Road which may reduce erosion or affect severity of coastal flooding and tidal inundation at road end parking areas.

- **State Park Campground Parking Lots:** With approximately 1 foot of sea level rise, the majority of parking in the State Park becomes vulnerable to coastal flooding, with risk of impacts extending to the entire campground with approximately 5 feet of sea level rise. In addition, these parking lots become vulnerable to coastal erosion with approximately 2 feet of sea level rise. With approximately 5 feet of sea level rise, these lots could be completely eroded.
- **State Beach Parking Lot:** Currently, a small portion of this large parking lot in front of the State Beach east of Linden along Sandyland Road is vulnerable to coastal flooding if a large storm event were to occur. With approximately 2 feet of sea level rise, the entire lot would be subject to coastal flooding during the 1 percent change major coastal storm. With approximately 5 feet of sea level rise, the southern edge of this parking lot could become exposed to erosion. In addition, the entire lot could be regularly inundated during an extreme high tide when combined with approximately 5 feet of sea level rise.

Linden Avenue provides several public parking spaces for coastal access. With approximately 5 feet of sea level rise, parking along this road could be lost to erosion or damaged by both episodic and periodic flooding.

- **Road End Parking and Street Parking along Ash, Holly, Elm, and Linden Avenues:** Currently, these road end street parking areas and parking lot are vulnerable to coastal flooding during a large storm, with risk and extent of flooding increasing as sea levels rise. With approximately 1 foot of sea level rise, these parking areas become vulnerable to damage from dune erosion. With approximately 5 feet of sea level rise, these parking areas become vulnerable to tidal inundation in addition to erosion and coastal flooding hazards.
- **Carpinteria Train Station Parking Lot:** This lot would not be exposed to any coastal hazards with up to approximately 5 feet of sea level rise. However, it is possible that this lot could be subject to flooding from a coastal storm or tidal inundation under the H++ scenario with approximately 10 feet of sea level rise.
- **Aliso School:** The parking lot at Aliso School could be exposed to coastal flooding combined with approximately 2 feet or more of sea level rise. With approximately 5 feet of sea level rise, this lot could also be periodically inundated during EMHW tides.
- **Dump Road:** This privately-owned parking lot near Casitas Pier becomes at risk of damage from erosion when combined with approximately 1 foot or more of sea level rise.

Table 6-11. Potential Parking Facilities Affected by Coastal Hazards

Parking Facility	Existing				~1 foot by 2030				~2 feet by 2060				~5 feet by 2100			
	BDE	CE	CF	TI	BDE	CE	CF	TI	BDE	CE	CF	TI	BDE	CE	CF	TI
State Park Campground Lots	--	--	X	--	--	X	X	--	X	X	X	--	X	X	X	X
State Beach Lot	--	--	--	--	--	--	--	--	--	--	X	--	X	--	X	X
Linden Avenue Parking	--	--	X	--	--	--	X	--	X	--	X	--	X	--	X	X
Ash Avenue Parking	--	--	X	--	--	--	X	--	X	--	X	--	X	--	X	X
Holly Avenue Parking	--	--	X	--	--	--	X	--	X	--	X	--	X	--	X	X
Elm Avenue Parking	--	--	X	--	--	--	X	--	X	--	X	--	X	--	X	X
Aliso School	--	--	--	--	--	--	--	--	--	--	X	--	--	--	X	X
Dump Road	--	--	--	--	--	X	--	--	--	X	--	--	--	X	--	--
Bluff II	--	--	--	--	--	--	--	--	--	--	--	--	--	X	--	--
Carpinteria Avenue (north of Salt Marsh)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	X
Carpinteria Train Station	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Note: All totals and losses are cumulative across planning horizons. Coastal hazards (e.g., coastal flooding and tidal inundation) may account for losses in the same area. Note that model does not account for existing structures such as homes along Sandyland Road or limited areas of seawalls and rock revetments which may reduce erosion or affect severity of coastal flooding tidal inundation
DE =Beach & Dune Erosion
CE = Cliff Erosion
CF = Coastal Flooding
TI = Tidal Inundation

Bikeways

Currently, no bike routes are vulnerable to coastal hazards. Out of the existing and planned bicycle facilities within the City, only the Class II route along Linden Avenue south of the railroad would be affected by coastal hazards with approximately 1 foot of sea level rise. Impacts to the bicycle network become increasingly greater with approximately 5 feet of sea level rise, affecting a total of 1.2 miles of facilities, or 29.3 percent of the bicycle network within the City. No existing or planned Class I routes would be exposed to coastal hazards with up to approximately 5 feet of sea level rise.

Currently, existing bikeways are not at risk of coastal hazards. However, with approximately 5 feet of sea level rise, 1.2 miles of bikeways, or about 30 percent of the City's bikeway system, would be exposed to coastal flooding.

Table 6-12. Length of Bikeways Potentially Impacted due to Coastal Hazards

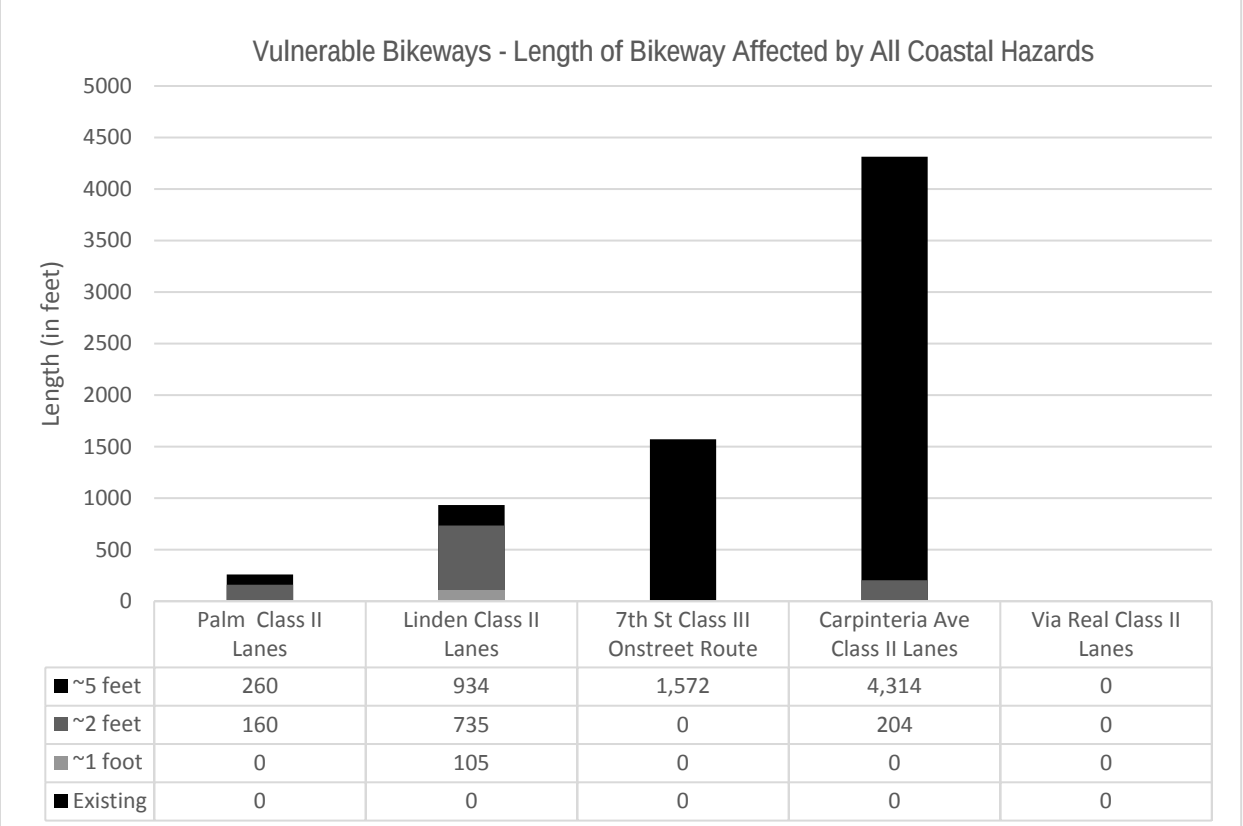
Planning Horizon		Coastal Erosion		Coastal Flooding		Tidal Inundation	
		Length	%	Length	%	Length	%
Existing		0 mile	0%	0	0%	0 mile	0%
~1 foot		0 mile	0%	<0.1 mile	<0.1%	0 mile	0%
~2 feet		< 0.1 mile	<0.1%	0.1 mile	2.4%	0 mile	0%
~5 feet		< 0.1 mile	<0.1%	1.2 mile	29.3%	0.7 mile	17.1%

Note: All linear totals and losses are cumulative along planning horizons. % indicates the percentage of the Carpinteria bikeway network affected out of 4.1 miles of dedicated Class I & II bikeway facilities within the City.

- **Carpinteria Avenue Class II Bike Lanes:** With approximately 2 feet of sea level rise, 204 linear feet of the Carpinteria Avenue Class II route may be subject to storm-based flooding north of the Carpinteria Salt Marsh and west of Plum Street. With approximately 5 feet of sea level rise, large sections of the Carpinteria Avenue Class II route west of Holly Avenue and north of the Carpinteria Salt Marsh become vulnerable to both coastal flooding and regular tidal inundation (4,314 linear feet and 2,145 linear feet, respectively).
- **Via Real Class II Bike Lanes:** The Class II bike route along Via Real is not vulnerable to coastal hazards across all planning horizons, however it is currently vulnerable to fluvial flooding from rainfall runoff and would continue to be subject to this type of flooding.
- **Linden Avenue Class II Bike Lanes:** Linden Avenue Class II route becomes exposed to damage from coastal flooding with approximately 1 foot of sea level rise (105 linear feet). With approximately 2 feet of sea level rise, the segment south of the railroad also

becomes vulnerable to dune erosion (76 linear feet), coastal flooding (735 linear feet), and tidal inundation (173 linear feet). With approximately 5 feet of sea level rise, the entire segment of Linden Avenue south of the railroad becomes exposed to coastal flooding and tidal inundation.

- **Palm Avenue Class II Bike Lanes:** A small section of the Class II bike route along Palm Avenue becomes vulnerable to coastal flooding when combined with approximately 2 feet of sea level rise (160 linear feet) or more. With approximately 5 feet of sea level rise, this route may also be subject to periodic tidal inundation.
- **7th Street Class III Onstreet Bike Route:** 7th Street Class III route is a shared roadway and would not be affected by coastal hazards until approximately 5 feet of sea level rise. In this scenario the entire road segment between Santa Ynez Avenue and Holly Avenue could be vulnerable to coastal flooding (1,572 linear feet) and tidal inundation (920 linear feet). However, as there are no bike facilities on this roadway, bicycles could be rerouted to other roadways if 7th Street is flooded.



	Palm Class II Lanes	Linden Class II Lanes	7th St Class III Onstreet Route	Carpinteria Ave Class II Lanes	Via Real Class II Lanes
~5 feet	260	934	1,572	4,314	0
~2 feet	160	735	0	204	0
~1 foot	0	105	0	0	0
Existing	0	0	0	0	0

Table 6-13. Length and Location of Potential Bike Route Loss due to Coastal Hazards

Bike Facility	Existing				~1 foot by 2030				~2 feet by 2060				~5 feet by 2100			
	BDE	CE	CF	TI	BDE	CE	CF	TI	BDE	CE	CF	TI	BDE	CE	CF	TI
Carpinteria Avenue Class II Bike Lanes	--	--	--	--	--	--	--	--	--	--	204 ft	--	--	--	4,314 ft	2,145 ft
Via Real Class II Bike Lanes	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Linden Avenue Class II Bike Lanes	--	--	--	--	--	--	105 ft	--	76 ft	--	735 ft	173 ft	206 ft	--	934 ft	778 ft
Palm Avenue Class II Bike Lanes	--	--	--	--	--	--	--	--	--	--	160 ft	--	--	--	260 ft	95 ft
7th Street Class III Onstreet Bike Route	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1,572 ft	920 ft

Note: All linear totals and losses are cumulative across planning horizons. Coastal hazards (e.g., coastal flooding and tidal inundation) may account for losses in the same area. Note that model does not account for existing structures such as homes along Sandyland Road or limited areas of seawalls and rock revetments which may reduce erosion or affect severity of coastal flooding and tidal inundation.

BDE = Beach & Dune Erosion

CE = Cliff Erosion

CF = Coastal Flooding

TI = Tidal Inundation

Bus Routes & Facilities

Currently, coastal hazards do not pose any risks to existing bus routes or facilities. With approximately 1 and approximately 2 feet of sea level rise, Metropolitan Transit District (MTD) Bus Route 36 – Seaside Shuttle becomes at rise of coastal flooding and tidal inundation. With approximately 5 feet of sea level rise, MTD Bus Routes 20 and 21x become at risk. No transit facilities (i.e., bus stops) would be subject to damage from erosion under any sea level rise scenario, and a very small portion of the Seaside Shuttle route could be affected by erosion of the roadway. In any scenario, bus routes could be rerouted to avoid eroded or flooded roadways, though significant flooding associated with a coastal storm or an EMHW tide combined with approximately 5 feet of sea level rise would inhibit transit services within the Downtown.

Table 6-14. Length of Bus Routes/Number of Bus Stops Potentially Impacted due to Coastal Hazards

Planning Horizon	Coastal Erosion	Coastal Flooding	Tidal Inundation
Existing	0 miles / 0 stops	0 miles / 0 stops	0 miles / 0 stops
~1 foot	0 miles / 0 stops	0.3 mile / 0 stops	< 0.1 mile / 0 stops
~2 feet	0 miles / 0 stops	0.7 mile / 0 stops	0.2 mile / 0 stops
~5 feet	< 0.1 mile / 0 stops	1.8 mile / 2 stops	0.9 mile / 0 stops

Note: All linear totals and losses are cumulative across planning horizons.

- **MTD Bus Routes 20 and 21x:** Line 20 – Carpinteria, travels along Carpinteria Avenue and Via Real through Carpinteria, then travels along Via Real until Summerland, where it travels on U.S. Highway 101 until Montecito, and along local roads until the transit center in downtown Santa Barbara. Line 20 includes multiple local stops along the route. Line 21x – Carpinteria Express, travels along Carpinteria Avenue and Via Real through Carpinteria then travels west along Via Real until Padaro Lane with multiple stops; it then travels on U.S. Highway 101 with no stops until downtown Santa Barbara, where there are multiple stops, including the transit center. Within the City, Line 20 and Line 21x have the same routes and stops. These bus routes are not considerably vulnerable to coastal hazards until approximately 5 feet of

Portions of the electric Seaside Shuttle bus route within the Downtown could be affected by coastal flooding and periodic inundation along Carpinteria Avenue with approximately 5 feet of sea level rise. However, bus routes are adaptable and can be rerouted to avoid coastal hazards.

sea level rise, when the route along Carpinteria Avenue between Santa Ynez Avenue and Franklin Creek, including two bus stops become at risk of coastal flooding.

- **MTD Bus Route 36:** Line 36 – Seaside Shuttle, travels in a loop within the City, with stops at the train station and along Linden Avenue, Carpinteria Avenue, Casitas Pass Road, El Carro Lane, and Santa Ynez Road. Connections are available to MTD Line 20 or 21x. The portion of the shuttle route along Carpinteria Avenue between Santa Ynez Avenue and Franklin Creek as well as one shuttle stop become vulnerable to coastal flooding with approximately 5 feet of sea level rise.

Rail

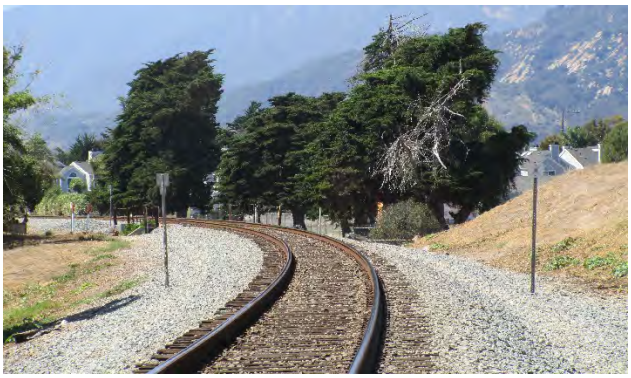
The City contains 3.6 miles of railroad that runs through the City. Currently, approximately 0.1 mile of railroad line along the Carpinteria Bluffs is vulnerable to cliff erosion if a 1 percent annual chance storm were to occur. In addition, the segment over the Carpinteria Creek crossing is currently subject to coastal flooding and tidal inundation; although, this section appears to be co-located with bridges, thus damages may not be as severe. With approximately 1 foot of sea level rise, 0.4 mile of railroad line along the bluffs could be vulnerable to cliff erosion. With approximately 2 feet, a cumulative total of 0.8 mile of railroad line could be vulnerable to cliff erosion. With approximately 5 feet of sea level rise, 1.4 miles of railroad line, or most of its alignment along the Carpinteria Bluffs, could be exposed to coastal erosion, and 1.5 miles of railroad could be vulnerable to coastal flooding along the Carpinteria Bluffs and where the railroad runs adjacent to the Carpinteria Salt Marsh. Over 80 percent of the railroad within the city could be vulnerable to coastal hazards with approximately 5 feet of sea level rise; however, the model does not account for existing rock revetments or seawalls, which may reduce erosion or affect severity of coastal erosion of the railroad.

While the parking lot adjacent to the train station becomes vulnerable to coastal flooding with approximately 5 feet of sea level rise, the train station remains outside of any coastal hazard zone.

Table 6-15. Length of Potential Railroad Line Loss due to Coastal Hazards

Planning Horizon	Coastal Erosion		Coastal Flooding		Tidal Inundation	
Existing	0.1 mile	2.8%	0.1 mile	2.8%	< 0.1 mile	<0.1%
~1 foot	0.4 mile	11.1%	0.4 mile	11.1%	< 0.1 mile	<0.1%
~2 feet	0.8 mile	22.2%	0.9 mile	25.0%	< 0.1 mile	<0.1%
~5 feet	1.4 miles	38.9%	1.5 miles	42.6%	< 0.1 mile	<0.1%

Note: All linear totals and losses are cumulative across planning horizons. % indicates the percentage of UPRR affected out of 3.6 miles of railroad track within the City. Note that model does not account for existing rock revetments or seawalls which may reduce erosion or affect severity of coastal erosion of the railroad.




With approximately 5 feet of sea level rise, over 80% of UPRR could be at risk of damage or loss from coastal hazards. A significant portion of the railroad north of Carpinteria Salt Marsh could be subject to coastal flooding during a large storm event, while nearly the entire segment along the Carpinteria Bluffs could be at risk of both long-term erosion and cliff failure during a storm.

Even closing a small portion of U.S. Highway 101 near and along exit 87B (southbound U.S. Highway 101 Carpinteria Avenue exit) would have serious consequences on commuters, business owners, and other travelers access to their respective destinations given the number of average daily trips (ADT) on this major interstate highway. Similarly, any disruption to the railroad services in the City would have economic losses far exceeding the costs of replacing UPRR.

Please refer to Chapter 1, *Sector Profiles*, for additional information related to road, parking, and public transportation systems vulnerable to coastal hazards including bikeways, bus routes, bus stops, and parking lots. In summary, with approximately 1 foot of sea level rise, parking in the Beach Neighborhood and Carpinteria State Beach becomes at risk from coastal flooding, which may include damage or loss of roadways. With approximately 2 feet of sea level rise coastal flooding impacts escalate and may impact 7 parking lots. With approximately 5 feet of sea level rise, impacts from all coastal hazards increase substantially. Coastal flooding could pose a risk to 11 parking lots in the Beach Neighborhood, Carpinteria State Beach and Downtown north (inland) of UPRR, including the train station parking lot (City Parking Lot #3). A total of 8 parking areas could become routinely inundated during monthly high tides, and 9 lots could be exposed to erosion in the Beach Neighborhood and Carpinteria State Beach.

6.3 Camping and Visitor Accommodations

The City is a small beach community with an annual population of 13,040. During the summer however, the population of the City can more than double with an influx of tourists and out of town visitors. Many of the local businesses and residents depend on this influx of tourism and the City benefits from the sales tax revenues. Parking and campgrounds are at risk to damages from coastal storms. As this vulnerability increases over time, damages to the Carpinteria State Park will affect attendance, and thus State and City revenues.

Short-term vacation rental units (less than 30 days) are a growing business for the City. There are an estimated 218 short-term vacation rental units located in the Beach Neighborhood (City 2018). Given that up to 170 units are located along Sandyland Road, with approximately 55 located along the seaward side of the road, a large majority of short-term vacation rentals would be vulnerable to loss as described in Section 6.1, *Residential Property Vulnerabilities*, of this Report. In addition, these units, as well as hotels and motels are required to pay TOT, currently estimated at $2.5 million per year for all visitor accommodations, which would result in significant loss of City revenues (City 2018).

Given that no impacts are expected to hotels or motels from coastal hazards and sea level rise, the following analysis focuses on beach recreation and camping. Both the City and State beaches, and the Carpinteria State Park campgrounds are vulnerable to existing and future coastal hazards. This Report examines campgrounds that are vulnerable to coastal erosion and coastal flooding and provides preliminary estimates of loss in campsites and campground activity. This beach-centered recreational value is important to consider when selecting and evaluating future adaptation options.

Beach Recreation

The City has two main beaches, Carpinteria City Beach and Carpinteria State Beach, which are adjacent to one another but administered separately. This Report employs data on beach visitation and spending from several sources. For Carpinteria State Beach, this Report uses recent State Parks data for camping and other attendance. The Report also uses data from the Coastal Regional Sediment Master Plan (CRSMP) prepared for Beach Erosion Authority for Clean Oceans and Nourishment (BEACON) (2009), updated for the growth within the population of Santa Barbara County as well as the State of California (numerous visitors come from beyond Santa Barbara County).

Table 6-16 presents the data/estimates for beach attendance and recreational value. This Report assumes that a day beach visit results in $40 of recreation spending per adult visitor, based on studies of non-market value for beaches in California and California Coastal Commission (CCC) guidance (CCC 2015). This Report bases economic benefits on studies of how much individuals are willing to pay for a day at the beach, based on numerous travel cost studies of beach attendance in southern California. Carpinteria experiences approximately 1.5 million beach day visits per year (Table 6-17). The total economic value of this activity is estimated at $60.4 million per year.

Table 6-16. Annual Attendance and Recreational Value of Carpinteria's Beaches

Site	Total Yearly Attendance	Yearly Camping	Source	Total Recreational Value
Carpinteria City Beach	600,000	-	BEACON	$24,000,000
Carpinteria State Beach	910,428	420,828	State Parks	$36,417,120
Total	**1,510,428**	**420,828**	**-**	**$60,417,120**

The total estimated consumer spending associated with beach recreation is just below $48 million annually, generating $445,000 in sales tax revenues for the City[4] and just under $1.9 million in TOT (Table 6-17).

Table 6-17. Annual Spending and Tax Revenue Generated by Beach Recreation Visitors

Site	Total Yearly Attendance	Estimated Spending in Carpinteria	Estimated Sales Tax	Estimated Transient Occupancy Taxes
Carpinteria City Beach	600,000	$21,900,000	$144,000	$1,440,000
Carpinteria State Beach	910,428	$26,068,708	$301,051	$437,005
Total	**1,510,428**	**$47,968,708**	**$445,051**	**$1,877,005**

Camping

Carpinteria State Beach has four campgrounds (Anacapa, Santa Cruz, Santa Rosa, and San Miguel), named after the Channel Islands, with an estimated 213 campsites (Table 6-18). These campgrounds draw an estimated 420,828 overnight visitors per year (Table 6-19). These campgrounds are vulnerable to to dune erosion, cliff erosion, and coastal storms (Table 6-18). This Report assumes that the potential reduction in camping attendance will be proportional to the loss in campground area due to coastal erosion or coastal flooding (i.e., camping population density remains constant per square foot area). The Report also assumes that tidal inundation will disrupt camping at least six days a month (20 percent of the time) based on the full moon-new moon spring tide cycle; given that the campground may also need to be closed and opened following flooding, this estimate may be low. Ultimately, coastal erosion may lead to a permanent loss of camping area at Carpinteria State Beach in the absence of any adaptation measures.

[4] These estimates only include the City share (1%) of sales tax revenues, not the County share.

Table 6-18. Percentage of Carpinteria State Campground subject to Coastal Hazards and Estimated Loss in Camping Visits per Year

Campground Name	# of Sites	Type	% of Area Loss to Coastal Erosion (by Time Horizon)	% of Area Flooded by Coastal Storm (by Time Horizon)
			(Existing / 2030 / 2060 / 2100)	
Anacapa	30	Tent Camping & RVs	0 / 0 / 0 / 0	0 / 23 / 99 / 100
Santa Cruz	47	Tent Camping & RVs	1 / 3 / 6 / 28	45 / 77 / 95 / 100
Santa Rosa	80	Mostly RVs	32 / 45 / 65 / 92	32 / 45 / 65 / 100
San Miguel	56	RVs only	0 / 2 / 30 / 100	0 / 1 / 30 / 100

Note that these categories may overlap. All percentages listed above are cumulative across time horizons. Campground sites are defined as single and group locations for tents, motorhomes, and trailers (camp host not included).

This Report does not estimate reduction of overnight camping attendancefrom wave run-up during 1 percent annual chance storms.[5] As indicated in Table 6-19, under existing conditions, 9 percent of all campground areas are vulnerable to dune or cliff erosion from a 1 percent annual chance storm. This loss increases over time to 33 percent with 5 feet of sea level rise, with those lost campground areas primarily reducing camping opportunities in the more southerly Santa Rosa and San Miguel campgrounds that have less dune protection. With 5 feet of sea level rise, nearly half (46 percent) of the entire campground areas may be subject to tidal inundation, and all campground areas (100 percent) could be subject to coastal flooding during a 1 percent annual chance storm.

Table 6-19. Projected Losses in Camping Days per Year

Timeline	% Loss of Campground Area (Dune Erosion)	# of Camp Visits Lost per Year	% Loss of Campground Area (Cliff Erosion)	# of Camp Visits Lost per Year	% Inundated Campground Area (Tidal Inundation)	# of Camp Visits Lost per Year
Existing	9	36,954	0	-	0	-
~1 ft	13	53,206	0	393	0	-
~2 ft	19	78,598	5	20,167	2	1,768
~5 ft	33	139,387	18	75,906	46	39,131

Note: Totals and losses are cumulative across horizon years.

[5] The analysis assumes that camping attendance will remain the same. However, while camping is generally at or close to capacity (approximately 40,000 campers per month) during the summer months, visitation is below capacity most other months. Storm waves usually arrive in winter and seasonal closures of some of the sites may avoid these impacts.

Hotels, Motels and Short-term Vacation Rentals

Beach tourism generates a significant portion of the City's revenue. As indicated in Table 6-17, beach tourism generates $1.9 million in TOT and $445,000 in sales tax revenues annually, partially from camping visitors in the Carpinteria State Beach campgrounds. A significant portion of visitors to the City Beach stay overnight, and a reduction in the number short-term vacation rentals could impact beach tourism and associated spending and tax revenues (BEACON 2009).

Presently, many of the oceanfront properties in the Beach Neighborhood are short-term vacation rentals and contribute a substantial amount to the City tax base from TOT. City records show that 75 short-term (less than 30 days) vacation rental operators were registered to collect TOT on 104 units in the City in 2015. However, the actual number of short-term vacation rentals was likely much higher.

In November 2016, the City Short-Term Vacation Rental program was approved by the CCC (Local Coastal Plan [LCP] Amendment No. LCP-4-CPN-16-0024-1). This program approved the licensing of 218 short-term vacation rentals in four (4) areas in the City primarily in the Beach Neighborhood (Figure 6-12). In fiscal years 2016-2017 and 2017-2018, 189 short-term vacation rentals were licensed, generating about $400,000 annually in TOT revenues.

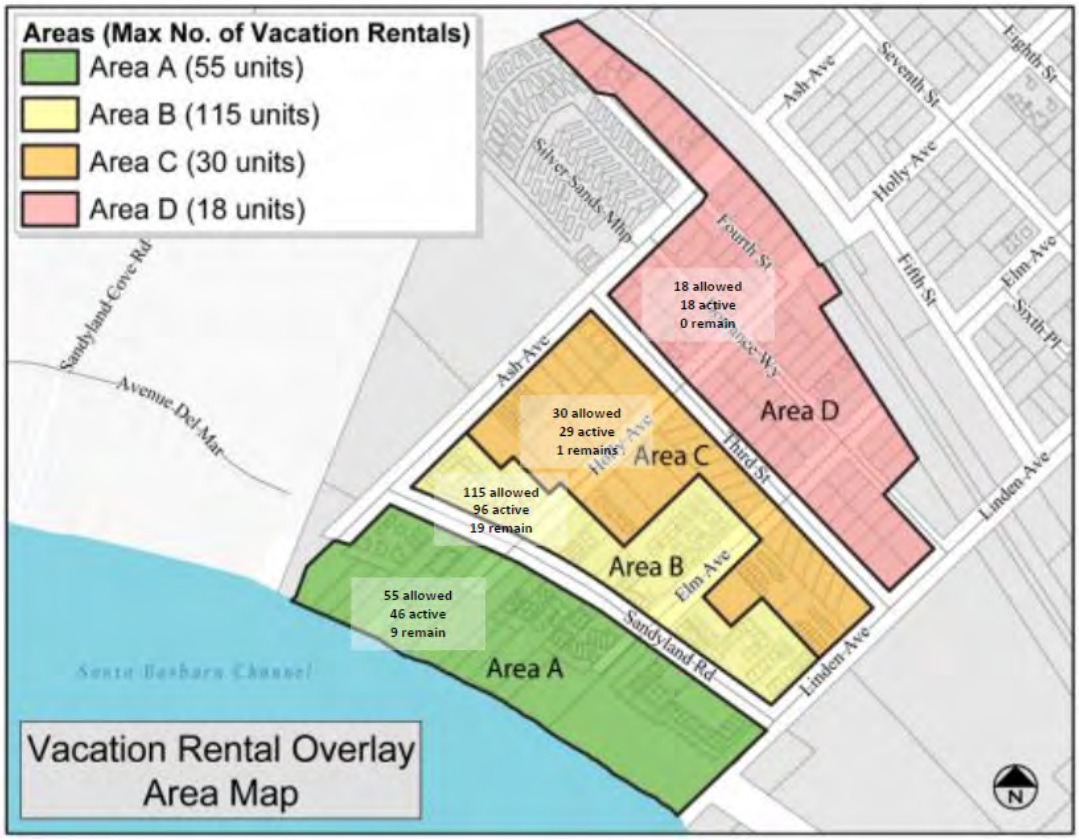


Figure 6-12. *Short Term Rental Overlay Map with Units permitted in 2017*

Analysis of vulnerable land uses in Section 6.1, indicate that many short-term vacation rental properties in the City are currently vulnerable to coastal hazards, particularly in Area A (Figure 6-12). With approximately 5 feet of sea level rise, nearly the entire short-term vacation rental overlay could be subject to episodic coastal flooding and periodic tidal inundation. However, coastal flooding, which typically occurs in the winter, may not significantly disrupt the short-term vacation rental market which peaks in the summer. Tidal inundation and coastal erosion are likely to have a larger impact on short-term vacation rentals and TOT revenues.

6.4 Coastal Access and Trails

Overall, in the City, there are an estimated 13 vertical beach access points, lateral beach access along the entire 2.5 miles of shoreline under most conditions, an additional estimated 0.4-mile of hiking trails within the Carpinteria Salt Marsh, and an additional estimated 6.7 miles of trails throughout the Carpinteria State Park and Carpinteria Bluffs. Each coastal access and trail has its own set of amenities (Table 6-20). The California Coastal Trail (CCT) also traverses the City but no designated alignment was available for analysis.

Under existing conditions, all of the vertical coastal access points and all lateral coastal trails are vulnerable to coastal erosion and coastal flooding, and more than half of the vertical coastal access points are potentially impacted by tidal inundation during monthly extreme tides or large coastal storm driven waves. By 2100 with 5 feet of sea level rise, all vertical coastal access points and all lateral coastal trails are vulnerable to coastal erosion, coastal flooding, and/or tidal inundation.

Table 6-20. Coastal Access Amenities and Coastal Trails

Park Name	Trail Name	Total Miles of Coastal Trail	Coastal Access Points	Facilities and Amenities
Salt Marsh Nature Park	Carpinteria Salt Marsh Trail	0.4	Access at terminus of Ash Ave	Parking, Restroom, Junior Guard Shed
Carpinteria City Beach	City Beach	0.3	Access throughout Downtown Beach Neighborhood from Ash Ave to Linden Ave	Parking, Lifeguard towers (3), Restroom
Linden Field	Beach boardwalk traversing sand dunes	<0.1	Access at Linden Ave, Palm Ave terminus and sand dunes	Parking
	Trail adjacent to Tomol Interpretive Play Area in State Park	<0.1	-	Playground and Street Parking

Table 6-20. Coastal Access Amenities and Coastal Trails (Continued)

Park Name	Trail Name	Total Miles of Coastal Trail	Coastal Access Points	Facilities and Amenities
Carpinteria State Beach	State Beach	0.6	Access throughout State Park from Linden Ave to San Miguel Campground	Day Use area, Parking, Camping
	Trail from Tomol Interpretive Play Area to 4th St	0.2	-	Parking, Playground, Restrooms
	Campground Trails	0.6	Access at Santa Cruz and Santa Rosa Campgrounds	Parking, Camping, Restroom, Lifeguard Tower
	Carpinteria Bluffs Trail	0.1	Access at stairs traversing the bluffs south of Calle Ocho	-
Tar Pits Park	Carpinteria Bluffs Trail	0.9	Access at western terminus of the park	Tar Pits
Carpinteria Bluffs Nature Preserve (Carpinteria Bluffs Area 1)	Carpinteria Bluffs Trail	2.2	Access from trail descending from Carpinteria Bluffs Trail to Seal Sanctuary	Seal Sanctuary, Parking, Restroom
Property between Carpinteria Bluffs Nature Preserve and Rincon Bluffs (Carpinteria Bluffs Area 2)	Carpinteria Bluffs Trail	0.7	-	-
Rincon Bluffs (Carpinteria Bluffs Area 3)	Carpinteria Bluffs Trail	0.9	-	-
Rincon Beach Park (Unincorporated County Adjacent to City)	-	-	Access at trail descending from Rincon Parking Lot to the beach at the eastern edge of the City	-

Table 6-21. Estimated Length of Public Trails Vulnerable to Storm Erosion, Storm Flooding and Chronic, Tidal Inundation

Trail Vulnerability	Coastal Erosion	Coastal Flooding	Tidal Inundation
	Miles		
Existing	1.2	1.3	<0 1
2030	1.9	2.2	<0.1
2060	2.7	3.4	0.1
2100	4.6	5.4	1.4

Note: All linear totals are cumulative miles across horizon years.

Trails

Currently, trails and UPRR tracks along the Carpinteria Bluffs are vulnerable to damage if a large coastal storm event (i.e., 1% annual chance storm) were to result in cliff failure.

To identify coastal access ways and trails potentially vulnerable to climate change and sea level rise hazards, this study evaluated 5.6 miles of trails, primarily within the Carpinteria Salt Marsh, Tar Pits Park, and Carpinteria Bluffs, as well as lateral coastal access that is proposed as the CCT alignment through the City. Table 6-22 presents projected public trail losses due to coastal erosion, coastal flooding, and tidal inundation. Under existing conditions, all coastal trails are vulnerable to coastal erosion and cliff failure during a 1 percent annual chance storm, and lateral beach access, the area seaward of the mean tide line, a dynamic boundary under sea level rise, would be affected by tidal inundation during high tides or large coastal storm driven waves. The portion of the Carpinteria Bluffs Trail along the entire extent of the Carpinteria Bluffs is may be particularly vulnerable to erosion, with potentially 0.1 mile at risk from coastal hazards currently, 0.6 mile at risk with approximately 1 foot of sea level rise, and 1.0 mile at risk with approximately 2 feet of sea level rise – encompassing most of the length of the trail along the bluffs. 1.2 miles of trails are currently vulnerable to coastal erosion from a 1 percent annual chance storm, and 1.3 miles of trail within the Carpinteria Salt Marsh are vulnerable to coastal flooding.

With approximately 5 feet of sea level rise, many trails adjacent to the Carpinteria Bluffs Trail are also vulnerable, putting 2.3 miles at risk to cliff erosion. It is anticipated that with approximately 5 feet of sea level rise, approximately 5.4 miles of Carpinteria's coastal trails will be eroded, flooded, or periodically inundated by tides (see Figure 4-1). With approximately 5 feet of sea level rise, all coastal trails become vulnerable to cliff erosion, coastal flooding, and tidal inundation (Table 6-22).

Table 6-22. Length of Potential Public Trail Damage due to Coastal Hazards

Planning Horizon	Coastal Erosion	Coastal Flooding	Tidal Inundation
Existing	1.2 miles	1.3 miles	< 0.1 mile
~1 foot	1.9 miles	2.2 miles	< 0.1 mile
~2 feet	2.7 miles	3.4 miles	0.1 mile
~5 feet	4.6 miles	5.4 miles	1.4 miles

Note: All linear totals and losses are cumulative across planning horizons.

- **Carpinteria Bluffs Trail:** From the eastern border of the Carpinteria Bluffs Nature Preserve, the Carpinteria Bluffs Trail runs west along the inland side of the railroad, crossing the railroad tracks near the seal haul out to run along the bluff edge until it ends at Tar Pits Park. The trail is currently vulnerable to cliff erosion, with potential impacts increasing with rising seas. With approximately 5 feet of sea level rise, the majority of the trail is at risk, with about one mile of the trail adjacent to the bluffs lost to erosion. However, it should be noted that several hundred feet of trail in the Carpinteria Bluffs industrial area is protected by an existing 200-foot long rock revetment which would substantially slow cliff erosion and retreat in this area. Further, more than 4,000 feet of the existing Bluffs Trail across the Carpinteria Bluffs and the industrial area lies landward of the UPRR. The UPRR typically responds to erosion and track failure with emergency coastal armoring, which if continued over time, would protect the tracks and the landward sections of coastal trail, but could lead to armoring of much of the shoreline of eastern Carpinteria, with secondary impacts to sand supply, coastal access and habitats.
- **California Coastal Trail (CCT):** The proposed CCT route follows the Carpinteria Bluffs Trail alignment along the bluffs for approximately two miles. While the CCT is not yet complete, and the alignment within the City is not yet approved, a route has been planned. From where the eastern City boundary meets the coast, the CCT would run west along the coast through Carpinteria State Beach until Linden Avenue, where it would turn inland from the coast and follow north along Linden Avenue; it would then turn west onto 7th Street and connect with Carpinteria Avenue, where it would then run along the northern boundary of the Carpinteria Salt Marsh and exit the western City boundary (Coastwalk 2005). Coastal erosion currently threatens the CCT; portions along the beach are vulnerable to dune erosion, and sections along the Carpinteria Bluffs are vulnerable to cliff erosion; these risks increase. Sections of the CCT along the beach and Carpinteria Salt Marsh are currently vulnerable to dune erosion, with this length increasing with rising sea levels and including sections of Linden Avenue and Carpinteria Avenue. With approximately 5 feet of sea level rise, the majority of the CCT within the City becomes vulnerable to coastal flooding, and tidal inundation also could periodically flood sections of the CCT along the beach, part of Linden Avenue, and near the Carpinteria Salt Marsh. Given sea level rise, the dynamic mean tide line, the boundary for lateral public access seaward of the line, will move landward; however, access could nonetheless become impassible along the beach given landward private properties and related protection structures.

- **Carpinteria Salt Marsh Trail:** The Carpinteria Salt Marsh Trail is a one-mile out and back trail that begins west of the intersection of Ash Avenue and Sandyland Road and runs along the eastern and northern edge of Salt Marsh Park, ending at Franklin Creek. Sections of the trail become vulnerable to coastal flooding approximately 1 foot or more of sea level rise. The trailhead becomes vulnerable to dune erosion with approximately 2 feet of sea level rise and the section of the trail closest to Franklin Creek could be regularly inundated by EMHW tides with approximately 2 or more feet of sea level rise. With approximately 5 feet of sea level rise, the entire trail could be subject to episodic coastal flooding and regular tidal inundation.

With as little as approximately 1 foot of sea level rise, the Carpinteria Marsh Trail would become at risk to coastal hazards (left). The Carpinteria Bluffs Trail is currently at risk of cliff erosion hazards if a large coastal storm event were to occur, and with approximately 5 feet of sea level rise, the entire trail could be eroded. However, it is noted that the railroad is located seaward of the trail for much of this alignment and could serve as coastal armoring that would help slow the rate of erosion along the Bluffs.

Other Potential Impediments to Coastal Recreation

The coastal hazard maps prepared for this Report indicate that paid parking access to the State Beach, as well as City-owned free parking often used to access the City Beach, are subject to flooding, which may also impede beach access and other tourism. This Report did not attempt to estimate these losses in beach-related spending, though they could be significant.

6.5 Hazardous Materials Sites, and Oil and Gas Wells

The City has 62 sites, consisting of legacy inactive oil wells and hazardous materials, with the potential to spill/leak hazardous materials. The economic costs of these leaks are not evaluated in the analysis above due to the difficulty and uncertainties inherent in this type of analysis and the fact that the costs would likely be borne by private parties other than the City. Therefore, any such costs would be in addition to the costs/losses discussed earlier.

The Carpinteria area has a long history of oil and gas development. The City provides regulatory oversight and permit compliance for existing oil and gas facilities (Table 6-23). The City has 53 legacy inactive oil wells, with 16 nearshore (up to 600 feet from mean high tide), and 37 onshore. Of the onshore wells, 8 are located on the beach, 5 are vulnerable to coastal erosion across later time horizons (2 in 2060, 3 in 2100), and 32 are unaffected by coastal erosion.

Table 6-23. Oil Wells in Carpinteria by Horizon/Location

Year	Number of Wells
Existing Nearshore	16
Existing Onshore	37
2030	0
2060	2 Onshore
2100	3 Onshore
Unaffected Onshore	32

Note: All totals are non-cumulative across horizon years.

The City has 43 distinct sites categorized by the State and U.S. Environmental Protection Agency (EPA) (Table 6-24).

Table 6-24. Hazardous Materials by Program

Category	Program	Total in City	Total Affected
Hazardous Waste Storage	EPA Toxics Release Inventory (TRI)	6	0
	EPA Small Quantity Generators (SQG)	35	4
	EPA Large Quantity Generators (LQG)	7	0
	State Geotracker Electronic Submittal of Information (ESI) Sites	10	3
Cleanup Programs	Leaking Underground Storage Tanks (LUST) - Active Cleanup	0	0
	State Active Cleanup Program Sites	4	1

See definitions section for a detailed description of Hazardous Material Monitoring Programs. Data was accessed from the State of California and the EPA in fall 2017).

Only one (1) hazardous material reporting site is vulnerable to coastal sea level rise hazards under existing conditions, which is a location at the terminus of Dump Road near the former oil and gas processing site at Bluff 0.

The State Electronic Submittal of Information (ESI) list has this site categorized as a former "Underground Storage Tank - Oil and Gas Plant". By 2030, these vulnerabilities remain the same. By 2060, one active cleanup site (the Conoco Phillips Kittie Ballard Well Site) may become vulnerable to both coastal erosion and flooding on the Carpinteria Bluffs in the Carpinteria Bluffs Nature Preserve. This site, an area of special biological significance (a harbor seal haul out and breeding ground), is located less than 600 feet to the south of Dump Road/Bluff 0. In addition, by 2100, another two hazardous material reporting sites become vulnerable to coastal flooding. These are light industrial business on Carpinteria Avenue in the west side of the City.

This Report did not attempt to estimate the costs of remediation for these sites, though these costs could be large. For example, the costs of remediating the recent Refugio Oil Spill are estimated at $257 million. The costs of mitigating a leaking underground storage tank are estimated (by the EPA) at $125,000 before leakage and $1.5 million after leakage. The cost of capping and remediating leaky oil wells have been estimated by the nearby town of Summerland which is currently facing this problem. Recapping costs from this effort range from $100,000 for wells onshore to $800,000 for wells offshore. These estimates are intended to provide an idea of the magnitude of the costs, and therefore, risks involved. Therefore, the City could incur anywhere from hundreds of thousands of dollars, to millions of dollars in costs mitigating these issues if the responsible party is negligent or given protections under bankruptcy.

Even though the legal liability of many of these wells and hazardous materials sites does not formally lie with the City, it is possible that the liable parties may fail to mitigate, mitigate inadequately, or go bankrupt and default on their liability. Consequently, the City may be compelled to ask state or federal authorities to cleanup. Given that the costs of mitigation are likely to be much higher after the fact, this Report strongly recommends that further study of the potential for oil and hazardous materials leaking into the environment be evaluated more thoroughly.

The City also regulates the 55-acre former oil and gas processing facility situated on the Carpinteria Bluffs at Bluff 0. This site contains oil storage, processing and cleaning facilities used to process offshore oil. A private oil corporation has re-acquired this site and is currently in discussion with the City about decommissioning and remediation. However, remediation could take several years. No impacts to any structures on the property would occur aside from those associated with Casitas Pier and associated access routes. Some erosion to the Casitas pier parking lot could occur as early as 2060 or with approximately 2 feet of sea level rise.

6.6 Infrastructure

This section contains this Report's results from several sectors involving City infrastructure for stormwater (drains and pipes), wastewater (sewer pumps and pipes), and water supply (water pipes). These sectors have been combined as they are likely of most interest to the City's Public Works Department. The tables for these categories have been combined in order to simplify the discussion and minimize the number of graphs/tables. As in previous sections, vulnerabilities to coastal erosion, coastal flooding, and tidal inundation are presented below. It is important to note that private sector utility providers (i.e. natural gas, fiber optic, electrical) data was not available for this analysis.

Stormwater Infrastructure

Carpinteria's stormwater system is managed by the City Public Works Department and Santa Barbara County Flood Control District These departments are responsible for stormwater management, flood control, and floodplain management. The stormwater system consists of a series of flood control channels along Franklin, Santa Monica, and Carpinteria Creeks, and 316 storm drain inlets and outfalls that discharge to the nearest body of water using gravity flow. A large portion of the City's storm drain system is near current sea level in the Beach Neighborhood and inland of the Carpinteria Salt Marsh. Storm drains have occasionally backed up at several locations in these neighborhoods during high tides or large storm events. Presently, none of the stormwater is diverted to the Wastewater Treatment Plant (WWTP) for treatment and there are no pumps to convey stormwater. As sea level rises, portions of the system may not drain during high tides and more of the tide cycle, which in turn may increase

stormwater flood depths and frequency. Culverts and pipes may also create flows of ocean water into the neighborhoods.

Wastewater Infrastructure

The wastewater system in Carpinteria is managed by Carpinteria Sanitary District (CSD). CSD owns and operates 43 miles of pipeline, 8 lift stations and the 2.5 million gallons per day WWTP. Maintenance to the system is accessed through 960 manholes. CSD provides service to a 3.1-square mile service area within the City and portions of unincorporated County within the Carpinteria Valley. This includes service to about 4,423 residential parcels and 500 non-residential parcels. Most of the system is gravity fed to the WWTP located just inland of UPRR on Carpinteria Creek. The WWTP provides secondary treatment and chemical disinfection before discharging to the Pacific Ocean through an ocean outfall. The 2005 Master Plan identifies that flows are higher during rain events, indicating significant inflow and infiltration. Coastal hazards could further increase the volume of flows to the WWTP through manholes and add additional complications from increased salinity, when combined with fluvial flooding from Carpinteria Creek.

Water Supply Infrastructure

The City's water supply system is managed by the Carpinteria Valley Water District (CVWD). CVWD's service area is approximately 17.6 square miles, including areas outside of the City. Domestic water service is provided to about 15,619 people and approximately 3,253 acres of irrigated crops. Water is distributed through 46 miles of pipelines, and maintained by 4 pressure regulators, 290 hydrants, and 1,550 valves, to connect to 3,516 customer water meters within the City.

Currently the District relies on three sources of supply to meet water demand in its service area. These are the Cachuma Project, the State Water Project, and 4 local groundwater wells within the Carpinteria Valley. The CVWD, CSD, and the City have partnered to investigate development of a recycled water project to offset imported water and declines in Lake Cachuma supply. The recycled water project would likely be collocated at the WWTP. CVWD is attempting to install a sentinel well to monitor saltwater intrusion into the groundwater basin but is presently stalled in regulatory processes.

Combined Results

The City has several types of infrastructure close to the coast that are vulnerable to coastal erosion and tidal inundation, including of roads, railroads, pipelines, and infrastructure components that are vulnerable to coastal hazards (Table 6-25). Analysis below estimates replacement costs of such infrastructure to extent data is available. In some cases, there is insufficient data to estimate the replacement cost. In other cases (e.g., roads), the analysis considered replacement costs, but not the cost of additional land acquisition or right-of-way

access, or potential costs of elevating roads to avoid flooding. Consequently, the estimates below may be too low in some cases. Further analysis of costs of acquiring the new land and right-of-way necessary for adaptation or the costs of elevating roads, railroad lines, and other infrastructure vulnerable to coastal hazards in the future is recommended.

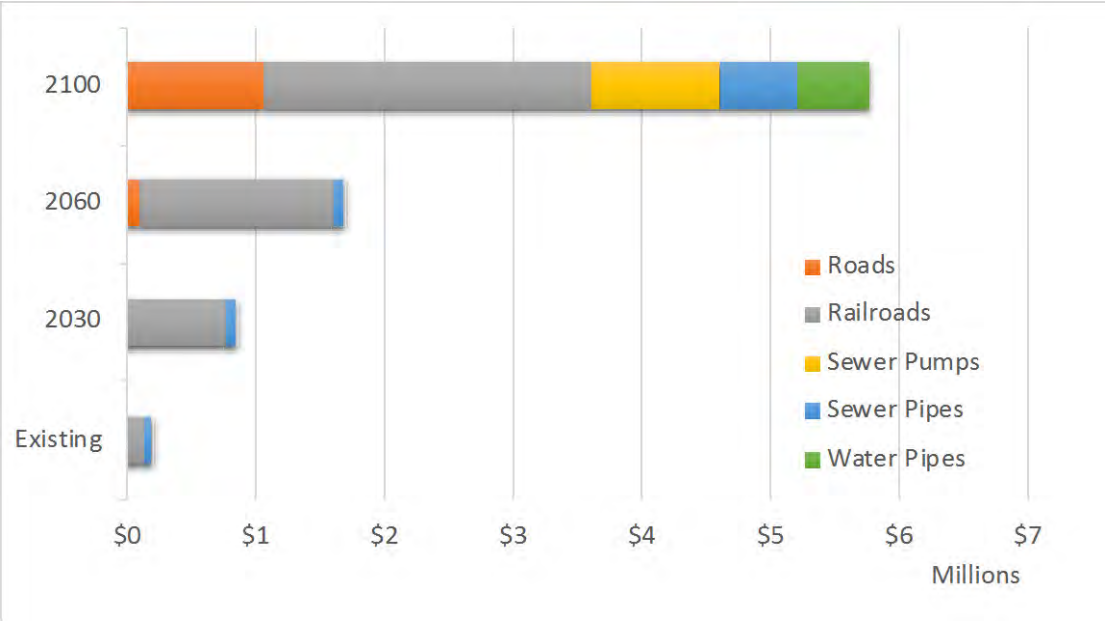
Table 6-25 presents estimates of the value of infrastructure vulnerable to coastal erosion, coastal flooding, and tidal inundation according to time horizon. While they also include the vulnerability to roads and railroads, the results for transportation-related infrastructure can be found above in Section 6.2, *Roads, Parking, and Public Transportation*, while impacts to recreational trails are described in Section 6.4, *Coastal Access and Trails.*

Table 6-25. Major Infrastructure in the City of Carpinteria

Category	# or Length in City	# or Length Affected by Coastal Flooding with ~5 ft of SLR
Roads	50.3 miles	4.8 miles
Railroad[1]	2.5 miles	1.5 miles
Hiking Trail	*Unknown*	5.4 miles
Sewer Pipe	36.5 miles	4.7 miles
Sewer Pump Stations	8 in District / 5 in City	3 in District / 2 in City
Water Pipe	45.6 miles	4.5 miles
Water Supply Pressure Regulators	4	1
Stormwater Drain	24.5 miles	4.2 miles
Stormwater Drain Inlets	342	95
Stormwater Drain Outlets	316	116

1. Railroad does not include the section from San Point Road to Franklin Creek adjacent to Carpinteria Salt Marsh, as it is outside of the City limits.

Water supply and wastewater pipelines and sewer pumps are not significantly exposed to coastal erosion with less than 5 feet of sea level rise.However, 0.5-mile of water pipelines ($560,000) and 0.5-mile of sewer pipelines ($610,000) primarily located under Sandyland Road and near the WWTP, and one sewer pump/lift station ($1 million) on Sand Point Road (inside the CVWD boundary, but outside of the City boundary), become vulnerable to coastal erosion. Altogether and including roads and railroads, a total of nearly $5.8 million in City infrastructure may be vulnerable with 5 or more feet of sea level rise. Similarly, stormwater infrastructure would not become substantially vulnerable to coastal erosion until 5 feet of sea level rise, at which point a total of 6 outlets, 3 outfalls, and 1.0-mile of storm drains may become vulnerable.



Erosion	Roads	Railroads	Sewer Pumps	Sewer Pipes	Water Pipes	Total
Existing	$0	$130,000	$0	$60,000	$0	$190,000
~1 ft	$0	$760,000	$0	$70,000	$0	$830,000
~2 ft	$90,000	$1,510,000	$0	$80,000	$0	$1,680,000
~5 ft	$1,050,000	$2,550,000	$1,000,000	$610,000	$560,000	$5,770,000

Erosion	Roads	Railroads	Sewer Pumps	Sewer Pipes	Water Pipes	Trails
Existing	< 0.1-mile	0.1-mile	0	< 0.1-mile	< 0.1-mile	1.2 miles
~1 ft	< 0.1-mile	0.4-mile	0	0.1-mile	< 0.1-mile	1.9 miles
~2 ft	0.1-mile	0.8-mile	0	0.1-mile	< 0.1-mile	2.7 miles
~5 ft	0.7-mile	1.4 miles	1	0.5-mile	0.5-mile	4.6 miles

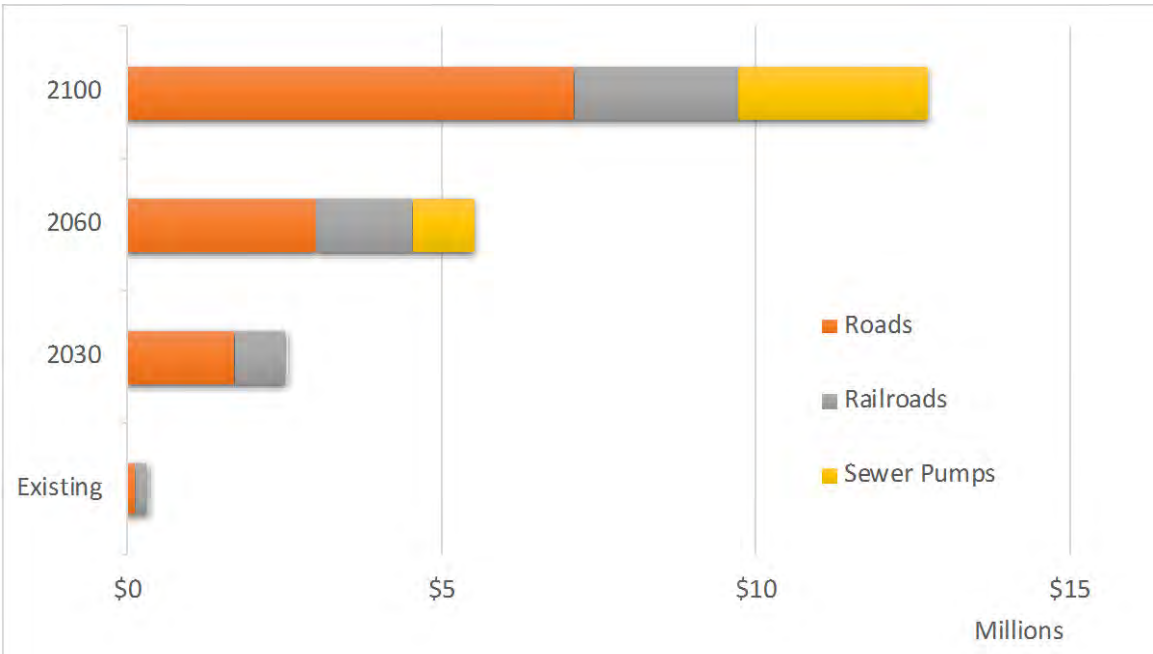
Note: Totals are cumulative across horizon years.

Figure 6-13. *Estimated Value and Length (in miles) of Infrastructure Vulnerable to Coastal Erosion from a 1% Annual Chance Storm (2017 dollars)*

Figure 6-14 depicts the replacement costs of water and sewer pipelines and pumps due to coastal flooding. Cleanup estimates are unavailable for coastal flooding to underground pipelines and for this reason our estimation of replacement costs is limited to those of sewer pumps. Currently, the length of water and sewer pipelines vulnerable to coastal flooding is limited to 0.1-mile and 0.2-mile, respectively. These numbers gradually grow over time, peaking with 5 feet of sea level rise with 4.5 miles of water pipelines and 4.7 miles of sewer pipelines becoming vulnerable. More significantly, with 5 feet of sea level rise, 3 sewer pumps also become vulnerable to coastal flooding with a combined replacement cost of $3 million. Adding in the exposure of roads and railroad lines to coastal flooding, $12.7 million in City infrastructure may be vulnerable to coastal flooding with 5 feet of sea level rise. As previously mentioned above, drainage and stormwater conveyance is currently inhibited and impacted in large areas of

the City, throughout the Beach Neighborhood, in portions of Downtown and in areas along the western end of Carpinteria Avenue north of the Marsh. However, coastal flooding would substantially increase impacts to stormwater infrastructure under even 1 foot of sea level rise. Under this condition, a total of 43 inlets, 69 outlets, and 1.4 miles of storm drains may be vulnerable. With further increases in sea level rise, impacts to stormwater infrastructure would similarly increase at a linear rate. For instance, with 5 feet of sea level rise, an additional 52 storm drain inlets (95 total), 47 outfalls (116 total), and 3.5 miles (4.2 miles total) of pipes across the City would be vulnerable to coastal flooding.

As in the case of coastal flooding of infrastructure, Figure 6-14 represents the replacement costs to infrastructure due to chronic tidal inundation according to time horizon. City pipelines and pumps are relatively safe from chronic tidal inundation with 2 feet of sea level rise. With 5 feet of sea level rise, approximately 2.9 miles of water pipelines, 3.1 miles of sewer pipelines, 128 hydrants and/or valves, and 2 sewer pumps ($2 million) become vulnerable to tidal inundation. Combined with the exposure to road and railroads, a total of $6.5 million in City infrastructure may be exposed to tidal inundation with 5 feet of sea level rise. City storm drains would be vulnerable to tidal inundation under existing conditions, with impacts being further exacerbated by sea level rise. With of 5 feet of sea level rise, approximately 82 inlets, 99 outlets, and 2.5 miles of storm drains become vulnerable to tidal inundation.

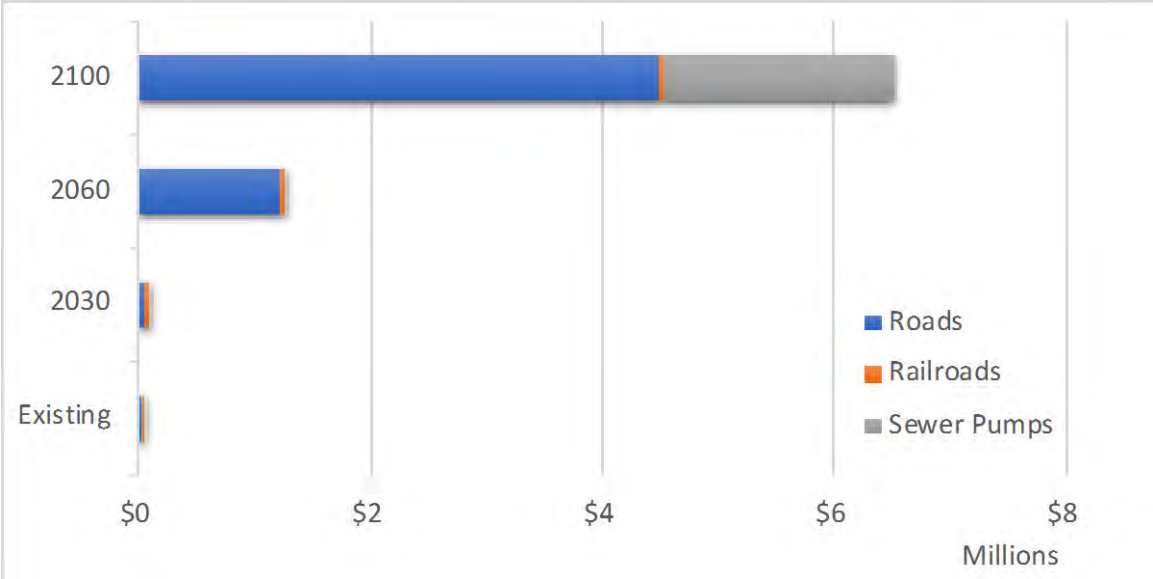


Coastal	Roads	Railroads	Sewer Pumps	Total
Existing	$120,000	$180,000	$0	$300,000
~1 ft	$1,690,000	$810,000	$0	$2,500,000
~2 ft	$2,970,000	$1,560,000	$1,000,000	$5,530,000
~5 ft	$7,090,000	$2,630,000	$3,000,000	$12,720,000

Coastal	Roads	Railroads	Sewer Pumps	Sewer Pipes	Water Pipes	Trails
Existing	0.1-mile	0.1-mile	0	0.2-mile	< 0.1-mile	1.3 miles
~1 ft	1.1 miles	0.4-mile	0	0.9-mile	1.0-mile	2.2 miles
~2 ft	2.0 miles	0.9-mile	1	2.0 miles	1.8 miles	3.4 miles
~5 ft	4.8 miles	1.5 miles	3	4.7 miles	4.5 miles	5.4 miles

Note: Totals are cumulative across horizon years.

Figure 6-14. *Estimated Value and Length (in miles) of Infrastructure Vulnerable to Coastal Flooding from a 1% Annual Chance Storm (2017 dollars)*



Tidal	Roads	Railroads	Sewer Pumps	Total
Existing	$20,000	$30,000	$0	$50,000
~1 ft	$50,000	$30,000	$0	$80,000
~2 ft	$1,220,000	$30,000	$0	$1,250,000
~5 ft	$4,480,000	$40,000	$2,000,000	$6,520,000

Tidal	Roads	Railroads	Sewer Pumps	Sewer Pipes	Water Pipes	Trails
Existing	< 0.1-mile	< 0.1-mile	0	< 0.1-mile	< 0.1-mile	< 0.1-mile
~1 ft	< 0.1-mile	< 0.1-mile	0	< 0.1-mile	0.1-mile	< 0.1-mile
~2 ft	0.8-mile	< 0.1-mile	0	0.6-mile	0.8-mile	0.1-mile
~5 ft	3.0 miles	< 0.1-mile	2	3.1 miles	2.9 miles	1.4 miles

Note: Totals are cumulative across horizon years.

Figure 6-15. *Estimated Value of Infrastructure Vulnerable to Tidal Inundation from a 1% Annual Chance Storm (2017 dollars)*

6.7 Community Facilities and Critical Services

With approximately 1 foot of sea level rise, coastal hazards are not anticipated to threaten any community facilities or critical services. With approximately 2 feet of sea level rise, one school building at Aliso Elementary School is potentially affected from flood damages due to coastal flooding. This Report found no emergency response facilities exposed to coastal hazards with up to approximately 5 feet of sea level rise. Up to eight buildings at Aliso Elementary School are vulnerable to tidal inundation hazards with approximately 5 feet of sea level rise and up to nine buildings at the school with a 1 percent annual chance storm and associated coastal flooding. At approximately 5 feet of sea level rise, one church (St. Joseph's Chapel), the WWTP, and the properties of the State Beach Service Yard and the

Sanitary District offices could also be impacted by a 1 percent annual chance storm. Finally, seawater infiltration into sewer lines throughout the years (from approximately 1 foot to approximately 5 feet of sea level rise) has an unknown increase in potential for additional complications and damage to the WWTP facility, due to the increase in salinity that may occur from seawater infiltration into inundated manholes.

6.8 Environmentally Sensitive Habitat Area

Climate change could affect all sensitive biological resources and Environmentally Sensitive Habitat Areas (ESHA) (see Figure 3-3). As with all habitats, there is a broad suite of physical and ecological processes responsible for creating and maintaining the habitats in their present location. Many of the impacts of climate change extend beyond sea level rise and will affect temperature, precipitation, drought, and wildfire risk (see Table 4-1). These climate effects, combined with the rising sea levels, will drive habitat changes. It is impossible to predict what will happen in the future with habitats as there is a complex interplay of variables for which future predictions remain uncertain (i.e. fog). However, coastal hazards and sea level rise may directly influence a substantial amount of acreage of existing designated ESHA within the City (Table 6-26). According to mapping acreages that consider the anticipated extent of coastal hazards, coastal flooding and cliff erosion affect the most amount of ESHA.

Table 6-26. ESHA Directly Influenced by Coastal Hazards and Sea Level Rise

Hazard	Dune Erosion	Cliff Erosion	Tidal Inundation	Coastal Flooding
	Acres			
Existing Onshore	19.3	15.6	10.1	46.5
~1 ft	1.9	3.8	1.6	7.3
~2 ft	2.3	9.1	3.1	12.9
~5 ft	3.0	27.1	14.6	30.2
Total	**26.5**	**55.6**	**29.4**	**96.9**

Note: The variability in the onshore acreages relates to where the different coastal hazard zones (arbitrarily drawn offshore) and the ESHA overlap. All totals are non-cumulative across horizon years.

Simply reporting acreages of ESHA severely misrepresents the vulnerability of sensitive habitat. If a wave overtops the Carpinteria Creek berm for example, that salt water volume is distributed across the entire estuary, not stopped by a line on the map. If the dunes at the State Park erode, then the sand is redistributed and the dune may migrate inland. If the wetland is inundated further, then it remains a wetland. If a freshwater wetland gets exposed to tides, then an estuarine wetland should gain area. Estuarine habitat by definition is habitat that is entirely exposed to coastal flooding and mostly exposed to existing tidal inundations,

as is the case with the Carpinteria Salt Marsh which lies largely outside the City limits. In addition, changes in climate may support existing or new pest/exotic species, including potential shifts in the range of diseases, which may have ecological impacts beyond the physical changes projected into the future.

Carpinteria has identified seven types of ESHA in the CLUP/General Plan. These habitats are summarized in Table 3-1. Brief descriptions and likely impacts from a suite of climate change variables and a host of ecological interactions are described below. The ESHA habitats are as follows:

- Carpinteria Bluffs
- Wetlands
- Beaches, Tidelands, and Subtidal Reefs
- Carpinteria Harbor Seal Rookery and Haul outs
- Creekways and Riparian Habitats
- Native Plant Communities
- Butterfly Habitat

Conceptually, the combined influence of sea level rise and climate changes may result in three different species response patterns. First, species may shift inland and to higher elevations to stay away from coastal hazards and sea level rise. With this consideration, there may be development or other impediments to inland migration, which may result in the net loss of species, as discussed further in the below discussion of beach habitat. Second, temperature changes may shift species toward the coast resulting in more interaction with coastal processes for some species. Third, species may shift along the coast, to find temperature and precipitation thresholds more conducive to their individual species life history (Loarie et al 2008). The faster the climate changes, the more difficult it is for species to migrate, particularly for non-mobile plants and vegetation. Nevertheless, some of the more resilient species may adapt in place to climate change or be outcompeted by invasive species.

Carpinteria Bluffs

The shoreline along the Carpinteria Bluffs consists of rocky intertidal pools interspersed with sandy beach areas. The Carpinteria Bluffs and adjacent shoreline hosts many sensitive animal species, including the white-tailed kite and the harbor seal. Nearshore habitats seaward/below the Carpinteria Bluffs may face increasing sea levels, causing additional erosion of material from the cliffs and increased depth and duration of flooding.

Sensitive plant habitats within the Carpinteria Bluffs include the Central Coast riparian scrub, coastal sage scrub, and coastal bluff scrub. Upland scrub habitats, which are relatively adapted to the Mediterranean climate, will face increasing temperatures and potentially

longer periods of extreme heat and drought. The projections of mild increases in precipitation may create more fuel for wildfires to spread during periods of drought.

Wetlands

Within the City, the Carpinteria Salt Marsh is the most studied and well-defined wetland. The Carpinteria Salt Marsh is a tidal salt marsh which is subject to a range of tides and receives freshwater flows from Franklin and Santa Monica Creeks. Other wetlands that have been historically identified, but not defined, include lower Carpinteria Creek and Higgins Spring at Tar Pits Park.

As the Carpinteria Salt Marsh is largely dependent on daily tidal inundation, it is anticipated that the increase in tidal elevations will be the largest stressor to the system unless the system is allowed to vertically expand or migrate landward and upslope. Recent ecosystem vulnerability assessment results for the Carpinteria Salt Marsh show that high salt marsh and transitional habitats are most vulnerable to sea level rise with a threshold of impact occurring with approximately 12 inches of sea level rise (Myers et al 2017). As the Carpinteria Salt Marsh is largely surrounded by flood control levees and concrete lined channels, one of the few places that salt marsh habitat could potentially transgress would be into the City's Salt Marsh Park. A decline in these wetland habitats could affect 14 of the 16 plant species of special concern found in the salt marsh (Myers et al 2017).

Beaches, Dunes, Tidelands, and Subtidal Reefs

The Carpinteria City Beach extends approximately 0.3-mile, from Ash Avenue to Linden Avenue. Carpinteria State Beach Park is located to the east of the City Beach and includes approximately 0.8-mile of beach and dune habitat from Linden Avenue to just east of Calle Ocho in the State Park.

Ecosystem results for the Carpinteria beaches, which form a valuable habitat and recreational resource, project beaches to narrow even in places where sand dunes (like Carpinteria State Beach) back the beach. With approximately 2 feet of sea level rise, approximately 60 percent of the dry sand beaches may be gone (Myers et al 2017). Dune erosion is anticipated to continue and depending on the chosen adaptation strategy may be able to migrate inland if the backshore is allowed to transgress. Nevertheless, species that shift inland and to higher elevations to stay away from coastal hazards and sea level rise may be hindered by development or other impediments to inland migration. This would reduce the overall area of habitat available to these species and may ultimately result in the net loss of species.

Tidelands and submerged lands within State waters extend 2 miles seaward from the mean high tide line between the City's east and west boundaries. The Carpinteria tide pools located offshore of Carpinteria State Beach have the most diverse intertidal habitat south of Point

Arguello. The Carpinteria Reef, located off of Sand Point, is a rocky reef adjacent to the Carpinteria Salt Marsh Reserve, which supports nearshore kelp bed communities off the Carpinteria coast.

For rocky intertidal habitats, species will migrate vertically within the active tidal range. For subtidal reefs, it is unclear what the climate impacts of increasing ocean temperature and ocean acidification will do to the viability of the rocky intertidal and subtidal reef communities found in Carpinteria.

Carpinteria Harbor Seal Rookery and Haul Out

The Carpinteria Harbor Seal Rookery is located in a sandy pocket beach that is connected by a sandspit to a shelf-like intertidal outcrop east of the Casitas Pier, below a portion of the Carpinteria Bluffs. Harbor seals seasonally use this area as a rookery to raise their young.

The seal haul out area could be exposed to more frequent inundation and wave action. If coastal erosion is allowed to continue unabated, the seal haul out may migrate inland; however, if the rate of sea level rise exceeds the rate of bluff erosion, then the beach and the haul out may be inundated for more of the tide cycle. If shoreline protection is paced to slow erosion, then the harbor seal haul out may cease to be viable in the nearer term as the habitat itself becomes inundated for more of the tide cycle.

Creekways and Riparian Habitats

Creeks in the study area include Santa Monica Creek, Franklin Creek, Carpinteria Creek, and Lagunitas Creek. The City's system of creeks provides habitat for a variety of sensitive plant and animal species. Carpinteria Creek is the most significant creek in terms of ESHA as it is one of only a few perennially flowing streams in the area. Its lagoon, extending above 6th Street, is a sensitive wetland that harbors a federally endangered fish species, the tidewater goby. Carpinteria Creek is also a designated Critical Habitat for southern steelhead trout. The creek's forested banks provide three riparian habitats including tall canopy, midstory, and understory, which serve a wide variety of wildlife including birds.

Provided that adequate sediment supply from upcoast Santa Barbara Harbor continues and the beach in front remains, then the seasonal lagoon opening and closing should be maintained as the beach migrates inland. However, changes in streamflow and increases in temperature may also create less desirable habitat and water quality conditions. Maintaining hydraulic connectivity upstream and into the tree-shaded riparian area should continue to be a management priority for ESHA policy development.

Native Plant Communities

As designated by the California Native Plant Society, native plant communities include: coastal sage scrub, oaks, chaparral, native oak woodland, riparian vegetation, and rare plant species. Oak trees also require special management, as certain subspecies are more susceptible to heat stress. Projected temperature increases and changes in precipitation are likely to stress native plant communities. Any restoration or native planting initiatives should consider native species that are more heat tolerant. Coastal hazards and Sea Level Rise (SLR) would impact these communities in different ways, depending on their location. For example, plant communities such as coastal sage scrub and chaparral that exist on the Carpinteria Bluffs would be increasingly vulnerable to cliff erosion as SLR increases. The vulnerability of riparian vegetation would increase as coastal flooding and tidal inundation extends further into the reaches of creeks, altering suitability of riparian habitat as SLR increases, which could result in additional estuarine or marsh habitat in these areas.

Monarch Butterfly Habitat

Monarch butterfly habitat exists in Salzgeber Meadow and the former oil and gas processing facility's vegetated buffer zone. During the fall and winter months, the trees within these areas are used by large numbers of migratory Monarchs as communal roosts.

Temperature changes, extreme heat, and longer droughts are likely to substantially impact the eucalyptus trees upon which the Monarchs depend. For example, after the recent seven-year drought, a catastrophic die off of the eucalyptus trees occurred in a eucalyptus grove along the Ellwood Mesa in the nearby City of Goleta, resulting in vastly reduced numbers of the large Monarch butterfly population which had historically inhabited the grove. For public safety reasons, the City of Goleta closed the grove to visitors in the winter of 2017/2018 due to the large die off of trees. In Carpinteria, the butterfly roosts within the riparian corridor of Carpinteria Creek are the most susceptible to coastal and fluvial flooding hazards, and a large flood event could uproot trees and disturb habitat. Ultimately, the monarch roosts in the oil and gas processing facility buffer parcels along the Carpinteria Bluffs may eventually become vulnerable to coastal cliff erosion.

6.9 Social Vulnerabilities

Areas containing the highest number of minority households and households below the poverty level in the City are the most at risk of being impacted from sea level rise. Additionally, bicycle and bus/transit routes that are utilized by low-income populations in the City as the primary means of transportation would be impacted. For instance, the 2017 Thomas Fire and related winter 2018 debris flows closed U.S. 101 for approximately three weeks, severely impacted services and associated jobs, increased childcare expenses, and destroyed homes. Affected populations included lower income populations and those with

lost wages, resulting in a disproportionate effect on these vulnerable populations (805Undocufund 2018; SAMHSA 2017).

Income and Poverty

Lower incomes often correlate with challenging access to necessary resources to prepare for or evacuate in the case of a disaster or to proactively adapt to climate change (e.g., moving out of a flood plain, elevating living space above a given flood elevation, purchasing sump pumps, or acquiring flood insurance). Such residents are also often more transit dependent, and disruption of transit service to this neighborhood, particularly by future regular monthly tidal inundation and coastal flooding could disrupt access to jobs and services. The lowest income areas of the City are in the downtown and low-lying inland portions of the Beach Neighborhood. Although a number of short-term rentals (up to 218) and expensive beach front homes are located in the Beach Neighborhood area, between 152 and 252 households in this neighborhood are below the poverty level (distributed between census tract 16.04, blocks 3 and 4). Because these areas would experience the greatest impacts from coastal hazards (coastal erosion, coastal flooding, and tidal inundation), those within the Beach Neighborhood and downtown that are unable to afford remodeling or relocating would be at a disadvantage. Because there is a higher number of below poverty level households in this area compared to the rest of the City, these populations may be disproportionately affected by coastal hazards.

Age and Populations with Reduced Mobility

Age can play a role in coping and adaptive capacity as well, as it affects mobility and dependence on others. Infants, for example, are less able to protect themselves from or escape extreme conditions (e.g., in extreme heat or during flood events) and depend on others for special assistance in times of emergency. Similarly, the elderly are often more vulnerable than younger adults in emergency situations because of possible mobility challenges or other pre-existing health impairments. Moreover, they may be less connected to email, social media, or other typical public outreach tools that inform residents about preparing for disasters and taking emergency actions. For instance, while approximately 88 percent of 18 to 29 year-olds use at least one social media site, only approximately 37 percent of those 65 and up are estimated to use at least one social media site (Pew Research Center 2018).

The general location of senior member households of the Carpinteria community could not be determined by this report. The one established senior living center, GranVida Senior Living and Memory Care Center, is not vulnerable to the identified coastal hazards under any of the studied scenarios. Special attention and services are needed to meet the communication and mobility needs of older vulnerable residents, as well as of those with pre-existing health conditions, to ensure proper evacuation responses during emergency events. While this study examines vulnerable populations, Carpinteria also has an elder

population that is active, healthy and mobile, and often volunteer in community affairs and services, and could provide very effective participation in the City's adaptation process.

The Mentally and Physically Impaired

Populations with physical and mental disabilities are of special concern for disaster planning and emergency response. The Sansum Clinic Family Medicine health center provides health services, including those with a disability, however as a clinic the facility does not provide beds for overnight stays and is located outside the identified coastal hazards under any scenario. People with physical and mental illnesses can have a greater sensitivity to high levels of stress during disasters and will require personalized attention during the crisis (American Medical Association 2012). Importantly, it is not necessarily the most disabled that are of greatest concern for the purposes of emergency response, as they are most likely to already receive ongoing assistance. By contrast, those among the impaired who – under normal circumstances – can handle life quite independently or with only minimal help, may require the most additional assistance when distress is high. It is important for emergency responders to know where these people reside, whether they live on their own or rely on a group living facility. Impaired populations may be dependent on the City and/or organizations which represent the interests of these populations to ensure that they are aware of where the disabled live, the nature of their disability, and what special needs they may have in an emergency (e.g., wheelchair accessibility). For long-term adaptive planning, the City and these organizations would need to take special care in addressing the special needs of these populations.

Minority Populations

Studies of public health and vulnerability to disasters indicate that minority populations tend to have less effective emergency disaster and climate change adaptation responses to natural hazards (California Energy Commission [CEC] 2012). This was illustrated in the City of Los Angeles during a major flood event in 2010, in which emergency response systems broke down in San Pedro and Wilmington when the American Red Cross opened a shelter in a local center for the elderly. Unfortunately, the flood victims that were of Hispanic/Latino descent, particularly those who did not speak English, did not know about the shelter. Many members of this population sought assistance at a local non-profit social services agency (the Toberman Settlement House/Neighborhood Center). This agency provides support services to Spanish-speaking and lower-income households but was not prepared to accommodate flood victims. Because the City of Carpinteria has a large proportion of Hispanic or Latino people, many of whom do not speak English, the City may need to provide relevant information and assistance in languages other than English, offering communication assistance during critical response efforts as well as adaptive planning efforts.

Minority populations of 60 percent or more are located on both sides of the freeway, near to the ocean, and further inland. The highest proportions of minority populations in Carpinteria

are located within the downtown (particularly within the inland Beach Neighborhood), west of Linden Avenue north of the freeway, and in the eastern regions of the City (largely with populations north of the freeway). Save for the north-central census tract 16.01 block 3 of the City, which has a minority population of less than 50 percent, the minority population of Carpinteria is relatively dispersed. Therefore, while minority populations would not necessarily be disproportionately affected by coastal hazards due to the dispersed concentrations of minority populations, lack of access to non-English information during emergencies and the overall planning process would disproportionately affect the sizeable minority population throughout the City. Overall, the high proportion of minority populations located throughout the City, who largely identify as Hispanic or Latino and may not speak English, indicates that the City must provide coastal hazard information and conduct outreach in both English and Spanish languages to engage the entire City's population.

Homeless

Homeless individuals living in coastal areas could be directly exposed to flood events because of living in the streets or in a parked vehicle. Very little information is usually collected to document the location and living situation of this population, making it difficult for emergency response during a disaster to find and help this population. Public education, awareness campaigns and pre-disaster planning often do not reach this population, and the homeless often do not have adequate means to move to alternative locations. Nevertheless, data is provided within the Existing Conditions Report detailing the homeless population within the City, of which there have been between 10 to 18 homeless people identified within the City between 2011 and 2017.

There are no homeless shelters in Carpinteria. However, there are at least 11 shelters within 25 miles of Carpinteria, with six approximately 10 miles away in Santa Barbara and two approximately 13 miles away in Ventura, suggesting that there is a needy population to be concerned about in the region. As with all special-needs populations, especially when housed in group shelters, emergency planning considers the evacuation and recovery needs should the need arise. The City's current (2017) Hazard Mitigation Plan and Emergency Operations Plan includes consideration for special needs populations, including checklists provided by the Department of Social Services to assist those with disabilities and other special needs in an emergency.

6.10 Housing

Home Ownership vs. Renting

Housing ownership affects people's ability to prepare, respond to, and recover from flood or storm events as well as in their ability to engage in household-level adaptation activities. Home ownership versus renting points to possible income differences. However, with regard

to adaptive capacity, it also indicates how much control individuals have over their housing, e.g., to make structural adjustments to their home for flood protection.

Along the southern coastal portion of the City, up to 70 percent of homes are renter-occupied, which is also the area that is most prone to flooding as sea level rises. The inland areas only have approximately 23 to 38 percent renter-occupied household units, indicating that there is a disproportionate impact that may occur due to coastal hazards, specifically on households that are currently occupied by renters that may not have control over what adaptive, protective measures can be made on their homes in the long term. In cases where landlords decide to retrofit or remodel their house property (e.g. raise above flood waters), these costs would likely result in raised rents for tenants to pay for the housing improvements. Displacement of renters could occur during major remodels or retrofits, or during post-flooding events.

Affordable Housing

Currently, no affordable units or mobile home units are vulnerable to modeled coastal hazards (coastal erosion, coastal flooding, or tidal inundation). Further, none of these units would experience these hazards with up to 1 foot of sea level rise, and only one mobile home park would experience flooding with 2 feet of sea level rise (Table 6-27). However, a number of affordable housing units are vulnerable to coastal flooding and regular monthly tidal inundation with 5 feet of sea level rise (up to 41 units). There are no affordable housing units that are subject to dune or cliff erosion in the City under any scenario.

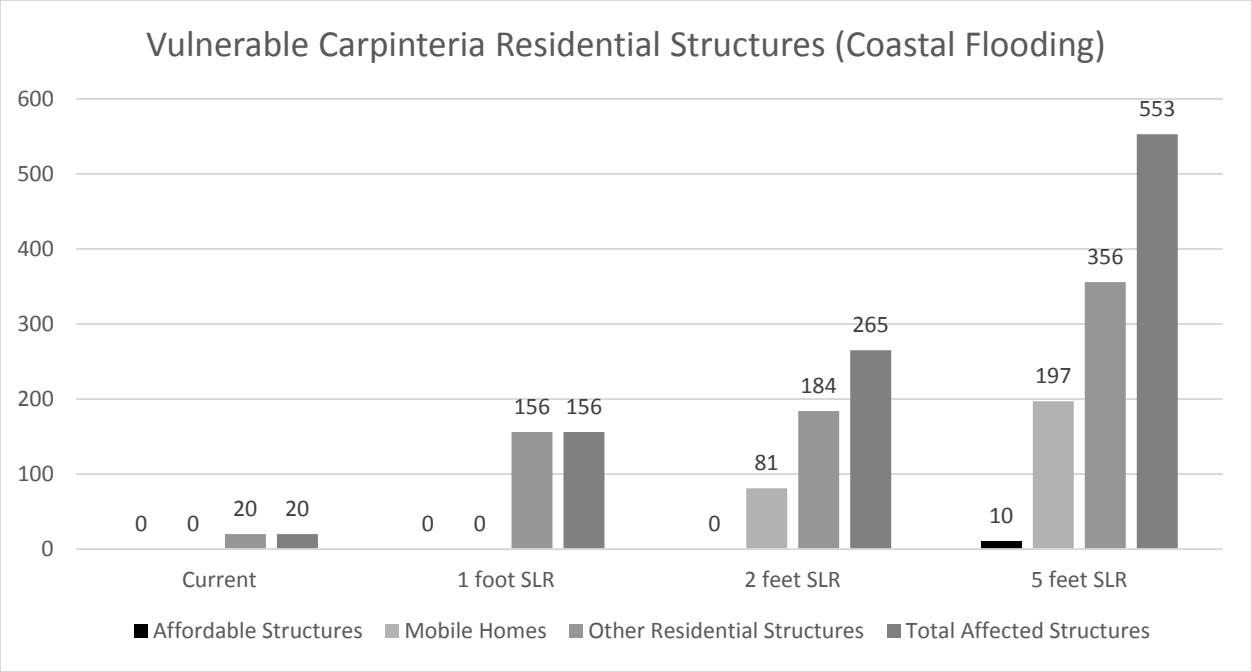
Coastal Flooding Impacts

Two of the six affordable low- to very-low-income housing projects in the City are vulnerable to potential future coastal flooding with 5 feet of sea level rise, representing approximately 22.7 percent of these units in the City. Of the three moderate- to above-moderate-income housing projects, only one unit is vulnerable with 5 feet of sea level rise, representing approximately 7 percent of these City units. Of the mobile home parks in the City, which are intended to be affordable by design according to the City's Housing Update, three of these parks are vulnerable, representing approximately 22.9 percent of mobile home park units in the City.

The City could experience up to total of 553 residential structures vulnerable to coastal flooding (579 to all coastal hazards including erosion and tidal inundation) (Revell Coastal 2018). It should be noted that the number of units quantified in this report do not correspond to the number of structures that may be affected. For instance, Chapel Court's 28 units are contained within 8 structures. Therefore, in total, there are approximately 10 affordable housing structures that are vulnerable to coastal hazards, in addition to approximately 197 mobile homes. Combined, this totals 207 affordable structures and mobile homes (238 units) vulnerable to coastal flooding, or approximately 37.4 percent of the 553 residential structures that may be affected by coastal flooding (see below chart).

Table 6-27. Affordable Housing Units in City of Carpinteria Vulnerable to Coastal Flooding

Affordable Housing Project	Number of Units	Number of Structures	1'	2'	5'
Affordable Low- to Very-Low-Income Housing Units in City of Carpinteria					
Casas de las Flores	43	7	No	No	No
Dahlia Court	54	10	No	No	No
Dahlia Court II	33		No	No	No
Chapel Court	28	8	No	No	Yes
Beach Court Accessible	6	2	No	No	No
Atrium Apartments	12	1	No	No	Yes
Total	*176*	*28*	*0*	*0*	*40 units (9 structures)*
Affordable Moderate- to Above-Moderate-Income Housing Units in City of Carpinteria					
Sparrow's Landing	1	1	No	No	Yes
Lagunitas Homes	11	11	No	No	No
Total	*12*	*12*	*0*	*0*	*1 unit (1 structure)*
Mobile Home Park Units in City of Carpinteria					
Sandpiper Mobile Village	281	281	No	No	No
Rancho Granada Mobile Home Park/Canbri Properties	116	116	No	No	No
San Roque Mobile Estates	142	142	No	No	No
Silver Sands Mobile Home Park	81	81	No	Yes	Yes
Seabreeze Mobile Home Park	71	71	No	No	Yes
Arbor Trailer Park	45	45	No	No	Yes
Vista De Santa Barbara Mobile Home Park	124	124	No	No	No
Total	*860*	*860*	*0*	*81*	*197 units (197 structures)*
Grand Total	1,048	900	0	81	238 units (207 structures)



Compared to the City as a whole, which contains 5,192 existing housing units, 1,048 units are affordable units or mobile homes. Of the 1,048 affordable units, 860 are mobile homes. If mobile home park housing is not included as affordable units, then there are only 188 affordable housing units within the City. Of these units, approximately 41 affordable units are vulnerable to coastal flooding with 5 feet of sea level rise, representing approximately 22 percent of the existing 188 affordable units.

Tidal Inundation Impacts

Many of the units that could be exposed to coastal flooding may also be at risk of tidal inundation with approximately 2 feet and 5 feet of sea level rise (Table 6-28). With 2 feet of sea level rise, the same units that would be affected by coastal flooding from a large storm would also be exposed to tidal inundation, with only the Silver Sands Mobile Home Park would be potentially affected. Fewer affordable housing units in the City are vulnerable to future monthly tidal inundation with 5 feet of sea level rise. With 5 feet of sea level rise, four affordable housing projects and mobile home parks would be affected by monthly tidal inundation (which is two less than the six that would be affected by coastal flooding). There would be 181 units (161 structures) of affordable housing projects and mobile home parks potentially affected by monthly tidal inundation with 5 feet of sea level rise. This number of structures is approximately 31.5 percent of the 510 total residential structures in the City that would be affected by tidal inundation. There are no affordable housing projects that are affected until 5 feet of sea level rise (only one mobile home park is affected, beginning at 2 feet of sea level rise). This indicates that affordable housing within the City is not significantly vulnerable to tidal inundation until after 2 feet of sea level rise. The inundation of the City's affordable and affordable by design housing stock would negatively affect renters, low and medium income populations, and minority populations which utilize this housing stock.

Table 6-28. Affordable Housing Units in City of Carpinteria Vulnerable to Tidal Inundation

Affordable Housing Project	Number of Units	Number of Structures	1’	2’	5’
Affordable Low- to Very-Low-Income Housing Units in City of Carpinteria					
Casas de las Flores	43	7	No	No	No
Dahlia Court	54	10	No	No	No
Dahlia Court II	33		No	No	No
Chapel Court	28	8	No	No	Yes
Beach Court Accessible	6	2	No	No	No
Atrium Apartments	12	1	No	No	No
Total	*176*	*28*	*0*	*0*	*28 units (8 structures)*
Affordable Moderate- to Above-Moderate-Income Housing Units in City of Carpinteria					
Sparrow’s Landing	1	1	No	No	Yes
Lagunitas Homes	11	11	No	No	No
Total	*12*	*12*	*0*	*0*	*1 unit (1 structure)*
Mobile Home Park Units in City of Carpinteria					
Sandpiper Mobile Village	281	281	No	No	No
Rancho Granada Mobile Home Park/Canbri Properties	116	116	No	No	No
San Roque Mobile Estates	142	142	No	No	No
Silver Sands Mobile Home Park	81	81	No	Yes	Yes
Seabreeze Mobile Home Park	71	71	No	No	Yes
Arbor Trailer Park	45	45	No	No	No
Vista De Santa Barbara Mobile Home Park	124	124	No	No	No
Total	*860*	*860*	*0*	*81*	*152 units (152 structures)*
Grand Total	1,048	900	0	81	181 units (161 structures)

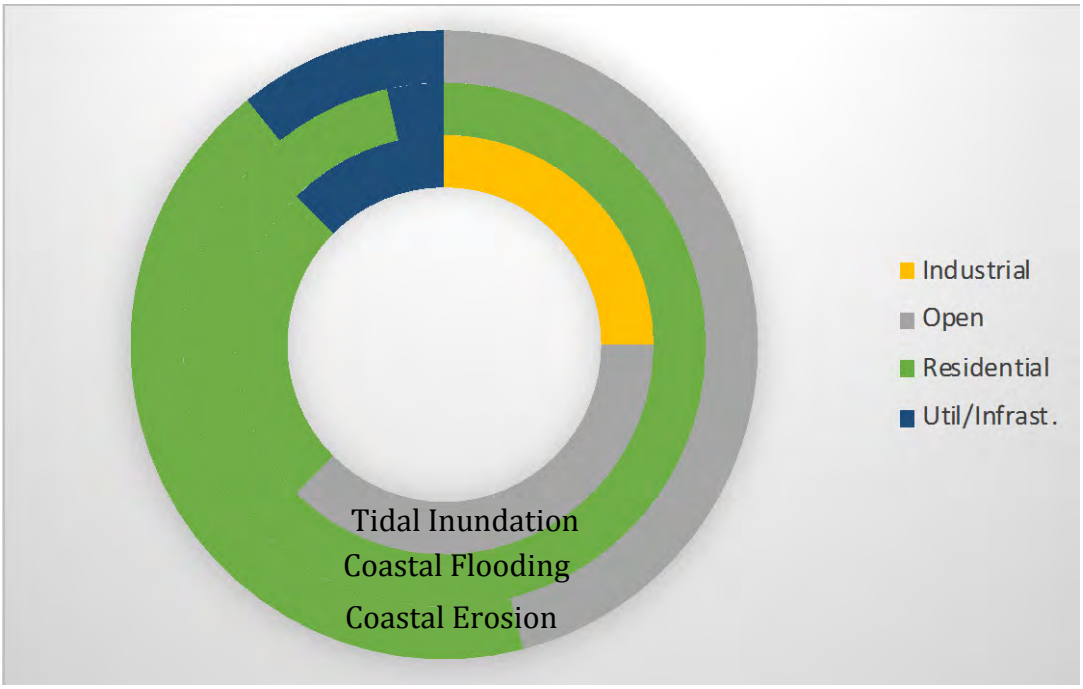
6.11 Conclusions

Coastal hazards and sea level rise escalate potential damages from coastal flooding exposure, coastal erosion, and tidal inundation. Storm waves associated with a 1 percent annual chance storm have historically caused coastal flooding and coastal erosion in the Beach Neighborhood, Carpinteria State Beach, and along the Carpinteria Bluffs. Coastal confluence flooding, (creek flooding exacerbated by sea level rise), are also a future risk; however, additional study is needed on this topic. Further information on coastal confluence and fluvial hazards is provided within Appendix C.

Existing Conditions

Under existing conditions, coastal flooding could result in severe economic damages to residential property. Existing vulnerabilities to tidal inundation are distributed among residential, commercial, open space, and industrial land uses. Vulnerable land uses to coastal erosion are largely residential and open space. Key findings for existing vulnerabilities are highlighted below:

- Carpinteria has approximately 1.5 million beach day visits per year. The estimated total recreational value of this activity is $60.4 million per year.
- The total estimated annual spending due to beach visitation is $48 million, generating $445,000 in sales taxes for the City and just under $1.9 million in TOT.
- 9 percent of the Carpinteria State Beach campground area is vulnerable to coastal erosion loss from a 1 percent annual chance storm.



Existing Conditions	Tidal	Coastal	Erosion
Totals	$800,000	$8,500,000	$3,700,000

Figure 6-16. *Distribution of Land Use Vulnerability to Coastal Erosion (outer layer), Coastal Flooding (middle layer), and Tidal Inundation (inner layer) under Existing Conditions*

- 1.2 miles of trails are currently vulnerable to coastal erosion from a 1 percent annual chance storm, and 1.3 miles are vulnerable to coastal flooding.
- $3.7 million in property and infrastructure is currently vulnerable to coastal erosion losses from a 1 percent annual chance storm. The City is vulnerable to an estimated $8.5 million in property and infrastructure damages from a 1 percent annual chance storm. $800,000 is currently exposed to tidal inundation.
- Less than 0.1 mile of railroad is currently vulnerable to coastal erosion with a 1 percent annual chance storm. This Report estimates the cost of replacement at $130,000 but this may underestimate costs. If UPRR is disrupted, the economic impacts to the region could be magnified.
- 0.1-mile of roadways are subject to coastal flooding.
- In terms of potential property loss weighted by market value, residential property is the largest land use at risk. Under existing conditions, $1.6 million in residential property is vulnerable to losses from coastal erosion, $8.2 million is vulnerable to losses from coastal flooding during a 1 percent annual chance storm, and $800,000 is exposed to tidal inundation.
- Residential dwellings are the most vulnerable land use exposed to coastal hazards and comprise over 90 percent of all parcels and structures at risk in the City. Most of these impacts occur in the Beach Neighborhood. Multi-family units (apartments and

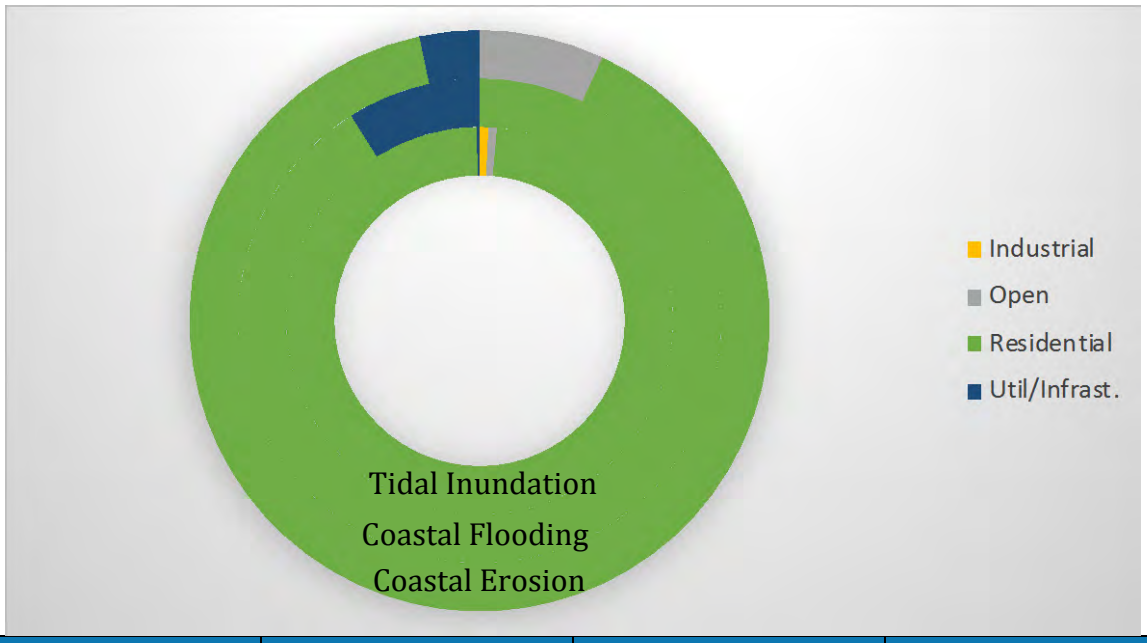
condominiums) represent over 80 percent of these losses both under current conditions and in the future and include short-term vacation rental properties; their loss would also impact transient occupancy and sales tax revenues for the City.

- Carpinteria has numerous sites with the potential to spill/leak hazardous waste including many inactive legacy oil wells and infrastructure associated with the oil and gas industry, which can be exacerbated by sea level rise. While the City may not be directly liable for the cleanup, bankrupt parties or impacts to tourism and habitats may result in a substantial economic impact to the City.
- Coastal hazards and sea level rise could result in erosion or inundation of beaches and dunes, transition of high marsh ESHA to mudflat or subtidal habitats, transition of riparian habitat along Carpinteria Creek to estuarine wetlands, and substantial erosion of coastal bluff scrub and other terrestrial ESHAs along the Carpinteria Bluffs. Refined ESHA mapping and site assessments are strongly recommended to identify effective adaptation strategies and develop sound preservation policies given sea level rise and coastal erosion will likely reduce the size and functioning of much of the ESHA in the City.

~1 Foot of Sea Level Rise

With approximately 1 foot of sea level rise, coastal beach and dune erosion could increase the landward extent of coastal flooding, which in turn could raise the vulnerabilities of oceanfront dwellings and increase the likelihood of infrastructure damages in the Beach Neighborhood and the Carpinteria State Beach without implementation of any additional adaptation strategies. Salt Marsh Park could also be affected during storm events. Cliff erosion along the Carpinteria Bluffs may affect UPRR and recreational trails.

Potential economic loss or damage associated with coastal erosion could increase substantially (ten-fold) and could be greater than that of coastal flooding (increased three-fold; Figure 6-17). This increased vulnerability is due to the prevalence of multi-story buildings (e.g. condominiums, apartments, etc.) that could be exposed to tidal inundataion and erosion. While coastal flooding could impact the ground floors of such buildings during a large storm event, entire structures may become unusuable if affected by routine tidal inundation and coastal erosion damages. It is for this same reason that the vulnerability of residential property (green) outweighs other types of land uses. That said, a non-trivial amount of utilities and infrastructure (blue) become vulnerable to erosion and flooding during a 1 percent probability storm (outer and middle rings, respectively).



~1 ft	Tidal	Coastal	Erosion
Totals	$42,100,000	$28,000,000	$35,900,000

Figure 6-17. *Distribution of Land Use Vulnerability to Coastal Erosion (outer layer), Coastal Flooding (middle layer), and Tidal Inundation (inner layer) with 1 foot of sea level rise*

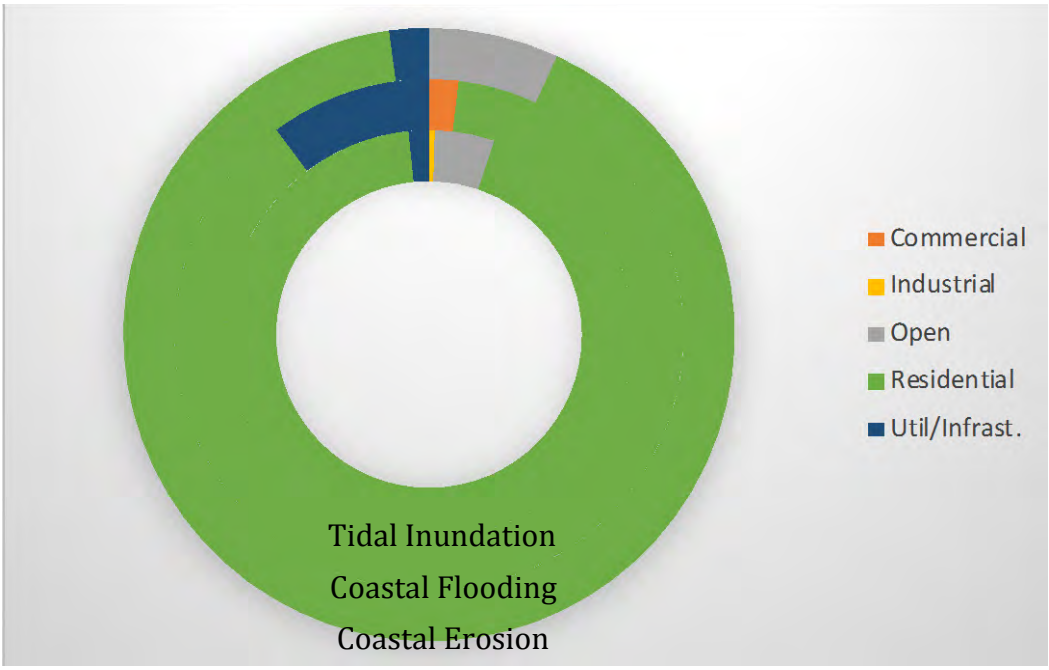
Key findings with 1 foot of sea level rise are highlighted below:

- 13 percent of the Carpinteria State Beach campground becomes vulnerable to coastal erosion loss from a 1 percent annual chance storm.
- 1.9 miles of trails become vulnerable to coastal erosion from a 1 percent annual chance storm, and 2.2 miles of trails become vulnerable to coastal flooding.
- $35.9 million in property and infrastructure become vulnerable to coastal erosion losses from a 1 percent annual chance storm. $28 million become vulnerable to coastal flooding losses from a 1 percent annual chance storm and $42.1 million become exposed to tidal inundation.
- 0.4-mile of railroad become vulnerable to coastal erosion with a 1 percent annual chance storm.
- Less than 0.1-mile of roads become subject to coastal erosion from a 1 percent annual chance storm. 1.1 miles of roads become subject to coastal flooding and less than 0.1-mile of roads become subject to tidal inundation.
- In terms of potential property loss weighted by market value, residential property represents the largest land use at risk. With 1 foot of sea level rise, $32.2 million in residential property becomes vulnerable to losses from coastal erosion, $25.5 million becomes vulnerable to losses from coastal flooding, and $41.4 million becomes vulnerable to tidal inundation.

~2 Feet of Sea Level Rise

With approximately 2 feet of sea level rise, more extensive coastal flooding and coastal beach erosion during storms could affect structures, land uses, and infrastructure between Ash and Linden Avenues north of UPRR, as well as the Carpinteria State Beach campgrounds, without additional adaptation strategies implemented. Coastal bluff erosion could continue to impact UPRR, recreational trails, and habitats along the Carpinteria Bluffs. Coastal flooding may also begin to encroach the Carpinteria Salt Marsh and extend further into the Beach Neighborhood. Routine monthly tidal inundation would largely be confined to the existing creek channels and the Carpinteria Salt Marsh, but during rain events increased tide elevations would likely back up stormwater drains and cause extensive flooding in low-lying neighborhoods.

While land uses vulnerable to coastal flooding will roughly double with 2 feet of sea level rise, land uses vulnerable to tidal inundation and coastal erosion will triple. Potential economic impacts associated with vulnerabilities to commercial parcels (orange) and infrastructure (dark blue) in the lower Downtown area along Linden Avenue will increase; and the vast majority of potential economic impacts would continue to be residential properties (green; Figure 6-18).



~2 ft	Tidal	Coastal	Erosion
Totals	$111,500,000	$53,800,000	$114,800,000

Figure 6-18. *Distribution of Land Use Vulnerability to Coastal Erosion (outer layer), Coastal Flooding (middle layer), and Tidal Inundation (inner layer) with 2 feet of sea level rise*

Key findings with 2 feet of sea level rise are highlighted below:

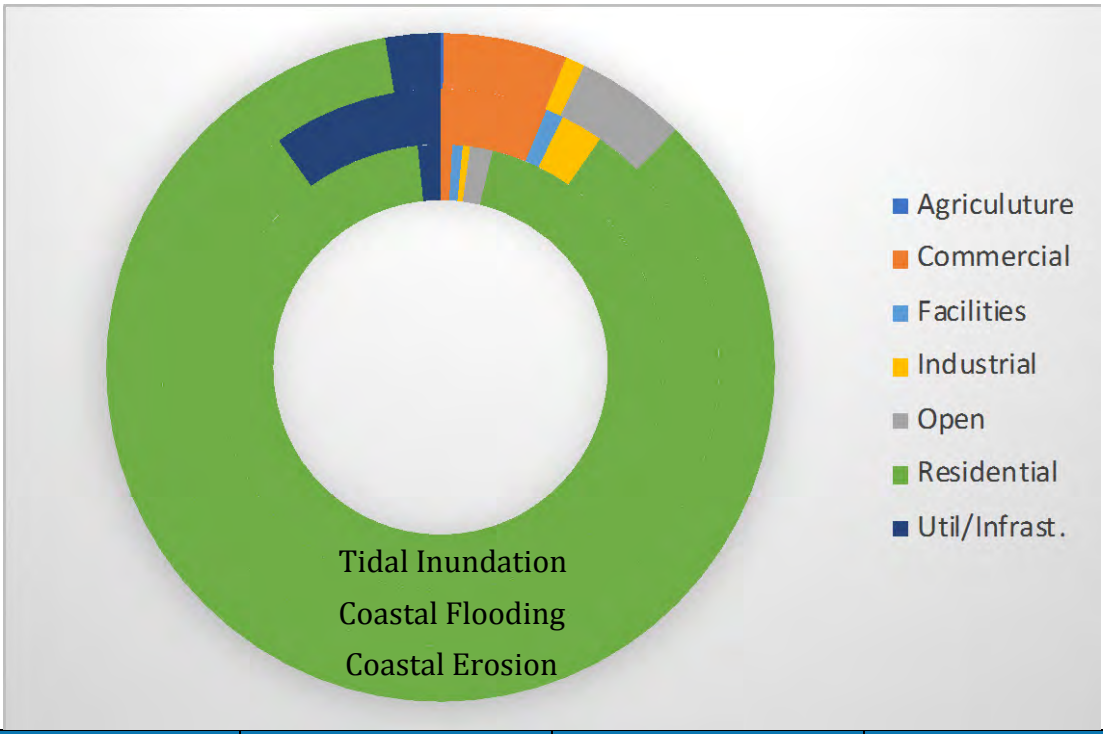
- 19 percent of Carpinteria State Beach campground becomes vulnerable to coastal erosion loss from a 1 percent annual chance storm.
- 2.7 miles of trails become vulnerable to coastal erosion from a 1 percent annual chance storm, and 3.4 miles of trails become vulnerable to coastal flooding.
- $114.8 million in property and infrastructure become vulnerable to coastal erosion losses from a 1 percent annual chance storm.
- $53.8 million in property and infrastructure become vulnerable to flooding losses from a 1 percent annual chance storm and $111.5 million is exposed to tidal inundation.
- 0.8-mile of railroad become vulnerable to coastal erosion with a 1 percent annual chance storm.
- Less than 0.1-mile of roadways become subject to coastal erosion from a 1 percent annual chance storm. 2.0 miles of roadways become subject to coastal flooding and 0.8-mile are subject to tidal inundation.
- In terms of property loss weighted by market value, residential property represents the largest land use at risk. With 2 feet of sea level rise, $104.5 million in residential property becomes vulnerable to losses from coastal storm erosion, $47.3 million becomes vulnerable to losses from a coastal storm, and $103.9 million in property becomes vulnerable to tidal inundation.

~5 Feet of Sea Level Rise

With approximately 5 feet of sea level rise, without implementation of any adaptation strategies, coastal erosion could extend through the first row of parcels to inland of Sandyland Road and begin to affect dwellings and infrastructure in the Concha Loma Neighborhood. Coastal flooding during a large storm wave event could expand in depths and inland extent into the Downtown core along Linden Avenue, affecting portions inland of UPRR, Carpinteria Salt Marsh, and areas along Franklin Creek. Coastal bluff erosion could continue to impact UPRR, recreational trails, and habitats along the Carpinteria Bluffs and potentially impact one commercial structure. Routine monthly high tides could inundate most of the Beach Neighborhood and Carpinteria State Beach inland to the Tomol Interpretative Park, even in areas not directly connected to the ocean due to daylighting of groundwater (surfacing). While this Report uses sea level rise scenarios and modeling data for approximately 5 feet of sea level rise occurring in 2100, under the worst-case H++ scenario, this could occur as early as 2070.

Figure 6-19 shows that land uses and property exposed to chronic tidal inundation could more than quadruple between 2 feet and 5 feet of sea level rise as all low-elevation structures within the City become exposed. Vulnerability to coastal flooding and coastal erosion could more than double during this same timeframe. While residential land uses (green) still accounts for the vast majority of vulnerable property values, commercial land uses (orange)

continue to increase in vulnerability. Industrial parcels (yellow) and community facilities (light blue) also become exposed to coastal flooding and erosion (middle and outer rings, respectively).



2100	Tidal	Coastal	Erosion
Totals	$496,700,000	$128,800,000	$285,500,000

Figure 6-19. *Distribution of Land Use Vulnerability to Coastal Erosion (outer layer), Coastal Flooding (middle layer), and Tidal Inundation (inner layer) in 2100*

Key findings with 5 feet of sea level rise are highlighted below:

- One-third of the Carpinteria State Beach campground becomes subject to dune erosion and nearly half (46 percent) of the entire campground area becomes subject to tidal inundation.
- $285.5 million in property and infrastructure become vulnerable to coastal erosion losses from a 1 percent annual chance storm. $128.8 million become vulnerable to coastal flooding losses from a 1 percent annual chance storm and $496.7 million become exposed to tidal inundation.
- 4.6 miles of trails become vulnerable to coastal erosion from a 1 percent annual chance storm, and 5.4 miles of trails become vulnerable to coastal flooding.
- 1.4 miles of railroad become vulnerable to coastal erosion with a 1 percent annual chance storm.
- 0.7-mile of roadways become subject to coastal erosion from a 1 percent annual chance storm. 4.8 miles of roadways become subject to coastal flooding and 3.0 miles of

roadways become subject to tidal inundation. This includes a 1,500-foot-long segment of U.S. 101 and the southbound Carpinteria Avenue off-ramp at exit 87B.

- In terms of property loss weighted by market value, residential property represents the largest land use at risk. By 2100, $242.4 million in residential property become vulnerable to losses from coastal erosion, $103.6 million become vulnerable to coastal flooding losses from a coastal storm, and $469.8 million become vulnerable to tidal inundation.