1. Sector Profiles

In order to address sea level rise and associated coastal hazards, the City of Carpinteria (City) and its consultant team prepared the 2019 Sea Level Rise Vulnerability Assessment and Adaptation Project (Report). The purpose of this Report is to provide technical analysis using climatic modeling and geospatial analyses to support the City's efforts to incorporate policy responses to a range of coastal and climate change hazards into the City's planning and regulatory processes in the Coastal Zone. This information will assist the City in making decisions regarding land use policies and development standards from a long-range planning level to the individual project level. These sector profiles summarize the findings of the vulnerability analyses to support decision-making. Each of the following sectors contain a vulnerability map and summary of findings:

- Land Use Parcels and Structures
- Roads and Parking
- Public Transportation
- Camping and Visitor Accommodations
- Coastal Trails and Access
- Hazardous Materials Sites, and Oil and Gas Wells
- Stormwater Infrastructure
- Wastewater Infrastructure
- Water Supply Infrastructure
- Community Facilities and Critical Services
- Environmentally Sensitive Habitat Area

Within each sector profile, an overview provides a summary of the key findings for each sector. Existing and future vulnerabilities highlight potential risks from tidal inundation, coastal erosion, and coastal flooding. For each projected sea level rise elevations, results are summarized based on what becomes vulnerable. If nothing is reported with additional sea level rise over that timeframe, no additional vulnerabilities are identified.

The approximately 5 feet of sea level rise by 2100 scenario identifies both what becomes vulnerable between approximately 2 and approximately 5 feet of sea level rise, as well as the cumulative totals for all planning horizons. Please note that under the worst-case H++, approximately 5 feet of sea level rise could occur as early as 2070.

A range of potential adaptation strategies to address potential vulnerabilities are identified within the sector.

Potential next steps include examples of policy direction, monitoring needs, and potential adaptation projects. Section 7, *Adaptation Overview,* and Section 8, *Specific Adaptation and Resiliency Strategies* further identify and recommend potential adaptation strategies based on vulnerable assets, community priorities, and stakeholder input, within the framework of the California Coastal Act, California Coastal Commission (CCC) 2018 *Sea Level Rise Policy Guidance – Final Science Update*.

LAND USE PARCELS AND STRUCTURES

Overview

Land uses are categorized by: (1) residential, (2) commercial and mixed use, (3) industrial, and (4) open space and recreation. To identify land uses vulnerable to SLR and coastal hazards, this study evaluated the following:

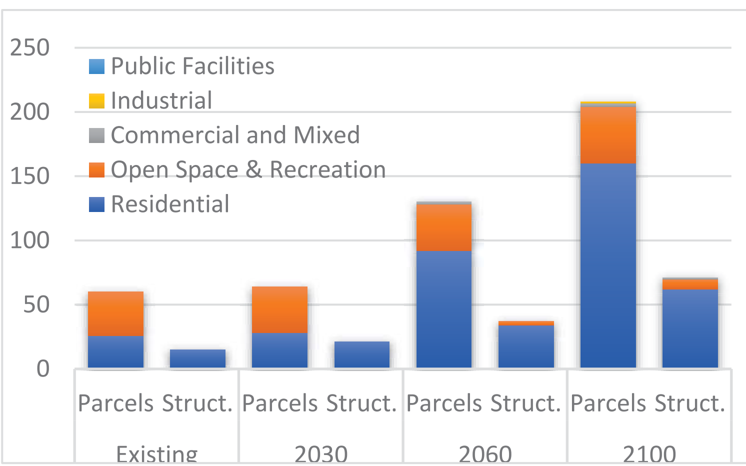
Number of Parcels/Acreages/Number of Structures at Risk with 5' of SLR

Residential	Commercial & Mixed Use	Industrial	Open Space & Recreational
769/44.8 acres/579	20/5.85 acres/16	10/5.02 acres/11	59/105.82 acres/11

- **Property damage from coastal flooding and erosion**
- **Property values exposed to tidal flooding**

Currently, residential parcels comprise approximately 90% of all parcels vulnerable to coastal hazards. Most of these vulnerable parcels are in the Beach Neighborhood. **With 1' of SLR**, coastal flooding extends further inland into the Beach Neighborhood. **With 2' of SLR**, beach/dune erosion could damage parcels/homes in the Beach Neighborhood south of Sandyland Road due to flooding and minor periodic tidal inundation. **With 5' of SLR**, the Concha Loma Neighborhood and Carpinteria Bluffs would see substantial erosion; much of the Beach Neighborhood could be damaged/inundated by high monthly tides. Although not the focus of this study, fluvial (creek) flooding creates substantial existing and future vulnerabilities to many land uses (see Appendix C).

Coastal Erosion

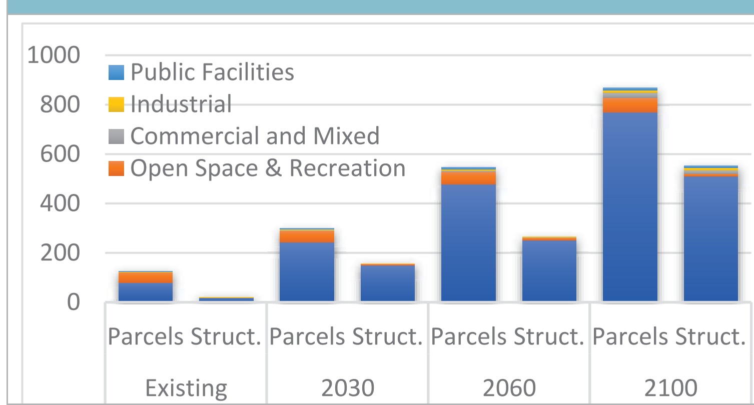


Currently, beach/dune erosion could damage 15 residential structures and State and City lifeguard towers are at risk. With 5' of SLR, 132 residential parcels may be eroded, with homes damaged/ destroyed and restrooms on Ash Ave. and State Beach become vulnerable. No commercial or industrial structures are at risk.

Cliff erosion currently exposes 18 open space parcels (39.2 acres) along the Carpinteria Bluffs to damage. With 5' of SLR, erosion accelerates and 44 open space parcels may be at risk, including Bluff 0, and 28 residential parcels and the UPRR and 21 structures with in the Concha Loma Neighborhood and up to 3 structures in bluffs industrial area.

ECONOMICS: Without adaptation, coastal erosion damage to all land uses escalate from an existing $3.7 million to $35.9 million with 1' of SLR, $114.8 million with 2' of SLR, and $285.5 million with 5' of SLR; damage primarily impacts Beach Neighborhood residential multi-unit properties in the, Concha Loma homes, Bluff industrial buildings Carpinteria Bluffs open space and UPRR.

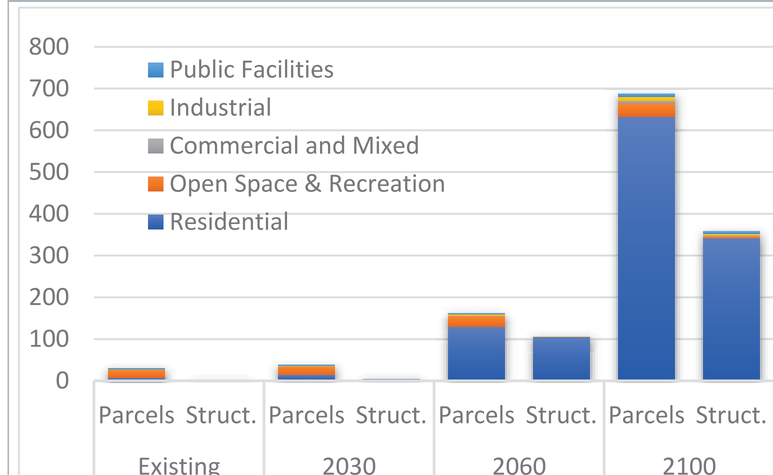
Coastal Flooding



Currently, 20 structures (19 residential and 1 industrial) are vulnerable. This increases to 156 structures with 1' of SLR, mainly in the Beach Neighborhood. With 2' of SLR, 265 total structures become vulnerable extending north of the railroad and inland of the Salt Marsh. With 5' of SLR, 553 total structures could be exposed to flooding; homes north of the State Park and the Salt Marsh may be at risk. 11 additional commercial buildings and 9 industrial structures become vulnerable in a large wave event with 5' of SLR, particularly along Carpinteria Avenue.

ECONOMICS: Currently $8.5 million of property is vulnerable to coastal flooding from a 1% wave event, rising to $28.0 million with 1' of SLR, $53.8 million with 2' of SLR, and $128.8 million with 5' of SLR, the majority of which is multi-unit residences in the Beach Neighborhood, with flooding extending inland to and beyond the UPRR.

Tidal Inundation



Currently, monthly tidal inundation does not impact structures. By 2' of SLR, risk increases to 105 residential structures. With 5' of SLR, monthly tidal inundation is projected to affect 510 residential, 13 commercial, and 11 industrial structures; monthly high tides inundate Beach Neighborhood to UPRR.

ECONOMICS: Estimates for tidal inundation impacts are for property value at risk. Actual damages will likely be smaller (e.g., frequent clean up and repair)**.** Currently, $800,000 (mainly open space) is exposed, though exposure rises quickly to $42.1 million in 2030, $111.5 million with 2' of SLR, and $496.7 million with 5' of SLR.

Adaptation Strategies

Range of Strategies:

Protect – Develop a regular beach nourishment program with both sand and cobbles. Transition the winter storm berm program to a permenant "living shoreline" dune system to protect against coastal erosion. Examine potential of offshore structures and sand retention structures to dissipate wave energy and/or widen the natural beaches.

Accommodate – Amend City building code and zoning ordinance to improve foundation requirements or to enable elevation and/or relocation to occur over time. Update setback requirements to account for acceleration of erosion.

Manage – Develop a repetitive loss program to allow for public acquisition of properties. Establish a coastal adaptation overlay zone that would encourage the siting of new development or redevelopment away from coastal hazards.

Trade-offs: Managed retreat strategies may result in loss of development and subsequent impacts to City's tax base/ revenues. Hard armoring may protect some structures, but could also threaten the beach, coastal recreation and access, natural processes and habitats over time. Green protection strategies (e.g., sediment nourishment, dunes) may benefit beach recreation and protect homes but require routine maintenance, regular secure funding, and may be less effective with 5' of SLR without other actions.

Potential Next Steps

Policy:

- Allow increases to base floor elevation or movable foundation standards for new development.
- Develop real estate disclosure requirements to inform homebuyers of the risk of living adjacent to the coast.
- Potentially require abandonment or relocation of derelict or threatened structures.
- Establish an assessment district or seek regular state/ federal funding for shoreline management (e.g., beach nourishment).

Projects:

- Support regional beach nourishment and develop a long-term dune and shoreline management plan.

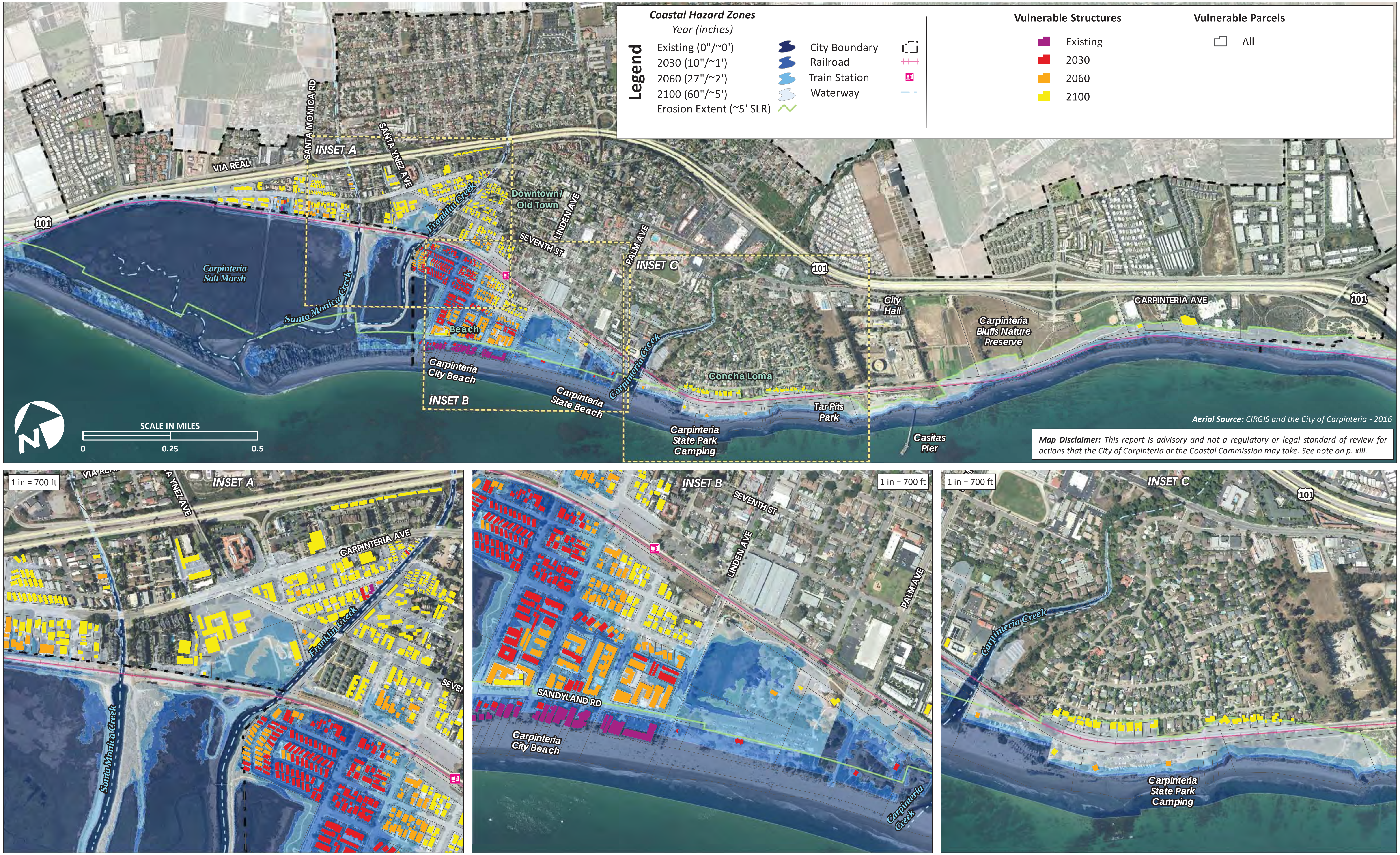
Monitoring:

- Monitor frequency, duration, and depth of flood impacts.

Tipping Point:

- With 2' of SLR, substantial damages are projected.

Figure 1-1. Land Use Parcels and Structures



ROADS AND PARKING

Overview

To identify roads and parking facilities potentially vulnerable to climate change and SLR hazards, this study evaluated:

- **50.3 Miles of Roads**
- **16 Parking Areas**

U.S. 101 in Carpinteria could be affected by coastal flooding with 5' of SLR.

Currently, coastal erosion and tidal inundation do not substantially impact roads or parking. Street end parking in the Beach Neighborhood and State Park lots are currently exposed to coastal flooding. **With 1' of SLR,** additional roads and street end parking in the Beach Neighborhood and Carpinteria State Beach becomes at risk from coastal flooding, which may include damage or loss of roadways. **With 2' of SLR,** coastal flooding impacts escalate and affect an additional 2.0 miles of roads and coastal erosion may impact 7 parking lots. **With 5' of SLR,** road impacts from all coastal hazards increase substantially. Coastal flooding could pose a risk to a total 4.8 miles of roads and 11 parking lots in the Beach Neighborhood, Carpinteria State Beach and Downtown north (inland) of the railroad, 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.

<u>**Tipping Point:**</u> With 2' of SLR, tidal inundation impacts to roads and erosion impacts to parking lots escalate.

Existing Vulnerabilities

Tidal Inundation	Coastal Erosion	Coastal Flooding
• Roads – <0.1-mile	• Roads – <0.1-mile	• Roads – 0.1-mile
• Parking Lots – 0	• Parking Lots – 0	• Parking Lots – 7

Roads: Roadways in the immediate vicinity of the City Beach and State Beach are the most vulnerable to coastal hazards.

Parking: Public coastal access parking lots at the ends of Ash, Holly, Elm, and Linden Avenues in the Beach Neighborhood, and Carpinteria State Beach parking lots are currently at risk from coastal flooding during a 1% annual chance storm.

ECONOMICS: Damage to parking facilities may affect beach visitation and consumer spending.

Future Vulnerabilities

10.2 inches (~1 foot) by ~2030

Tidal Inundation (total)	Coastal Erosion (total)	Coastal Flooding (total)
• Roads – <0.1-mile	• Roads – <0.1-mile	• Roads – 1.1 miles
• Parking Lots – 0	• Parking Lots – 1	• Parking Lots – 8

Roads: 1.1 miles of roads become vulnerable to hazards along lower Linden and Elm Avenues.

Parking: 1 additional parking lot at the end of Linden Avenue in the Beach Neighborhood becomes at risk to coastal erosion, and 1 additional parking lot at Carpinteria State Beach becomes vulnerable to coastal flooding.

ECONOMICS: Damage to parking facilities may affect beach visitation, consumer spending and require recurring expensive clean up and repair.

27.2 inches (~2 feet) by ~2060

Tidal Inundation (total)	Coastal Erosion (total)	Coastal Flooding (total)
• Roads – 0.8-mile	• Roads – 0.1-mile	• Roads – 2.0 miles
• Parking Lots – 1	• Parking Lots – 7	• Parking Lots – 8

Roads: Coastal hazards expand to impact Ash, Holly, Elm, and Linden Avenues further into the Beach Neighborhood.

Parking: Additional parking facilities that were previously exposed to only coastal flooding become exposed to coastal erosion and tidal inundation.

ECONOMICS: Potential road damage from coastal erosion (325 feet) is estimated at $90,000; recurring impacts to roads and parking areas would require expensive clean up and repair costs that could impact City and State Park budgets.

60.2 inches (~5 feet) by ~2100

Tidal Inundation (total)	Coastal Erosion (total)	Coastal Flooding (total)
• Roads – 3.0 miles	• Roads – 0.7-mile	• Roads – 4.8 miles
• Parking Lots – 8	• Parking Lots – 9	• Parking Lots – 11

Roads: Impacts from all coastal hazards increase substantially, affecting additional roadways including all of the Beach Neighborhood, Carpinteria State Beach, north of the railroad, U.S. Highway 101, and inland of the Salt Marsh along portions of Carpinteria Ave and 7th Street near Franklin Creek.

Parking: Coastal hazard impacts could extend to onstreet parking in the Beach Neighborhood, facilities in Carpinteria State Beach, the train station parking lot (City Parking Lot #3), and curbside parking along Holly Avenue.

ECONOMICS: Potential road replacement costs are estimated at $1,050,000 (3,733 feet) from coastal erosion. Disruption to U.S. Highway 101 could have significant economic consequences. Damage to parking may affect beach visitation and spending; recurring impacts to roads and parking areas expensive clean up and repair could impact City and State Park budgets.

Adaptation Strategies

<u>**Range of Strategies:**</u>

Protect – Implement regular beach nourishment program with both cobbles and sand. Expand the winter storm berm program to create a "living shoreline" dune system to protect against coastal erosion. Consider a combination of dune system with sand retention where needed to maintain a sandy beach buffer that protects essential roads or parking.

Accommodate – Elevate roads and parking lots above future projected coastal flood levels through construction of raised causeways, or by incrementally elevating road and parking area surfaces by 2-3 inches during routine repaving. Install storm drain pumps to dewater the most vulnerable road segments and parking areas.

Manage – Relocate or remove roads and parking lots from the hazardous areas along the shoreline.

<u>**Trade-offs:**</u>

Management strategies may impact traffic and coastal access, depending on the location of realigned roads. Increasing road and parking elevation may flood adjacent properties or exacerbate storm water flooding. Green protection measures such as beach or dune nourishment require recurring maintenance expenses, with more frequent maintenance requirements for higher levels of SLR. Gray techniques using revetments would provide protection, but could impact beach and dune habitats, natural processes and coastal access.

Potential Next Steps

<u>**Policy:**</u>

- Coordinate with Caltrans to ensure that regional connections such as U.S. Highway 101 remain intact.
- Coordinate with State Parks on shoreline management, beach nourishment, and coastal access parking.
- Coordinate with the County, coastal cities, BEACON, and local state legislators to create a sustainable funding mechanism for beach nourishment.

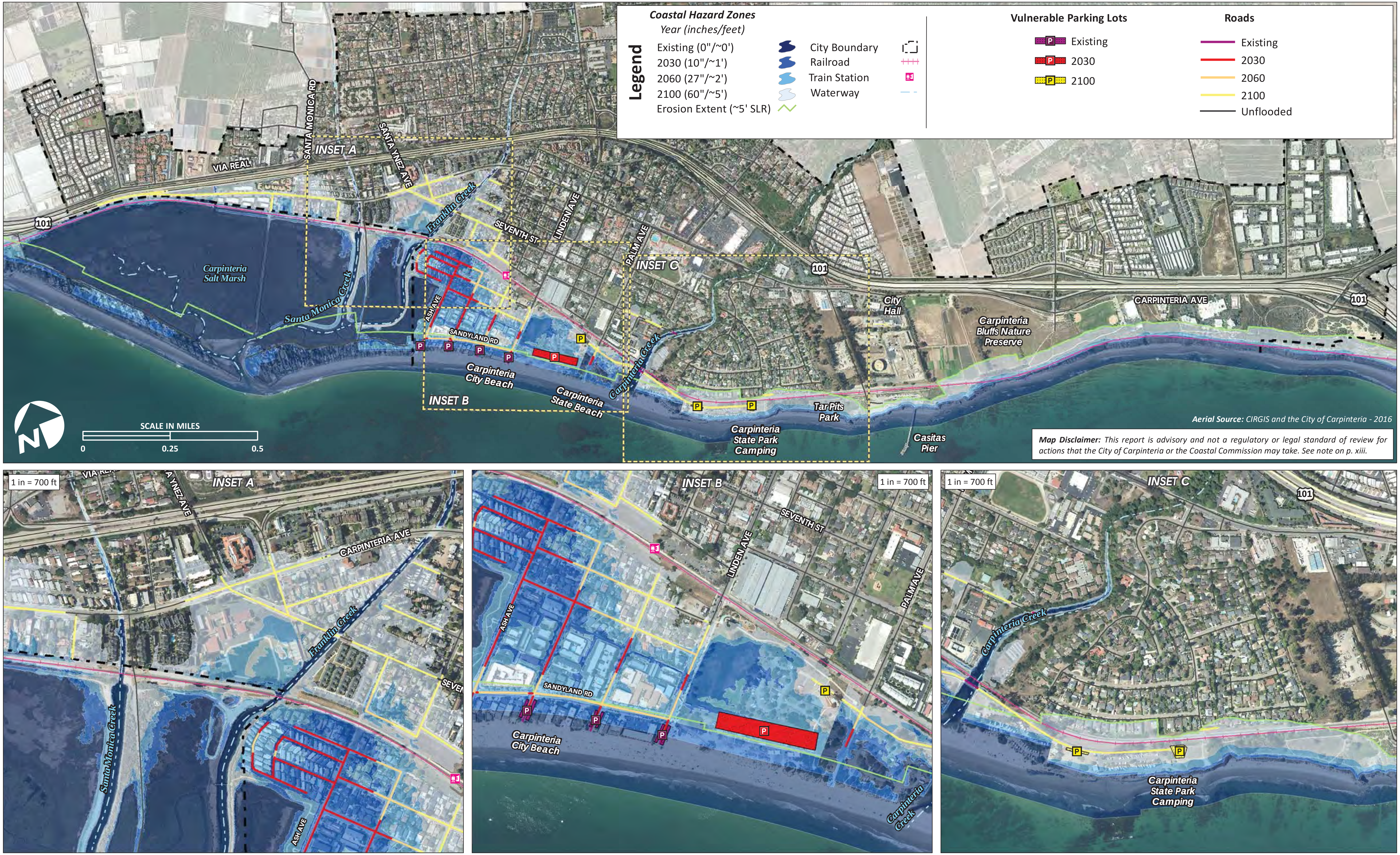
<u>**Projects:**</u>

- Redesign, realign, or relocate critical roads and parking.
- Amend the City's Capital Improvement Plan to require roadway elevation during street resurfacing.
- Perform regular beach nourishment and dune restoration.

<u>**Monitoring**</u>:

- Update the Local Hazard Mitigation Plan (LHMP) to identify preferred adaptation strategies to reduce impacts to roads and parking facilities.
- Monitor depth, extent, and frequency of road and parking facility flooding along areas with identified vulnerability.

Figure 1-2. Roads and Parking



PUBLIC TRANSPORTATION

Overview

To identify public transportation facilities potentially vulnerable to climate change and SLR hazards, this study evaluated the following:

- **13.4 Miles of Class I, II, and III Bikeways**
- **21.8 Miles of Bus Routes; 50 Bus Stops**
- **2.54 Miles of Railroad; 1 Train Station**

Union Pacific Railroad (UPRR) along Carpinteria Bluffs, with Casitas Pier in the background. (Photo: M. MacDougall)

Currently, episodic coastal bluff erosion damage to railroad segments has led to construction of emergency revetments. **With 1' to 2' of SLR,** additional public transportation facilities, such as bus and bike routes within the Beach Neighborhood, Downtown, and along the Bluffs, become vulnerable to coastal hazards, such as bike routes on Sandyland Road and the Seaside Shuttle bus route Linden Avenue. **With 5' of SLR,** cliff erosion may damage 1.5 miles or roughly ½ of the rail alignment through the City. An estimated 1.5 mile of railroad, 2.0 miles of bus routes, and 1.2 miles of bike routes may be subject to coastal flooding. Tidal inundation will routinely close about <0.1-mile of railroad, 1.0 mile of bus routes, and 0.7-mile of bike routes during high tides. Disruption of the rail line could seriously disrupt freight, commuter, and other visitor traffic in Carpinteria and throughout the region.

Tipping Point: With ~1' of SLR, the railroad faces an expanded risk of cliff erosion. With ~2' of SLR, damage becomes widespread to rail. With ~5' of SLR as tidal inundation forces routine closures, overlapping bike and bus route vulnerabilities escalate.

Existing Vulnerabilities

Tidal Inundation	Coastal Erosion	Coastal Flooding
• Bike – 0 miles • Bus – 0 miles • Rail – <0.1-mile	• Bike – 0 miles • Bus – 0 miles • Rail – 0.1-mile	• Bike – <0.1-mile • Bus – 0 miles • Rail – 0.1-mile

Bike: A small portion of the Class II lane along Linden Avenue is currently at risk from coastal flooding.
Bus: Currently, coastal hazards do not pose any risk to bus facilities.
Rail: Portions of the railroad near Carpinteria Creek and along the Bluffs are currently at risk from all coastal hazards.
ECONOMICS: Potential railroad damages from coastal erosion (388 feet) are estimated at $130,000. Damage costs only consider construction costs of a new rail segment. Any disruption to the railroad, bus, and/or bike facilities would have costs due to loss of alternative transportation, coastal access, and recreation; however, these costs are not quantified.

Future Vulnerabilities

10.2 inches (~1 foot) by ~2030

Tidal Inundation (total)	Coastal Erosion (total)	Coastal Flooding (total)
• Bike – 0 miles • Bus – <0.1-mile • Rail – <0.1-mile	• Bike – 0 miles • Bus – 0 miles • Rail – 0.4-mile	• Bike – <0.1-mile • Bus – 0.3-mile • Rail – 0.4-mile

Bike: Coastal flooding could expand along an additional 209 feet (265 feet total) of Class III routes along Sandyland Road and Ash and Linden Avenues.
Bus: Portions of Seaside Shuttle bus route along Linden Avenue become vulnerable to tidal inundation and coastal flooding.
Rail: Coastal erosion impacts to the railroad could expand an additional 0.3-mile (0.4-mile total) along the Bluffs, and coastal flooding impacts to the railroad could expand an additional 0.3-mile (0.4-mile total) near Carpinteria Creek.
ECONOMICS: Potential railroad replacement costs increase to $760,000 (2,223 feet total) from coastal erosion.

27.2 inches (~2 feet) by ~2060

Tidal Inundation (total)	Coastal Erosion (total)	Coastal Flooding (total)
• Bike – 0 miles • Bus – 0.2-mile • Rail – <0.1-mile	• Bike – <0.1-mile • Bus – 0 miles • Rail – -0.8-mile	• Bike – <0.1-mile • Bus – 0.7-mile • Rail – 0.9-mile

Bike: Coastal flooding may affect an additional 408 feet (673 feet total) of Class III routes in the Beach Neighborhood. A small portion of the Class II lanes along Linden Avenue becomes vulnerable to coastal erosion.
Bus: Tidal inundation and coastal flooding may affect an additional 0.4-mile (0.7-mile total) and 0.4-mile (0.6-mile feet total) respectively of the Seaside Shuttle bus route along Linden Avenue.
Rail: Coastal erosion and flooding may damage an additional 0.4-mile of railroad segments along the Bluffs.
ECONOMICS: Potential railroad replacement costs increase to $1,510,000 (4,394 feet total) from coastal erosion; costs of substantial flood damage to bus and bike facilities is unknown.

60.2 inches (~5 feet) by ~2100

Tidal Inundation (total)	Coastal Erosion (total)	Coastal Flooding (total)
• Bike – 0.7-mile • Bus – 0.8-mile • Rail – <0.1-mile	• Bike – <0.1-mile • Bus – 0.3-mile • Rail – 1.4 miles	• Bike – 1.2 miles • Bus – 2.0 miles / 2 stops • Rail – 1.5 miles

Bike: Bike routes become vulnerable to tidal inundation, an additional 132 feet (194 feet total) become at risk of coastal erosion, and an additional 1.1 miles (1.2 miles total) become at risk of coastal flooding. All coastal hazards could impact portions of Class III routes in the Beach Neighborhood along Sandyland Road and Ash Avenue. Coastal flooding may impact the Carpinteria Avenue Class II lane east of the Salt Marsh and the Carpinteria Avenue and 7th Street Class III route around Franklin Creek.

Bus: Tidal inundation and coastal flooding may inundate an additional 0.6-mile (0.8-mile total) and 0.6-mile (1.5 miles total) respectively of the Seaside Shuttle bus route in the Downtown. Two bus stops may become impacted by coastal flooding on Linden and Carpinteria Avenues. Coastal erosion may damage a 0.3-mile total of the Seaside Shuttle bus route in the Beach Neighborhood.

Rail: Coastal erosion and coastal flooding impacts may expand to a total of 1.4 miles (55%) and 1.5 miles (59%) of railroad, respectively, along the Bluffs, State Park, and near the Train Station.

ECONOMICS: Potential railroad replacement costs increase to $2,550,000 (7,432 feet total) from coastal erosion, costs of substantial flood damages to bus and bike facilities is unknown.

Adaptation Strategies

Range of Strategies:

Protect – Work with UPRR to coordinate railroad track elevations that protect the railroad as well as important resources in the Salt Marsh and Downtown. Control bluff face drainage and restore coastal bluff scrub vegetation to minimize bluff erosion. Build or augment cobble and sand dunes and/or other shoreline protective devices.

Accommodate – Elevate roads and bikeways to accommodate higher flood water levels. Add an additional 2-3 inches of asphalt during routine repaving of roads and bikeways. Coordinate with LOSSAN to elevate portion of the railroad Downtown.

Manage – Relocate or reroute bikeways and bus routes from the hazardous areas along shoreline. Install stormwater pumps to dewater the most vulnerable road segments.

Trade-offs: Accommodation through increased road elevation may create additional stormwater drainage issues. Green protection measures such as beach and dune nourishment may require frequent maintenance, particularly with higher levels of SLR. Gray protection strategies would likely be effective in protecting public transportation facilities, but could have negative impacts for beach and dune habitats, natural processes, and coastal access.

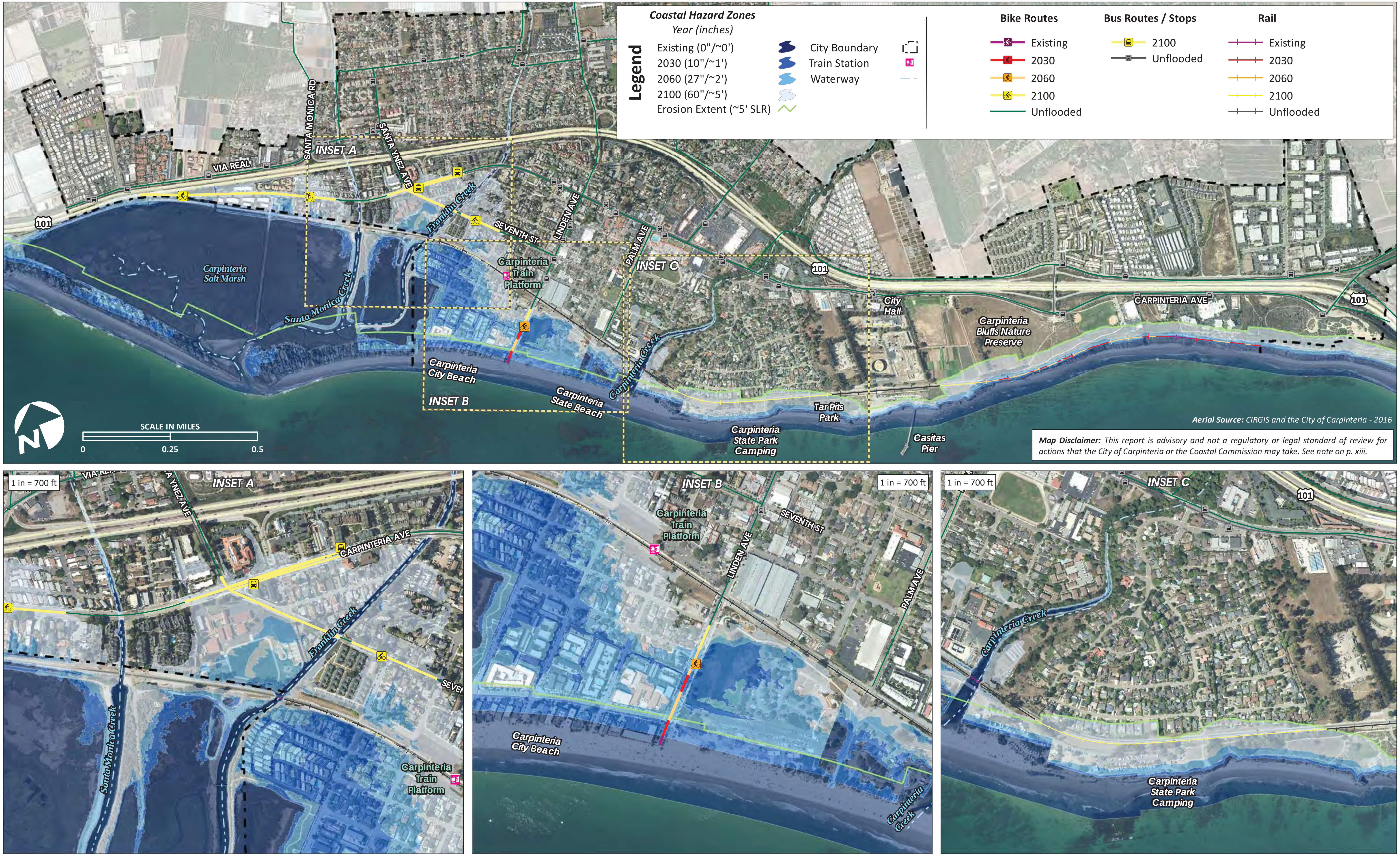
Potential Next Steps

Policy:
- Develop alternative bikeways and bus routes further inland.
- Identify the status of various coastal armoring strategies in the County.
- Coordinate with UPRR on use of green and gray protection measures, and identify the opportunity for collaboration on future plans and adaptation strategies.

Projects:
- Amend the City's Capital Improvement Plan to add additional inches to roadways during routine street resurfacing efforts in order to gain elevation at or greater than the pace of SLR.
- Coordinate with BEACON to identify and develop strategic beach nourishment projects.

Monitoring:
- Monitor the depth, extent, and frequency of road and railroad flooding and erosion along existing alignments.

Figure 1-3. Public Transportation



CAMPING AND VISITOR SERVING LAND USES / ACCOMMODATIONS

Overview

To identify camping and visitor serving accommodations potentially vulnerable to SLR hazards, this study evaluated the following:

- **4 Campgrounds in Carpinteria State Beach - 18.6 Acres of Camping Area**
- **231 State Park Campsites – Santa Cruz (47 sites), Santa Rosa (80 sites), Anacapa (30 sites), San Miguel (56 sites)**
- **5 Hotels/Motels**
- **218 Short Term Rental (STR) Unit Permitted Licenses (189 existing rentals)**

Currently, 2 State Beach campgrounds are vulnerable to coastal erosion and coastal flooding. **With 1' and 2' of SLR,** all 4 campgrounds become vulnerable to all coastal hazards. **With 5' of SLR,** potential impacts to all 4 campgrounds increase for all coastal hazards; coastal erosion could affect one-third of current State Beach camping visitation. No hotels/motels are at risk from any coastal hazard currently or in the future, but the majority of STR units located in the Beach Neighborhood are vulnerable to all coastal hazards with 5' of SLR. The estimated 189 existing STR units (e.g., AirBnB) of the 219 permitted under City ordinance, primarily located in the Beach Neighborhood generate an estimated $400,000 in annual transient occupancy taxes (ToT) for the City. Carpinteria State Beach averages over 420,000 overnight campers annually, the City and State Beaches average over 1.5 million visitors annually, and beach visitors currently generate $445,000 in sales tax revenue and hotel guest and STR renters generate $2.3 million in ToT revenue for the City annually.

__Tipping Point:__ With 2' of SLR, coastal erosion and flooding could impact camp visits by damaging/destroying a substantial number of campsites and associated acreage.

Existing Vulnerabilities

__Tidal Inundation__	__Coastal Erosion__	__Coastal Flooding__
• Campgrounds – 0 / 0 acres	• Campgrounds – 2 / 1.1 acres	• Campgrounds – 2 / 3.0 acres

Camping: 2 campgrounds, Santa Cruz and Santa Rosa, are potentially vulnerable to coastal (dune) erosion and coastal flooding during a large wave event. Dune erosion from a 1% annual chance wave event may lead to a loss of 36,954 campers annually.

Hotels/Motels: Currently, there are no hotels/motels at risk from any coastal hazards.

STR: All 55 allowable STR units within Area A located seaward of Sandyland Road in the Beach Neighborhood are potentially vulnerable to coastal flooding, particularly first floor units. The majority of allowable STR units in Areas Band C (up to 145 units) inland of Sandyland Road are also potentially vulnerable to coastal flooding, particulalry ground floor damage.

ECONOMICS: Carpinteria's City and State beaches generate ~1.5 million visits per year, generating $445,000 in sales tax and hotels/ modtels $1.9 million in ToTannual revenues for the City. STRs generated ~$400,000 in transient occupany tax (TOT) revenues for the City annually. As potential vulnerabilities increase, damages may affect visitation and in turn, State and City revenues. Coastal fooding that affects beach parking may also diminish attendance and spending.

Future Vulnerabilities

10.2 inches (~1 foot) by ~2030

__Tidal Inundation (total)__	__Coastal Erosion (total)__	__Coastal Flooding (total)__
• Campgrounds – 0 / 0 acres	• Campgrounds – 2 / 1.6 acres	• Campgrounds – 2 / 5.5 acres

Camping: 2 additional campgrounds (4 total), Anacapa and San Miguel, become vulnerable to 0.5-acre (1.6 acres total) of potential coastal (beach/ dune) erosion, and 2.5 acres (5.5 acres total) of camping area become at risk from coastal flooding during a large wave event.

STR: Potential coastal flooding with 1' of SLR exposes STR units in Areas B inland of Sandyland Road, and a few in Area C further inland in the Beach Neighborhood become vulnerable to coastal flooding, particularly ground floor areas. Potential STR units in Area A become vulnerable to damage from beach/ dune erosion, including ground floor and parking.

ECONOMICS: The State Beach could lose ~53,000 camping days due to coastal (beach/ dune) erosion with a 1% annual chance wave event, with the City potentially loosing ToT revenue during cleanup/ repair of flooded STR units. Coastal (cliff) erosion could impact a small area of State Beach campground potentially losing approximately 400 annual visitors.

27.2 inches (~2 feet) by ~2060

__Tidal Inundation (total)__	__Coastal Erosion (total)__	__Coastal Flooding (total)__
• Campgrounds – 1 / 0.3-acre	• Campgrounds – 0 / 2.3 acres	• Campgrounds – 4 / 9.7 acres

Camping: Portions of the Anacapa campground become vulnerable to tidal inundation. An additional 1.4 acres (2.9 acres total) of area in Anacapa and San Miguel campgrounds becomes at risk to coastal (dune and cliff) erosion. An additional 4.2 acres (9.7 acres total) of area in all 4 campgrounds could be impacted by coastal flooding during a large wave event.

STR: 55 allowable STR units in Area A of the Beach Neighborhood become vulnerable to more frequent and severe damage due to beach/ dune erosion and coastal flooding; extent and severity of coastal expands in Areas B, C, and D to inland of 4th Street, with more frequent and severe damage to up to 163 STR units, particular to ground floors.

ECONOMICS: The State Beach could lose ~79,000 camping days (19% of total) due to coastal (beach/ dune) erosion from a 100-year storm, and ~20,000 camping days due to coastal (cliff) erosion, or almost 5% of total camping days, impacting City sales tax and State Beach revenues. Damage to and required cleanup/ repair of STR units would reduce City ToT revenue.

60.2 inches (~5 feet) by ~2100

__Tidal Inundation (total)__	__Coastal Erosion (total)__	__Coastal Flooding (total)__
• Campgrounds – 5.8 acres	• Campgrounds – 4.1 acres	• Campgrounds - 12.4 acres

Camping: Tidal inundation may affect an additional 5.5 acres (5.8 acres total; 31%) of campgrounds. Coastal erosion could impact an additional 1.8 acres (4.1 acres total; 34%) of campgrounds. Coastal flooding may impact an additional 2.7 acres of camping areas (12.4 acres total; 67% of camping areas) during large wave events.

Hotels/Motels: No hotels/motels become at risk from any coastal hazards.

STR: The majority of the 218 allowable STR units in the Beach Neighborhood become vulnerable to tidal inundation and coastal flooding, with more frequent and severe damage. The 55 allowable STR units in Zone A seaward of Sandyland Road becone exposed to frequent wave attack and severe recurring damage, reducingng continued viability of these units.

ECONOMICS: State Beach camping days could be reduced by ~140,000 camping days annually (33%) of total) due to beach/ dune erosion; ~76,000 annual camping days (18% of total) vulnerable due to cliff erosion. Tidal inundation could reduce camping days by ~40,000 (~10% of total). impacting City sales tax and State Beach revenues. Damage to and required cleanup/ repair of STR units would reduce City ToT revenue that was $400,00 in 2017.

Adaptation Strategies

__Range of Strategies:__

Protect – Consider implementing gray shoreline protective measures such as sand retention and offshore breakwaters. Consider green strategies such as development of a "living shoreline" dune system and regular beach nourishment with sand and/or cobbles.

Accommodate – Elevate the grade of campgrounds and STR units to reduce imapcts of coastal flooding/tidal inundation. Encourage flood proofing and reinforcement of first floors in STRs. Upgrade storm drainage in Beach Neighborhood by installing pumps, lift stations, and other improvements.

Manage – Coordinate with State Parks to redesign or relocate campsites and facilities to less vulnerable areas of the State Beach. Adjust Short Term Rental program as needed to shift allowable units to less vulnerable areas.

__Trade-offs__***:*** STR upgrades and location shifting may be contentious among property owners. Green adaptation measures require regular maintenance and associated costs, particularly with higher SLR. Coastal armoring strategies would protect capgrounds and STRs but would impact beach/dune habitats, natural processes and coastal access.

Potential Next Steps

__Policy:__

- Coordinate with State Parks to identify a long-range plan for future beach access and seasonal closures for the State Park campgrounds considering SLR and coastal hazards.
- Coordinate with the County, coastal cities, BEACON and local legislators to create sustainable funding mechanism for beach nourishment.

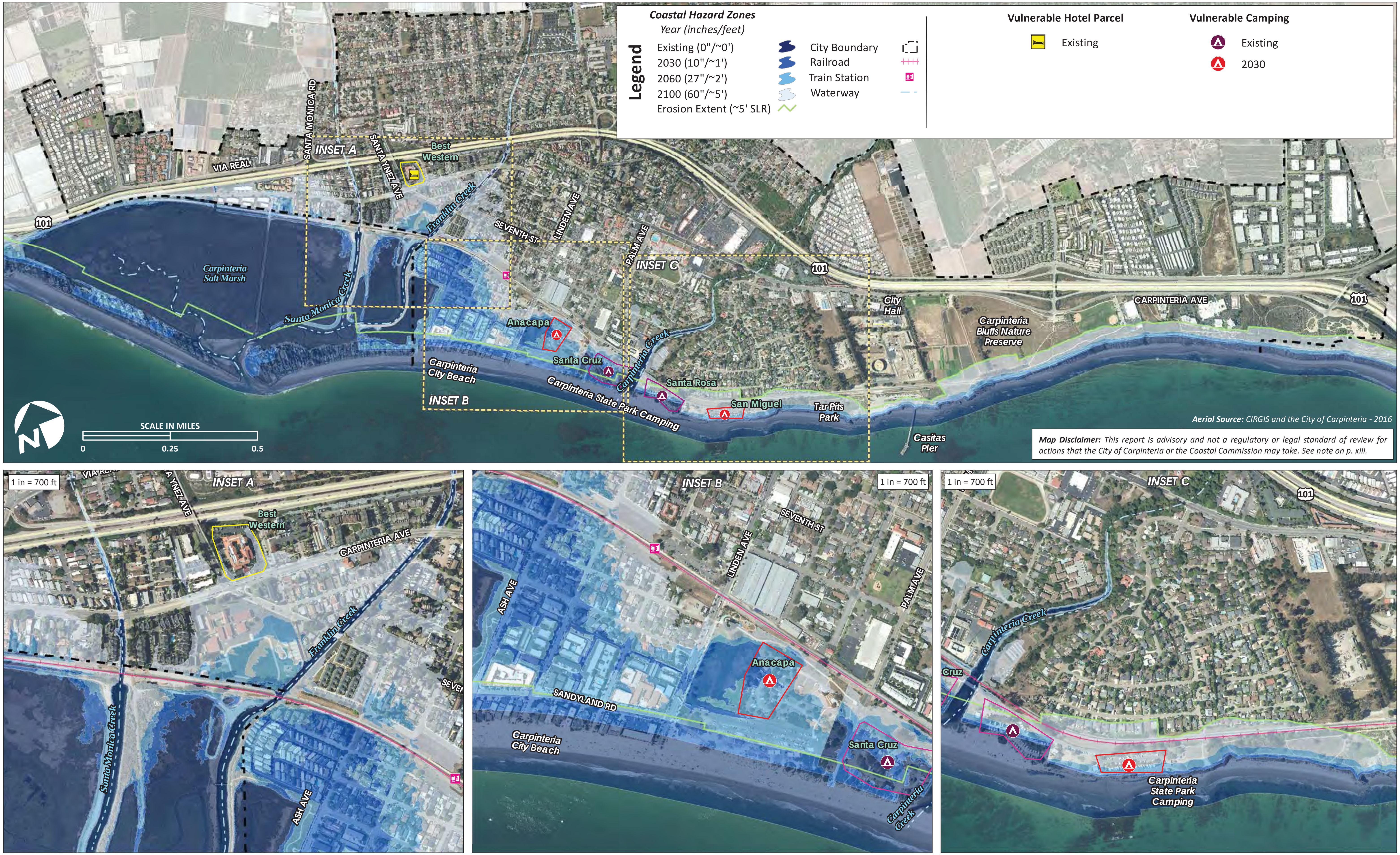
__Monitoring:__

- Monitor depth, extent, and frequency of flooding within the State Park.

__Data Gaps:__

- Precise campground/ amenity footprints.

Figure 1-4. Camping and Visitor Accommodation



COASTAL ACCESS AND TRAILS

Overview

To identify coastal access ways and trails potentially vulnerable to climate change and SLR hazards, this study evaluated the following:

- **13 Vertical Coastal Access Points**
- **2.5 Miles of Lateral Coastal Access**
- **5.2 Miles of Trails (Salt Marsh & Bluffs)**

Ash Avenue Vertical Coastal Access and Carpinteria Salt Marsh Trail (*Photo: California Coastal Records Project*).

Vertical Coastal Access and bluff top trail near seal haulout *(Photo: California Coastal Records*

Currently, all the vertical coastal access points and all lateral coastal trails are vulnerable to coastal erosion and coastal flooding, and more than half of them are vulnerable to tidal inundation. **With 5' of SLR,** all vertical access trails, lateral coastal access along beach and all bluff top coastal trails and those within Carpinteria Salt Marsh Park are vulnerable to coastal erosion, coastal flooding, and tidal inundation.

Tipping Point: With 2' of SLR, coastal erosion and flooding regularly impacts beaches, and dunes and cliff erosion impact lateral and vertical access trails.

Existing Vulnerabilities

Tidal Inundation	Coastal Erosion	Coastal Flooding
• Vertical Coastal Access Points – >6 • Lateral Coastal Access – 2.5 miles • Trails – <0.1-mile	• Vertical Coastal Access Points – 13 • Lateral Coastal Access – 2.5 miles • Trails – 1.2 miles	• Vertical Coastal Access Points – 13 • Lateral Coastal Access – 2.5 miles • Trails – 1.3 miles

Vertical Coastal Access: At least half of the vertical access points west of Carpineria Creek are susceptible to tidal inundation during monthly extreme tides or large coastal storm waves, and all access points are currently at risk from coastal erosion and and coastal flooding; vertical access points east of Carpinteria Creek (e.g., Tar Pits Park, Carpinteria Bluffs) are vulnerable to cliff erosion.

Lateral Coastal Access: All 2.5 miles (100%) of lateral access along City beaches are vulnerable to coastal flooding and erosion from a 100-year wave event, but generally recover post-storm.

Trails: 0.4-mile (100%) of the Carpinteria Salt Marsh Trail is susceptible to coastal flooding.

ECONOMICS: Carpinteria's beaches generate 1.5 million beach-day visits per year, with 600,000 going to the City Beach and 910,000 attending the State Beach. Beach visitors spend $48 million per year, generating $445,000 in sales tax revenue for the City and $2.3 million in ToT revenue from hotels and short term rentals. This study did not estimate costs associated with loss in recreational value or replacement of trails.

Future Vulnerabilities

10.2 inches (~1 foot) by 2030

Tidal Inundation (total)	Coastal Erosion (total)	Coastal Flooding (total)
• Vertical Coastal Access Points – 13 • Lateral Coastal Access – 2.5 miles • Trails – <0.1-mile	• Vertical Coastal Access Points – 13 • Lateral Coastal Access – 2.5 miles • Trails – 1.9 miles	• Vertical Coastal Access Points – 13 • Lateral Coastal Access – 2.5 miles • Trails – 2.2 miles

Vertical Coastal Access: All vertical access points are susceptible to tidal inundation and continue to be vulnerable to coastal erosion and coastal flooding.

Lateral Coastal Access: Lateral beach access along all 2.5 miles of City beaches becomes more vulnerable to to tidal inundation, coastal erosion, and coastal flooding.

Trails: Coastal erosion may impact an additional 0.7-mile (15%) of the bluff top trail through the Carpinteria Bluffs.

27.2 inches (~2 feet) by 2060

Tidal Inundation (total)	Coastal Erosion (total)	Coastal Flooding (total)
• Vertical Coastal Access Points – 13 • Lateral Coastal Access – 2.5 miles • Trails – 0.1-mile	• Vertical Coastal Access Points – 13 • Lateral Coastal Access – 2.5 miles • Trails – 2.7 miles	• Vertical Coastal Access Points – 13 additional • Lateral Coastal Access – 2.5 miles • Trails – 3.4 miles

Vertical Coastal Access: All vertical access points continue to be vulnerable to coastal/cliff erosion and/or coastal flooding. At the State Beach, coastal hazards could extend further inland from the vertical access points.

Lateral Coastal Access: All lateral access is susceptible to tidal inundation, coastal erosion, and coastal flooding.

Trails: Coastal cliff erosion may impact an additional 0.8-mile (17%) of the bluff top trail that transverses the Carpinteria Bluffs, Carpinteria State Beach, Tar Pits Park, and Carpinteria Salt Marsh Park.

60.2 inches (~5 feet) by 2100

Tidal Inundation (total)	Coastal Erosion (total)	Coastal Flooding (total)
• Vertical Coastal Access Points – 13 • Lateral Coastal Access – 2.5 miles • Trails – 1.4 miles	• Vertical Coastal Access Points – 13 • Lateral Coastal Access – 2.5 miles • Trails – 4.6 miles	• Vertical Coastal Access Points – 13 • Lateral Coastal Access – 2.5 miles • Trails – 5.4 miles

Vertical Coastal Access: All vertical access points continue to be vulnerable to coastal erosion and coastal flooding. At the State Beach, coastal hazards could extend further inland from the vertical access points.

Lateral Coastal Access: Depending on degree of shoreline retreat, beach may transition to intertidal and subtitidal, severely limiting lateral beach access.

Trails: Coastal erosion may impact an additional 1.9 miles or 40% a total of 4.6 miles of the bluff top trail and interweaving trails of the various parks along the City's almost 3.0-mile long shoreline extent.

Adaptation Strategies

Range of Strategies:

Protect – Consider green protection measures such as augmentation of sand dunes and cobble beach nourishment. Consider gray protection devices such as sand retention structures or offshore breakwaters.

Accommodate – Elevate the grade of trails to accommodate future coastal flood levels.

Manage – Remove or relocate trails and coastal access ways away from areas vulnerable to coastal hazards.

Trade-offs: Green protection measures may benefit lateral access by maintaining sandy and intertidal beaches for recreational uses, but require regular maintenance, particularly with higher levels of SLR. Gray protection measures would effectively protect coastal access and trails but could lead to loss of beaches and public access over time. Measures such as sand retention or offshore breakwaters may better maintain access and beaches over time as compared to revetments.

Potential Next Steps

Policy:

- Coordinate with State Parks and regional partners on shoreline management to maintain beach access.
- Coordinate with the County, other coastal cities (e.g., BEACON), and local legislators to create sustainable funding mechanism for beach nourishment and other measures.
- Develop a long-range plan for the California Coastal Trail.

Projects:

- Relocate portions of trails exposed to erosion.
- Perform regular beach nourishment/ dune restoration.

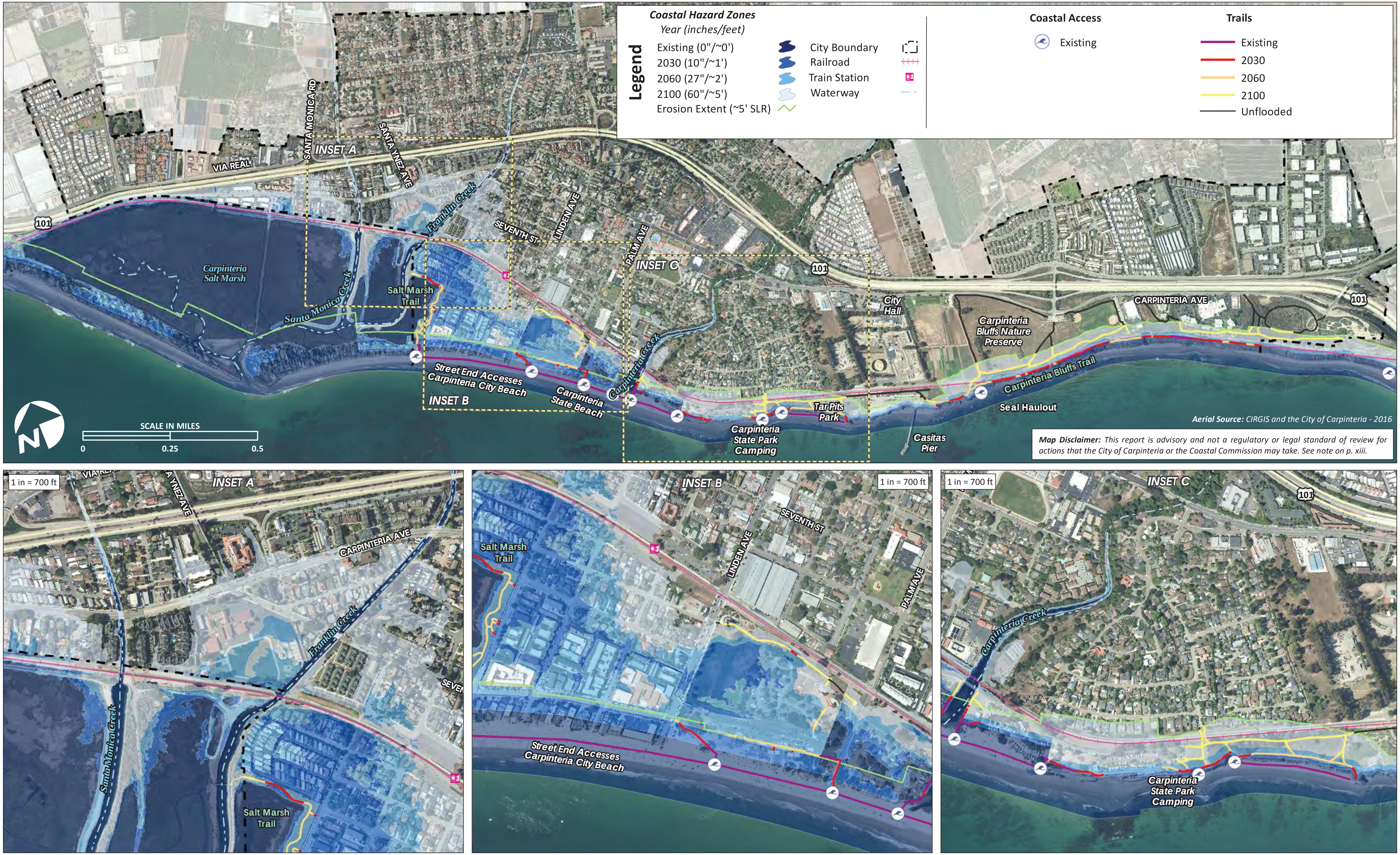
Monitoring:

- Monitor depth, extent, and frequency of flooding within the State Beach.

Data Needs:

- Designated alignment of the California Coastal Trail.
- Complete trail network in the City.

Figure 1-5. Coastal Trails and Access



HAZARDOUS MATERIALS SITES, AND OIL AND GAS WELLS

Overview

Hazardous Materials Sites: The California State Water Resources Control Board (SWRCB) monitors hazardous materials storage and contamination. Sites that are exposed to flooding, erosion, or tidal inundation could potentially result in a release of hazardous materials into the environment, affecting soils and water quality.

Legacy Oil and Gas Wells: The Carpinteria area has a long history of oil development. The City provides regulatory oversight and permit compliance for existing oil and gas facilities, whereas nearshore wells within 3 miles are governed by the California State Lands and Coastal Commission (CSLC). There are at least 53 known inactive legacy wells within the City or just offshore. It is unclear how these wells were capped, but older abandoned wells were sometimes capped with a short concrete plug (e.g., 20 feet) or even phone poles with some concrete, but often do not meet modern standards for a 50-foot concrete plug. Nearby Summerland continues to deal with leaking nearshore wells. Large storm events and tidal inundation could erode, expose, and damage existing well infrastructure, and result in leaks and spills. To identify potentially vulnerable hazardous materials sites, and oil and gas wells, this study considered the following known, existing sites:

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

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 Sites (ESI)	10	3
Cleanup Programs	Leaking Underground Storage Tanks - Active Cleanup (LUST)	0	0
	State Active Cleanup Program Sites	4	1

Currently, coastal hazards may expose 22 legacy oil wells; 5 more wells may be at risk **with 5' of SLR.** With 5' of SLR, coastal hazards may expose an additional 2 ESIs and 1 business. This study did not estimate remediation costs, though these costs can be large; for example, the recent Refugio oil spill on a minor pipeline cost $257 million to mitigate.

Tipping Point: With 2' of SLR, one of the active cleanup sites related to oil and gas becomes exposed to coastal erosion and coastal flooding.

Existing Vulnerabilities

Tidal Inundation
- 0 active cleanup sites
- 0 ESIs
- 0 businesses
- 22 wells

Coastal Erosion
- 0 active cleanup sites
- 1 ESI
- 0 businesses
- 0 wells

Coastal Flooding
- 0 active cleanup sites
- 1 ESI
- 0 businesses
- 22 wells

Hazardous Materials: One ESI, an underground storage tank associated with the Venoco operations is just east of Casitas Pier is at risk from erosion and coastal flooding hazards. No active cleanup sites are exposed to any hazards.

Oil and Gas: There are 16 legacy oil wells offshore of Carpinteria beaches that are currently inundated. An overlapping number of these wells, totaling 8 onshore legacy wells located within Carpinteria's beaches, are currently also exposed to coastal dune and bluff erosion.

Future Vulnerabilities

10.2 inches (~1 foot) by ~2030

There are no additional hazardous material sites or legacy oil wells at risk.

27.2 inches (~2 feet) by ~2060

Tidal Inundation (total)
- 0 active cleanup sites
- 0 ESIs
- 0 businesses
- 22 wells

Coastal Erosion (total)
- 1 active cleanup site
- 1 ESIs
- 0 businesses
- 2 wells

Coastal Flooding (total)
- 1 active cleanup site
- 1 ESIs
- 0 businesses
- 24 wells

Hazardous Materials: One active cleanup site with potential soil contamination from crude oil and hydrocarbons and is potentially vulnerable to erosion and coastal flooding along the Carpinteria Bluffs.

Oil and Gas: There are 2 additional legacy wells exposed to erosion and related coastal flooding located in the State Park and off Elm Avenue in the Beach Neighborhood.

60.2 inches (~5 feet) by ~2100

Tidal Inundation (total)
- 0 active cleanup sites
- 1 ESI
- 0 businesses
- 26 wells

Coastal Erosion (total)
- 1 active cleanup sites
- 1 ESIs
- 0 businesses
- 5 wells

Coastal Flooding (total)
- 1 active cleanup sites
- 3 ESIs
- 1 business
- 27 wells

***Hazardous Materials**:* The previously exposed ESI site is vulnerable to tidal inundation. One light industrial building north of the Carpinteria Salt Marsh is exposed to coastal flooding.

Oil and Gas: There are 3 more legacy wells exposed to erosion and coastal flooding with 5' of SLR, including two wells within the State Park and one within Carpinteria Bluffs I. It is unknown how these wells were abandoned.

Adaptation Strategies

The majority of the hazardous material and impacts identified in the vulnerability assessment are avoidable if the City updates storage requirements and expedites clean-up measures.

Range of Strategies: The City should update storage requirements for businesses storing hazardous materials that would either elevate or floodproof the storage to accommodate potential levels of flooding without exposing the hazardous materials to the environment. Another policy approach would be to rezone so that businesses with a Hazardous Materials Business Plan (HMBP) are excluded from the Coastal Hazard Overlay Zone.

Active cleanup sites should remediate or adjust the timing to reduce exposure of contaminants to prolonged and more frequent coastal hazards. Adaptation strategies that reduce the exposure of the contaminants would include coastal armoring, flood proofing containment, and remediation.

Oil and gas wells could be protected in place. Well casings and onshore support infrastructure may be re-exposed as erosion continues. Maintaining or constructing coastal armoring would be one means to protect these legacy oil and gas wells. A green protection option would be to construct or augment sand dunes in the Beach Neighborhood and cobbles below the Carpinteria Bluffs to minimize exposure of oil and gas wells to erosion.

Secondary Impacts: The "do nothing" approach could have substantial cleanup impacts if spills or leaks occur. Delays in any response could result in oil spills and release of contaminants. Environmental remediation and permitting require substantial time and are high in cost.

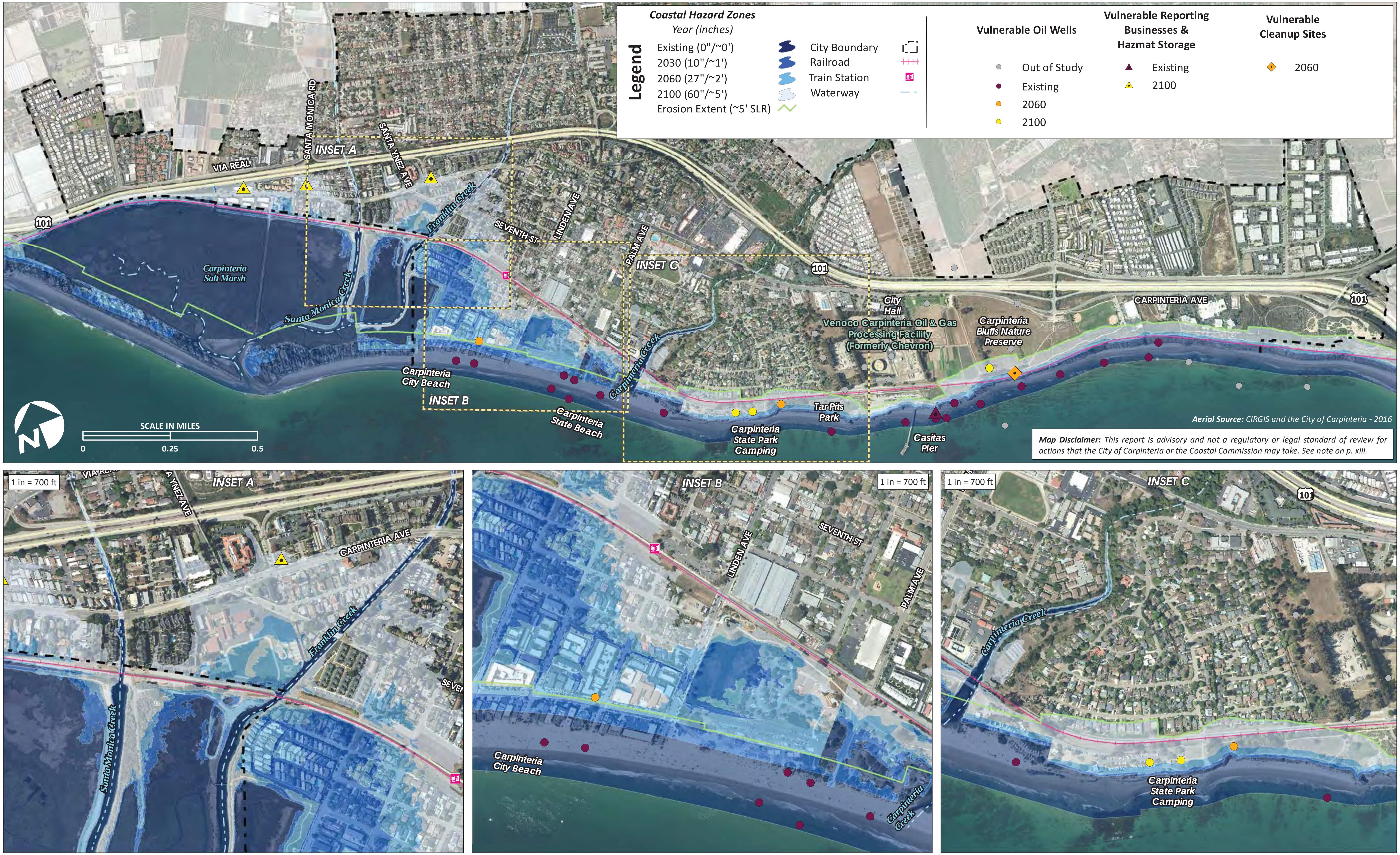
Potential Next Steps

Policy:
- Coordinate with California Department of Toxic Substances and Control (DTSC) to improve hazardous materials storage, management, and remediation in the risk zones.
- Formalize and participate in a regional Joint Powers Authority (JPA) with Office of Spill Prevention and Response (OSPR), CSLC, Coast Guard, and the County. A JPA would form a round table for oil and gas responses and lessons learned.
- Develop a regional environmental and permit streamlining process for rapid remediation of legacy wells.

Projects:
- Generate rapid response funds to remove damaged wells.
- Decommissioning of active sites such as Venoco should require permit holders to remove all shore protection, access roads, pipes and other oil and gas infrastructure.

Monitoring:
- Continue monitoring of remediation actions.

Figure 1-6. Hazardous Materials, and Oil and Gas Infrastructure



STORMWATER INFRASTRUCTURE

Overview

To identify stormwater infrastructure potentially vulnerable to climate change and SLR hazards, this study evaluated the following:

- **342 Storm Drain Inlets**
- **316 Storm Drain Outfalls**
- **24.5 Miles of Storm Drain Pipe**

The City's stormwater system consists of concrete flood control channels along Santa Monica and Franklin Creeks, the natural channel of Carpinteria Creek, and storm drain inlets that gather water from City streets and outfalls that discharge to these creeks or other water bodies via gravity flow. Much of the City's storm drain system is near mean sea level elevation in the Beach Neighborhood and inland of the Salt Marsh, increasing difficulty of rapid drainage during high tides. **Currently,** 36 outfalls are affected by high tides, which increases risk of storm drain backup and flooding, especially in low lying areas such as the Beach Neighborhood and floodplains in the Downtown. Storm drains can back up at several locations in these neighborhoods during high tides. **With 1' of SLR,** portions of the system may not drain during high tides, which in turn may increase stormwater flood depths and frequency. Culverts and pipes may also create flows of ocean water into the neighborhoods. Outfalls along Franklin and Santa Monica Creeks become at risk from high tides, and additional infrastructure around the Beach Neighborhood, State Park open space, and Tomol Interpretive playground become at risk from coastal flooding. **With 2' of SLR,** additional stormwater infrastructure becomes vulnerable to tidal inundation along the railroad corridor in the Downtown, to coastal erosion along the Bluffs, and to coastal flooding in the Beach Neighborhood. **With 5' of SLR,** tides could impair drainage 100% of the tide cycle and may be a source of flooding into neighborhoods, and 1/3 of all outfalls in the City would be covered, reducing stormwater conveyance during high tide. Half of all outfalls become at risk from coastal flooding, and may channel ocean waters into various parts of the City. Coastal erosion threatens 1.0-mile of storm drains/outfalls.

<u>Tipping Point:</u> With 2' of SLR, pipe, inlets, and outfalls become substantially vulnerable to coastal hazards, resulting in loss or damage.

Existing Vulnerabilities

<u>Tidal Inundation</u>	<u>Coastal Erosion</u>	<u>Coastal Flooding</u>
• Inlets – 3	• Inlets – 0	• Inlets – 2
• Outfalls – 36	• Outfalls – 1	• Outfalls – 60
• Pipe – 0.5-mile	• Pipe – <0.1-mile	• Pipe – 0.7-mile

Tidal inundation may reduce stormwater conveyance by potentially inundating a number of inlets and outfalls and 0.5-mile of storm drains, particularly in the Beach Neighborhood. **Coastal erosion** may impact 2 outfalls and 277 feet of storm drains along the Carpinteria Bluffs. **Coastal flooding** from a 100-year wave event may impact stormwater infrastructure along the shoreline, which may be a source of flood waters into the City.

Future Vulnerabilities

10.2 inches (~1 foot) by ~2030

<u>Tidal Inundation (total)</u>	<u>Coastal Erosion (total)</u>	<u>Coastal Flooding (total)</u>
• Inlets – 10	• Inlets – 0	• Inlets – 43
• Outfalls – 49	• Outfalls – 1	• Outfalls – 69
• Pipe – 0.6-mile	• Pipe – 0.1-mile	• Pipe – 1.4 miles

Tidal inundation potentially backs up an additional 7 inlets (10 total), 13 outfalls (49 total), and 662 feet (0.6 miles total) of storm drain along Franklin and Santa Monica Creeks. **Coastal erosion** may potentially damage an additional 276 feet (553 feet total) of storm drain pipes near the Casitas Pier. **Coastal flooding** from a 100-year wave event may impact an additional 41 storm drain inlets (43 total), 9 outfalls (69 total), and an additional 0.7-mile (1.4 miles total) of storm drains around the Beach Neighborhood, State Park open space, and Tomol Interpretative playground.

27.2 inches (~2 feet) by ~2060

<u>Tidal Inundation (total)</u>	<u>Coastal Erosion (total)</u>	<u>Coastal Flooding (total)</u>
• Inlets – 34	• Inlets – 2	• Inlets – 62
• Outfalls – 61	• Outfalls – 1	• Outfalls – 85
• Pipe – 1.1 mile	• Pipe – 0.5-mile	• Pipe – 2.3 miles

Tidal inundation could impact an additional 24 inlets (34 total), 12 outfalls (61 total), and 0.5-mile (1.1 miles total) of storm drains along the railroad corridor inland of the Salt Marsh and Beach Neighborhood. 2 storm drain inlets become vulnerable to **coastal erosion**, which also could damage an additional 0.4-mile (0.5-mile total) of pipe along the Bluffs. **Coastal flooding** from a 100-year wave event may impact an additional 19 inlets (62 total), 16 outfalls (85 total), and an additional 0.9-mile (2.3 miles total) of pipe in the Beach Neighborhood and along the Bluffs.

60.2 inches (~5 feet) by ~2100

<u>Tidal Inundation (total)</u>	<u>Coastal Erosion (total)</u>	<u>Coastal Flooding (total)</u>
• Inlets – 82	• Inlets – 6	• Inlets – 95
• Outfalls – 99	• Outfalls – 3	• Outfalls – 116
• Pipe – 2.5 miles	• Pipe – 1.0-mile	• Pipe – 4.2 miles

Tidal inundation potentially impacts an additional 48 inlets (82 total), 38 outfalls (99 total), and 1.4 miles (2.5 miles total) of storm drains in Franklin, Carpinteria, and Santa Monica Creeks, and the Upper Beach Neighborhood off Ash Ave. **Coastal erosion** may damage an additional 4 inlets (6 total), 2 outfalls (3 total), and 0.5-mile (1.0-mile total) of storm drain pipe across the City. **Coastal flooding** from a 100-year wave event may impact an additional 33 storm drain inlets (95 total), 31 outfalls (116 total), and 2.0 miles (4.2 miles total) of pipes across the City. Drainage and stormwater conveyance is 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.

Adaptation Strategies

<u>Range of Strategies:</u> A range of strategies include relocation and elevation of key vulnerable infrastructure, increasing conveyance and pumping capacity, or flood proofing retrofits to protect existing system components.

Protect – Flood proof pump stations to protect electrical and system operations. Sediment nourishment and dune construction may help reduce loss of storm drains resulting from erosion damage.

Accommodate – Expand pumping capacity in low lying areas in the Beach Neighborhood and landward of the Salt Marsh. Install tide/ flap gates on outfalls into creeks. Acquire land to expand floodplain setbacks. Consider expanding the size of conveyance pipes. Develop a drainage plan for the Carpinteria Bluffs to reduce bluff erosion.

Manage – Develop a repetitive loss program to allow phased relocation of stormwater infrastructure as development is relocated over time. Add longer term considerations of sea level rise and expanded hazards into the Capital Improvement Plan.

<u>Trade-offs:</u> Pump station floodproofing may provide a short-term, relatively low-cost option to accommodate SLR. Potential elevation of railroad and roadways may require additional stormwater drainage planning.

Potential Next Steps

<u>Policy:</u>

- Increase base flood elevation requirements for new development to reduce storm water flood vulnerability.
- Update CLUP/General Plan drainage policies and Capital Improvements Plan to address SLR and future decline in conveyance.
- Coordinate with County Flood Control on regional drainage.
- Develop a Stormwater Master Plan for low-lying areas in the City, such as the Beach Neighborhood.

<u>Data Gaps:</u>

- Elevation information for the outfalls would allow more robust analysis of each drain and subdrainage basin.

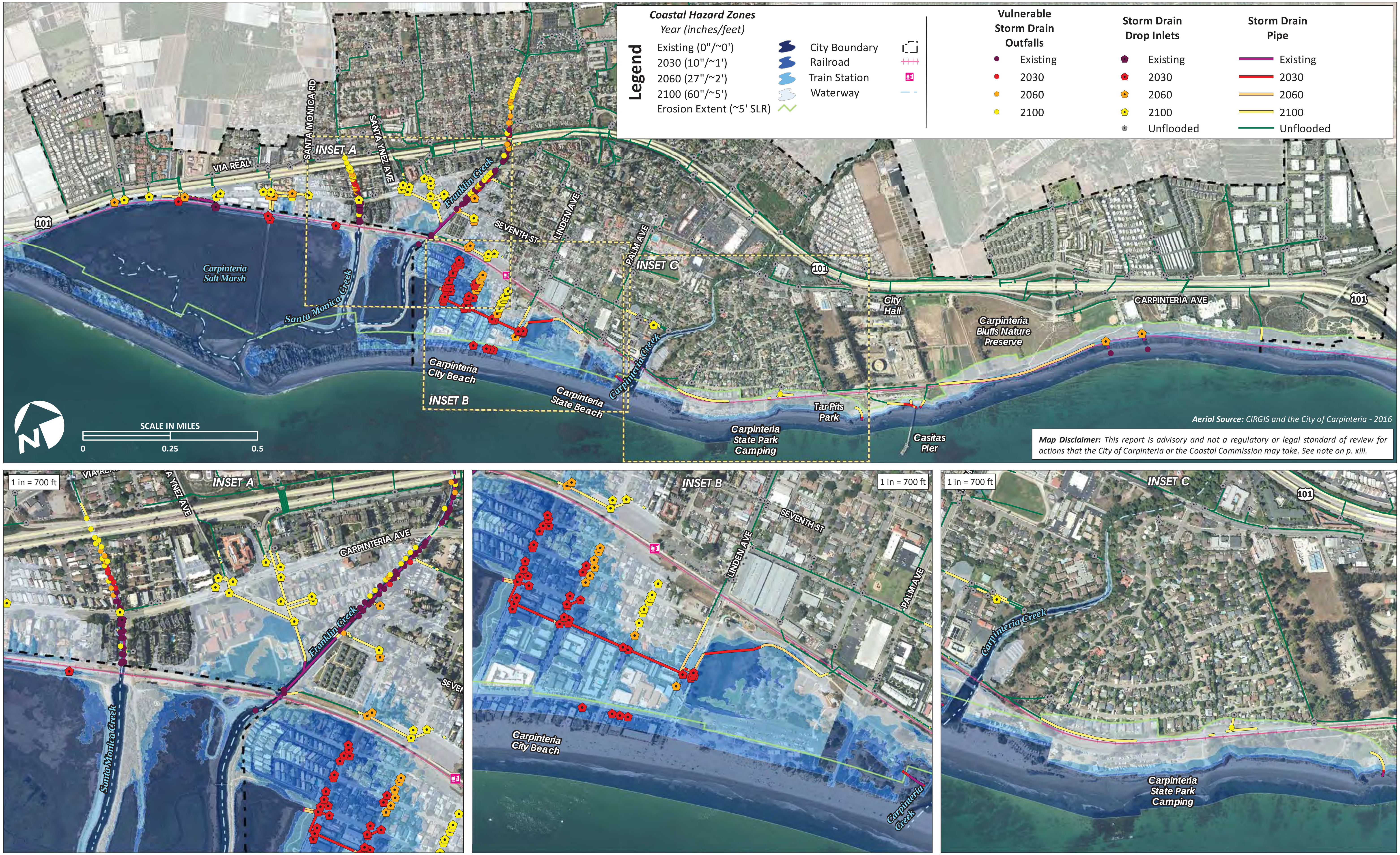
<u>Projects:</u>

- Conduct a stormwater system analysis that examines potential pump locations.
- Add tide/flap gates/coffer dams, to reduce inflow from high tides and storm waves into neighborhoods.
- Develop culvert replacements and stormwater retention basins that allow for reuse or release once tides drop to sufficiently low levels.

<u>Monitoring:</u>

- Monitor frequency, duration, and depths of floods in low-lying areas around the City (e.g., Beach neighborhood).

Figure 1-7. Stormwater



WASTEWATER INFRASTRUCTURE

Overview

To identify wastewater infrastructure potentially vulnerable to climate change and SLR hazards, this study evaluated the following:

- **39.7 miles of Sewer Pipe**
- **762 Manholes**
- **6 Lift Stations**
- **Wastewater Treatment Plant (WWTP)**

Currently, portions of the sewer pipe network are vulnerable to all coastal hazards. Coastal hazards could further increase the volume of flows to the WWTP through infiltration into manholes and add additional complications from increased salinity. **With 1' and 2' of SLR,** increasing segments of sewer pipes and manholes in the Beach Neighborhood become at risk from all coastal hazards, with vulnerability of all wastewater infrastructure substantially increasing **with 5' of SLR,** including the WWTP.

Tipping Point: With ~5 feet of SLR, there is a substantial escalation of coastal flooding, tidal inundation and erosion risk to pipes, manholes and lift stations.

Existing Vulnerabilities

Tidal Inundation	Coastal Erosion	Coastal Flooding
• Pipe – <0.1-mile	• Pipe – <0.1-mile	• Pipe – 0.2-mile
• Manholes – 0	• Manholes – 0	• Manholes – 0
• Lift Stations – 0	• Lift Stations – 0	• Lift Stations – 0

Coastal erosion may damage pipes in the Beach Neighborhood, while **coastal flooding** may temporarily affect maintenance and repair access to pipes north of the Salt Marsh during storm events. A sewage lift station just outside the City boundary west of the Carpinteria Salt Marsh is subject to coastal flooding and its disruption could affect the wastewater system.

ECONOMICS: The estimated cost of replacing eroded sewer pipes from coastal erosion is estimated at $60,000 (261 feet). If the sewer pipes have to be rerouted or protected, the cost could be considerably higher; this analysis only estimates the cost of pipeline infrastructure replacement, without factoring in additional manhole vaults or costs of land acquisition or rerouting.

Future Vulnerabilities

10.2 inches (~1 foot) by ~2030

Tidal Inundation (total)	Coastal Erosion (total)	Coastal Flooding (total)
• Pipe – <0.1-mile	• Pipe – 0.1-mile	• Pipe – 0.9-mile
• Manholes – 0	• Manholes – 0	• Manholes – 20
• Lift Stations – 0	• Lift Stations – 0	• Lift Stations – 0

Additional lengths of sewer pipe in the Beach Neighborhood become at risk to **all coastal hazards**, **coastal erosion** may impact an additional 30 feet (291 feet total) of pipe. **Coastal flooding** may affect an additional 0.8-mile (0.9-mile total) of pipe, and 20 manholes in the Beach Neighborhood.

ECONOMICS: Potential replacement costs of sewer pipes damaged by erosion are estimated at $10,000 more than the existing vulnerabilities, for a cumulative total of $70,000 (291 feet); higher if pipes need to be rerouted or protected. Potential economic effects of any damage to the wastewater treatment plant from increased salt water infiltration through manholes from coastal flooding are unknown and have not been calculated.

27.2 inches (~2 feet) by ~2060

Tidal Inundation (total)	Coastal Erosion (total)	Coastal Flooding (total)
• Pipe – 0.6-mile	• Pipe – 0.1-mile	• Pipe – 2.0 miles
• Manholes – 13	• Manholes – 0	• Manholes – 32
• Lift Stations – 0	• Lift Stations – 0	• Lift Stations – 1

In the Beach Neighborhood, **tidal inundation** could affect 0.6-mile of pipe and 13 manholes, **coastal erosion** could impact an additional 46 feet (337 feet total) of pipe. **Coastal flooding** from a 100-year storm event may affect an additional 1.1 miles (2.0 miles total) of pipe, an additional 12 manholes (32 total), and 1 lift station to the northwest of the City limits, disruption of which could affect the wastewater system.

ECONOMICS: Potential replacement costs of sewer pipes are estimated at a cumulative total of $80,000 (337 feet) from coastal erosion (increasing $10,000 from 2030); these costs could become higher if pipes need to be rerouted or protected. Coastal flooding could damage 1 pump station west of the Marsh, which would cost $1 million to replace. Potential economic effects of any damage to the wastewater treatment plant from increased salt water infiltration through manholes from coastal flooding and tidal inundation are unknown and have not been calculated.

60.2 inches (~5 feet) by ~2100

Tidal Inundation (total)	Coastal Erosion (total)	Coastal Flooding (total)
• Pipe – 3.1 miles	• Pipe – 0.5-mile	• Pipe – 4.7 mile
• Manholes – 56	• Manholes – 12	• Manholes – 95
• Lift Stations – 2	• Lift Stations – 1	• Lift Stations – 3
		• WWTP

Tidal inundation may affect 2 lift stations in the Beach Neighborhood; an additional 43 manholes (56 total), resulting in substantial saltwater infiltration to the wastewater system; and an additional 2.5 miles (3.1 miles total) of pipe, limiting maintenance and repair access to the sewer pipe network. **Coastal erosion** may affect 1 lift station, 12 manholes, and an additional 0.4-mile (0.5-mile total) of pipe within the Beach Neighborhood. **Coastal flooding** may affect 2 additional lift stations (3 total) and an additional 2.7 miles (4.7 miles total) of pipe inland of the Salt Marsh up to Carpinteria Avenue and in the Beach Neighborhood. Also see Appendix C.

ECONOMICS: Potential cumulative replacement costs of sewer pipes are estimated at $610,000 (0.5-mile) from coastal erosion; higher if manhole vaults need to be replaced, or if pipes need to be rerouted or protected. Tidal inundation, coastal erosion, and/or coastal flooding from a 100-year wave event could risk damaging 2 lift additional stations, which may cost $2 million to replace ($1 million each). Potential economic effects of any damage to the wastewater treatment plant from substantially increased salt water infiltration through manholes from coastal flooding and tidal inundation, as well as damage to wastewater treatment plant buildings are unknown and have not been calculated.

Adaptation Strategies

Range of Strategies: A range of strategies include managed retreat, elevating key vulnerable infrastructure, increasing conveyance and pumping capacity, or flood-proofing retrofits that protect existing system components.

Protect – Raise flood walls on Carpinteria Creek to protect against a 500 year FEMA fluvial event. Flood-proof vulnerable lift stations to protect electrical and pump system operations. Seal manholes to prevent coastal flooding and tidal inundation from overwhelming the sewage system. Fund regular sustained beach nourishment and restore sand dunes and integrate with sand retention or offshore breakwater devices to protect from coastal erosion and flooding.

Accommodate – Elevate lift stations, shut off valves, and vulnerable components above future coastal flood levels. Require any metal parts to be of an alloy more resistant to salt corrosion. Install tide gates/flaps at key drainage outfalls and coffer dams across Carpinteria creek channels.

Manage – Phased relocation of the wastewater infrastructure, tied to a community-wide shoreline management strategy and regional coordination with neighboring jurisdictions. Add longer term considerations of sea level rise and expanded hazards into the Infrastructure Improvement and Maintenance Plan.

Trade-offs: Retrofits may provide a short-term, relatively low-cost option to protect from flood hazards. Green protection such as beach and dune nourishment may require frequent maintenance and associated ongoing costs with higher levels of SLR. Gray protection strategies could negatively impact beach and dune habitats, natural processes, and public coastal access, but could effectively protect wastewater infrastructure.

Potential Next Steps

Policy:

- Update the 2005 Wastewater Master Plan to incorporate future climate change and sea level rise vulnerabilities.
- Develop wastewater management policies to require accommodation or avoidance of coastal hazard areas to the extent possible.
- Coordinate with BEACON and state legislators to fund and perform regular beach and dune nourishment.

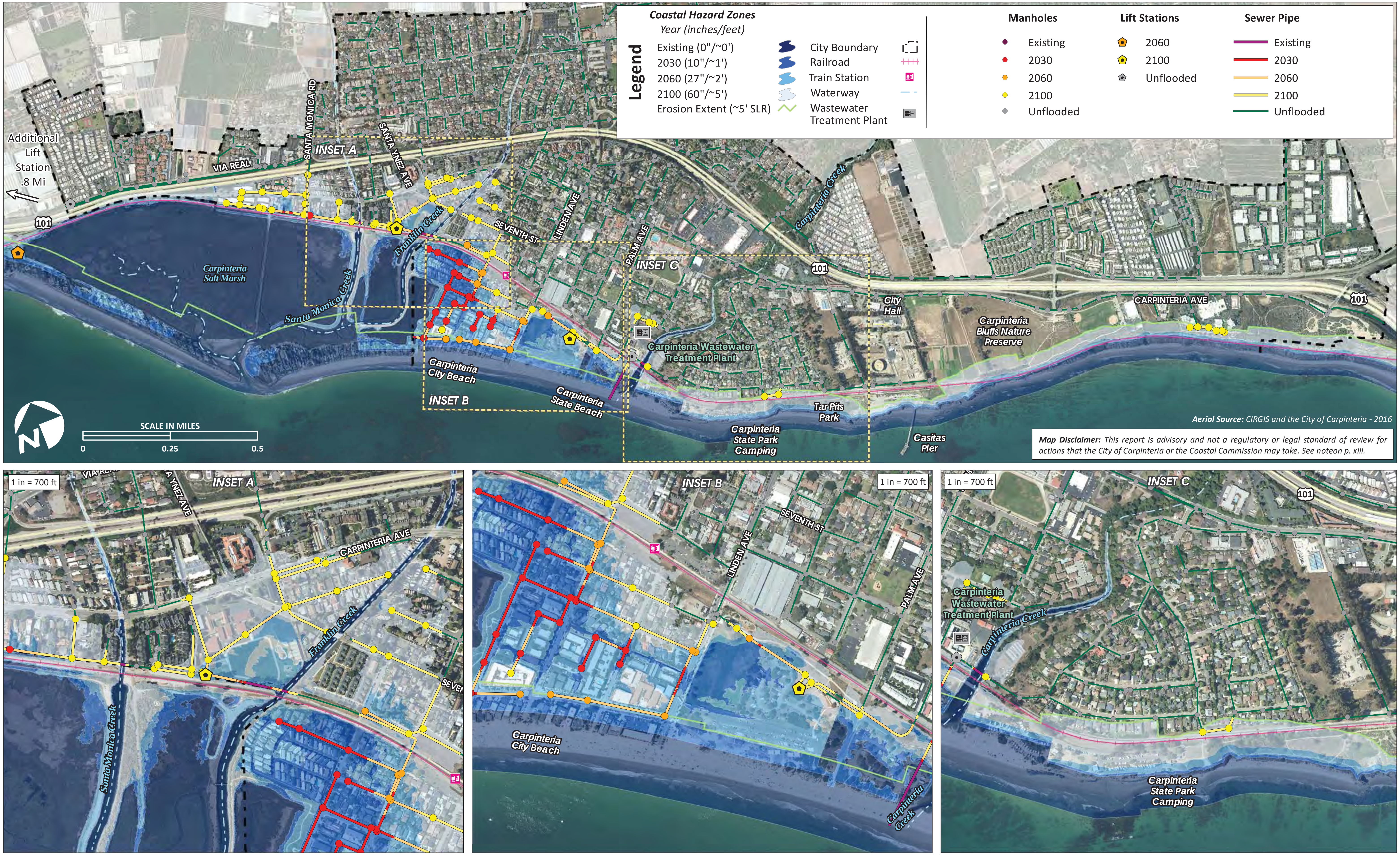
Projects:

- Relocate sewer pipe segments susceptible to coastal erosion. Segments should be prioritized based on the timing of potential impacts.
- Flood proof lift stations and WWTP.
- Install tide gates/flaps at outfalls and coffer dams across creeks.
- Retrofit manholes to reduce flood water intrusion into the sewage system.
- Upgrades should consider additional elevation or setbacks, correspondent with expected sea levels.

Monitoring:

- Monitor the volume and salinity levels of water during storm events to understand the impacts on sewer capacity.

Figure 1-8. Wastewater



WATER SUPPLY INFRASTRUCTURE

Overview

To identify water supply infrastructure potentially vulnerable to climate change and SLR hazards, this study evaluated the following:

- **46 Miles of Water Supply Pipes**
- **290 Hydrants**
- **1550 Control Valves**
- **4 Pressure Regulators**
- **3516 Customer Water Meters *(not mapped)***
- **4 Groundwater Wells *(not mapped)***

The City's water supply system is managed by the Carpinteria Valley Water District (CVWD) and maintained by pressure regulators, hydrants, and control valves that distribute water through pipes to connect to customer water meters. The Beach Neighborhood and neighborhood north of the Salt Marsh have the most vulnerable water supply infrastructure to future coastal hazards. Saltwater intrusion into the groundwater aquifers is not currently a major problem, but could pose substantial risk to groundwater supplies, a key source of City water; additional analysis is needed to understand this issue. **Currently,** small portions of the water supply pipe network are at risk from coastal hazards. **With 1' and 2' of SLR,** coastal flooding and tidal inundation impacts escalate, primarily in the Beach Neighborhood. **With 5' of SLR,** coastal erosion impacts occur, and other coastal hazard impacts escalate, expanding north of the Salt Marsh. While not the focus of this study, fluvial (creek) flooding creates substantial existing and future water infrastructure vulnerabilities (see Appendix C).

Tipping Point: With 2' of SLR, pipes, hydrants and valves, pressure regulators, meters and wells for water supply become substantially vulnerable to coastal hazards, resulting in loss or damage.

Existing Vulnerabilities

Tidal Inundation	Coastal Erosion	Coastal Flooding
• Pipe – <0.1-mile • Hydrants – 0/Valves – 0 • Pressure Regulators – 0 • Meters – 0/Wells – 0	• Pipe – <0.1-mile • Hydrants – 0/Valves – 0 • Pressure Regulators – 0 • Meters – 0/Wells – 0	• Pipe – <0.1-mile • Hydrants – 0/Valves – 0 • Pressure Regulators – 0 • Meters – 0/Wells – 0

Portions of the water supply pipe network are vulnerable to **coastal flooding** in the Beach Neighborhood.

Future Vulnerabilities

10.2 inches (~1 foot) by ~2030

Tidal Inundation (total)	Coastal Erosion (total)	Coastal Flooding (total)
• Pipe – 0.1-mile • Hydrants – 0/Valves – 3 • Pressure Regulators – 0 • Meters – 3/Wells – 0	• Pipe – <0.1-mile • Hydrants – 0/Valves – 0 • Pressure Regulators – 0 • Meters – 0/Wells – 0	• Pipe – 1.0-mile • Hydrants – 4/Valves – 38 • Pressure Regulators – 0 • Meters – 136/Wells – 0

Tidal inundation may affect a number of control valves, some water meter connections, and 0.1-mile of supply pipe, which may hinder access periodically in the Beach Neighborhood. **Coastal flooding** may impact a number of hydrants, control valves, water meter connections, and 1.0-mile of pipe during a large wave event; impacts would primarily occur in the Beach Neighborhood along lower Linden and Elm Avenues. No impacts to groundwater resources are anticipated with this level of SLR, but additional study is required.

27.2 inches (~2 feet) by ~2060

Tidal Inundation (total)	Coastal Erosion (total)	Coastal Flooding (total)
• Pipe – 0.8-mile • Hydrants – 2/Valves – 35 • Pressure Regulators – 0 • Meters – 79/Wells – 0	• Pipe – <0.1-mile • Hydrants – 0/Valves – 0 • Pressure Regulators – 0 • Meters – 0/Wells – 0	• Pipe – 1.8 miles • Hydrants – 9/Valves – 67 • Pressure Regulators – 0 • Meters – 194/Wells – 0

Tidal inundation may routinely impact hydrants, as well as 0.8-mile of pipe, 32 control valves (35 total), and 76 meter connections (79 total), primarily in the Beach Neighborhood. During a large wave event, **coastal flooding** may impact an additional 0.8-mile of pipe (1.8 miles total), 5 hydrants (9 total), 29 control valves (67 total), and 58 water meter connections (194 total), with impacts expanding in the Beach Neighborhood along Sandyland Road, and lower Linden and Elm Avenues. No impacts to groundwater resources are anticipated with this level of SLR, but additional study is required.

60.2 inches (~5 feet) by ~2100

Tidal Inundation (total)	Coastal Erosion (total)	Coastal Flooding (total)
• Pipe – 2.9 miles • Hydrants – 18/Valves – 128 • Pressure Regulators – 0 • Meters – 302/Wells – 0	• Pipe – 0.5-mile • Hydrants – 1/Valves – 15 • Pressure Regulators – 0 • Meters – 47/Wells – 0	• Pipe – 4.5 miles • Hydrants – 27/Valves – 182 • Pressure Regulators – 1 • Meters – 444/Wells – 0

Tidal inundation may routinely inundate 2.9 miles of pipe, 16 hydrants (18 total), 93 control valves (128 total), and 223 water meter connections (302 total), with hazards increasing primarily in the Beach Neighborhood, above 3rd Street toward the railroad tracks. Water supply pipe (0.5-mile total), a hydrant, and 15 total control valves and 47 total water meter connections become vulnerable to **coastal erosion** on the oceanfront parcels in the Beach Neighborhood and along the Carpinteria Bluffs. **Coastal flooding** may affect 4.5 miles of pipe, 18 hydrants (27 total), 115 control valves (182 total), and 250 water meter connections (444 total), with impacts expanding in the Beach Neighborhood inland of the railroad and on the north side of the Salt Marsh, also exposing a pressure regulator. While it is unknown of this level of SLR would affect groundwater resources through potential for saltwater intrusion, additional study is required to ascertain at what level SLR may begin to affect groundwater resources.

ECONOMICS: The replacement cost of water pipes due to coastal erosion is estimated at $560,000 (0.5-mile). This analysis only factors cost of replacement for eroded water supply pipes and does not consider additional costs to replace or repair hydrants, valves or pressure regulators. Cost is not estimated for previous planning horizons as water supply pipes would not be impacted by coastal erosion with less than 5' of SLR.

Adaptation Strategies

Range of Strategies: Adaptation strategies over the coming decades could include infrastructure changes to improve water supply reliability and storage capability, as well as increased conservation efforts and availability of recycled water.

Protect – Construct additional flood control channels or shoreline protective devices. Augment, nourish, and/or construct sand dunes to protect against future coastal hazards.

Accommodate – Elevate key system maintenance components or replace with remotely operated valves. Require any metal parts to be of an alloy more resistant to salt corrosion.

Manage – Relocate distribution pipelines away from erosion hazard areas. Identify future locations for pump stations and wells such to avoid potential coastal hazards. Add longer term considerations of sea level rise and expanded hazards into the Infrastructure Improvement and Maintenance Plan.

Trade-offs: Green protection measures such as beach and dune nourishment may require frequent and expensive maintenance, particularly with higher levels of SLR. Gray protection strategies could effectively protect water supply infrastructure, but could also have negative impacts on beach and dune habitats, natural processes, and public coastal access.

Potential Next Steps

Policy:

- Develop CVWD-wide policies that promote water conservation and increase reclaimed water use and availability.
- Coordinate regionally with local water districts and relevant County departments to adapt the water supply system to future demands and include climate change into the Integrated Water Resource Management and Sustainable Groundwater Management Act plans.
- Ensure adequate long-term water supplies for the lifetime and intended use of development prior to permitting.
- Restrict development of new wells in hazardous areas.

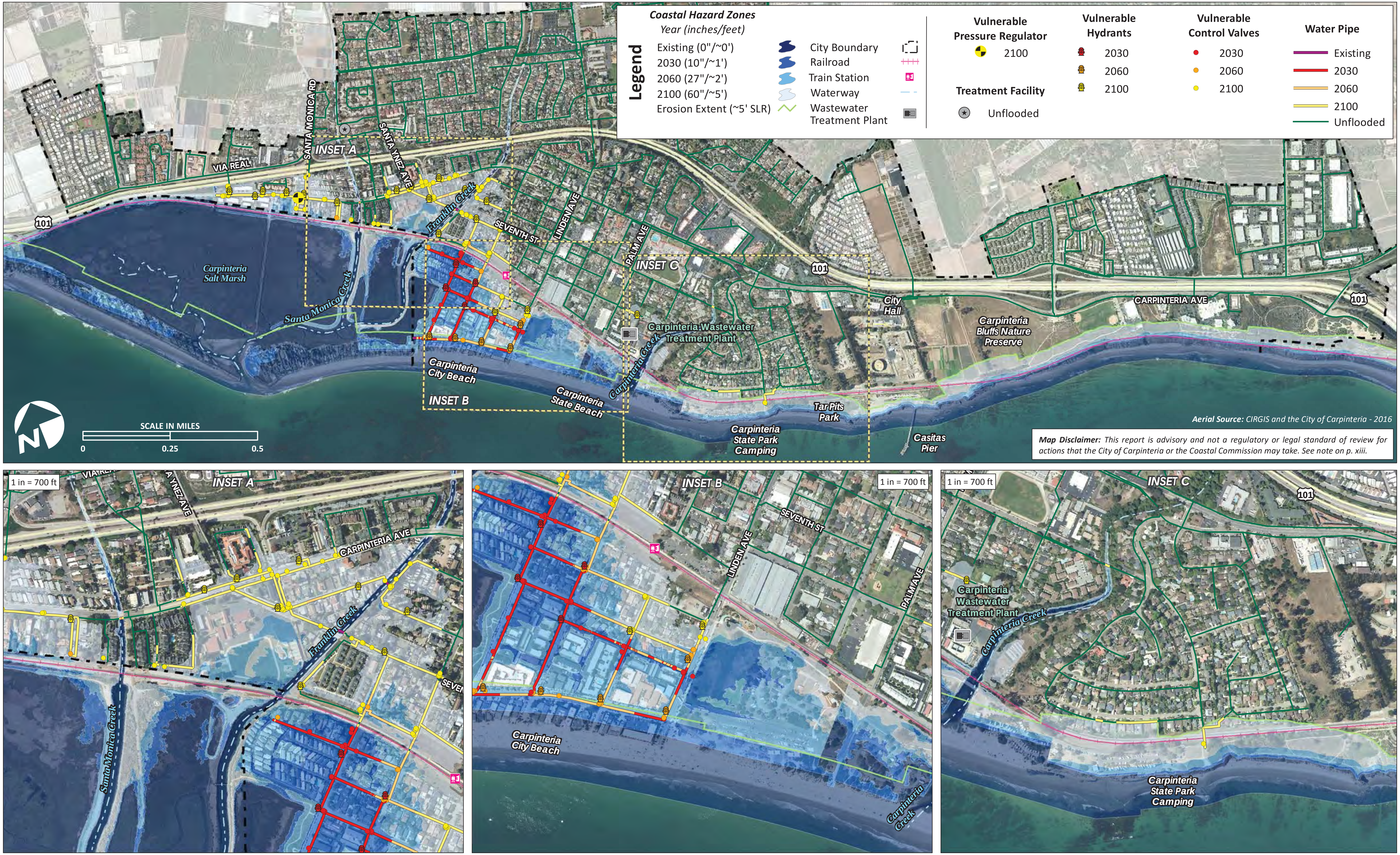
Projects:

- Specific projects should be identified in other water supply planning documents such as updates to the Carpinteria Valley Recycled Water Facilities Plan or Groundwater Basin Master Plan.

Monitoring:

- Support CVWD efforts to develop a monitoring well to evaluate salinity intrusion into the aquifer.

Figure 1-9. Water Supply



COMMUNITY FACILITIES AND CRITICAL SERVICES

Overview

To identify community facilities and critical services potentially vulnerable to climate change and SLR hazards, this study evaluated the following:

- **# Community Facilities**
  - **6 School Campuses / 34 School Buildings**
  - **3 Churches**
  - **6 Other Community Facilities (Post Office, Wastewater Treatment Plant [WWTP])**
- **# Critical Services**
  - **1 Fire Station/1 Admin Office**
  - **1 Police Station**
  - **1 Medical Facility**

The City's Wastewater treatment plant is located along Carpinteria Creek inland of the State Beach and railroad. (Photo: California Coastal Records Project)

Currently and with 1' of SLR, coastal hazards do not threaten any community facilities or critical services. **With 5' of SLR,** up to nine buildings at Aliso Elementary School building are vulnerable to coastal flooding and tidal inundation hazards and seawater infiltration into sewer lines has an unknown increase in potential for additional complications and damage to the WWTP. No emergency response facilities are exposed to coastal hazards with up to 5' of SLR.

Tipping Point: With 5' of SLR, tidal inundation may regularly affect Aliso Elementary School, and coastal flooding may impact the WWTP, State Beach Service Yard, and Sanitary District offices.

Existing Vulnerabilities

Tidal Inundation	Coastal Erosion	Coastal Flooding
• School Buildings – 0 • Churches – 0 • Other Community Facilities – 0 • Critical Services – 0	• School Buildings – 0 • Churches – 0 • Other Community Facilities – 0 • Critical Services – 0	• School Buildings – 0 • Churches – 0 • Other Community Facilities – 0 • Critical Services – 0

No community facilities or critical services are exposed to existing coastal hazards.

Future Vulnerabilities

10.2 inches (~1 foot) by ~2030

Tidal Inundation (total)	Coastal Erosion (total)	Coastal Flooding (total)
• School Buildings – 0 • Churches – 0 • Other Community Facilities – 0 • Critical Services – 0	• School Buildings – 0 • Churches – 0 • Other Community Facilities – 0 • Critical Services – 0	• School Buildings – 0 • Churches – 0 • Other Community Facilities – 0 • Critical Services – 0

No community facilities or critical services are exposed to coastal hazards. Nevertheless, seawater infiltration into sewer lines via manhole covers has an unknown increase in potential for complications and/or damage to the WWTP (see Wastewater Infrastructure Sector for more detail).

27.2 inches (~2 feet) by ~2060

Tidal Inundation (total)	Coastal Erosion (total)	Coastal Flooding (total)
• School Buildings – 0 • Churches – 0 • Other Community Facilities – 0 • Critical Services – 0	• School Buildings – 0 • Churches – 0 • Other Community Facilities – 0 • Critical Services – 0	• School Buildings – 1 • Churches – 0 • Other Community Facilities – 0 • Critical Services – 0

During a 100-year wave event, one building at the Aliso Elementary School may be susceptible to temporary flood damages from **coastal flooding**. No critical services are at risk from coastal hazards. An increased amount of seawater into sewer lines has an unknown increased potential for complications and/or damage to the WWTP.

60.2 inches (~5 feet) by ~2100

Tidal Inundation (total)	Coastal Erosion (total)	Coastal Flooding (total)
• School Buildings – 8 • Churches – 0 • Other Community Facilities – 0 • Critical Services – 0	• Schools Buildings – 0 • Churches – 0 • Other Community Facilities – 0 • Critical Services – 0	• Schools Buildings – 9 • Churches – 0 • Other Community Facilities – 4 • Critical Services – 0

Tidal inundation and **coastal flooding** may impact an additional 8 buildings (9 total) at Aliso Elementary School during routine high tides. Coastal flooding could also impact the WWTP. A potentially large increase of seawater infiltration into sewer lines has an unknown potential for complications and/or damage to the WWTP (see Wastewater Infrastructure Sector for more detail). Finally, the properties of the State Beach Service Yard and the Sanitary District offices could be affected.

Adaptation Strategies

Range of Strategies:

Protect – Transition the winter storm berm program to a permanent "living shoreline" persistent dune system. Consider additional opportunities for beach nourishment with cobble and sand. Work with UPRR to elevate tracks on berms that could protect Aliso Elementary School from tidal inundation and coastal flooding. Install independent berms at perimeters of WWTP and Aliso Elementary School.

Accommodate – Require retrofitting buildings during major remodels to increase elevation or setbacks. Amend City building code and zoning ordinance to enable elevation to occur over time. Install tide gates/ flaps at key drainage outfalls and coffer dams across creek channels.

Manage – Develop evacuation routes that avoid roadways that are vulnerable to existing and future coastal hazards.

Trade-offs: Elevation of structures could be costly, depending on the types of structural foundation improvements needed, although the extended time until potential impacts allows for appropriate planning. Building elevation may also result in negative aesthetic impacts on the community. Green protection strategies may benefit beaches by maintaining recreational uses but would require frequent maintenance with higher levels of SLR and may offer limited protection. Coffer dams and tide gates/ flaps require initial capital outlays as well as operations and maintenance funding.

Potential Next Steps

Policy:

- Work with School District to evaluate site options (e.g., tide gates/ flaps/ berms, building elevation, school relocation).
- Coordinate with UPRR of increasing track elevations.
- Coordinate with BEACON and local state legislators to create a sustainable funding program for beach nourishment efforts.
- Include policy language (e.g., renewal of school leases, health care, etc.) that considers SLR and flood hazards.

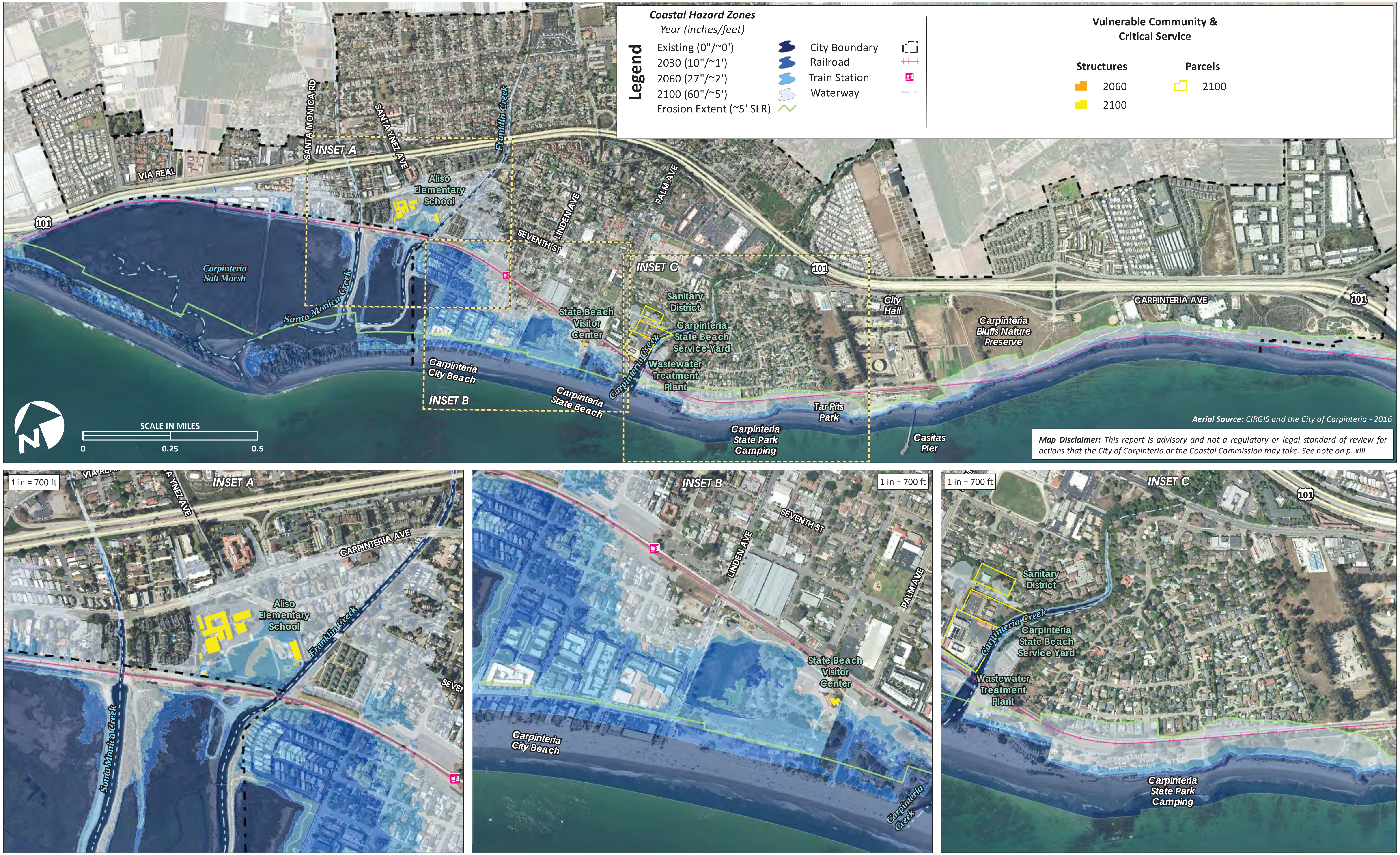
Monitoring:

- Monitor extents, depths, and frequency of tidal inundation at Aliso Elementary School.

Data Gap:

- No evacuation route information was determined.

Figure 1-10. Community Facilities and Critical Services



Environmentally Sensitive Habitat Area (ESHA)

Overview

Within the City, ESHA includes native habitats on the Carpinteria Bluffs (e.g., coastal bluff scrub), wetlands of the Carpinteria Salt marsh and Carpinteria Creek, beaches, dunes, reefs, a harbor seal rokery and monarch butterfly roosts. Coastal hazards and SLR could directly impact substantial acreage of existing ESHA in the City. Coastal flooding and cliff erosion could impact the greatest acreage of ESHA; SLR may cause transitions in wetland habitats. Impacts of climate change extend beyond sea level rise and would affect temperature, precipitation, droughts, and wildfire risk; for more information see Section 6.8, *Environmentally Sensitive Habitat Area*.

ESHA Directly Influenced by Coastal Hazards and Sea Level Rise

Hazard	Dune Erosion	Cliff Erosion	Tidal Inundation	Coastal Flooding
	Combined Acreage of ESHA Habitats			
Existing Vulnerabities	19.3	15.6	10.1	46.5
2030	1.9	3.8	1.6	7.3
2060	2.3	9.1	3.1	12.9
2100	3.0	27.1	14.6	30.2
Cumulative 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 mapping overlap; boundaries of offshore ESHA (e.g., kelp beds, subtidal reefs are not well defined).

Reporting acreages of vulnerable ESHA may misrepresent habitat vulnerability. Quantitatively predicting future habitats is challenging as there is a complex interplay of variables. As coastal hazards and SLR progress, habitats may disappear from current location (e.g., dune erosion) if strategies are implemented to protect landward resources or migrate landward if there is adapatation (e.g., managed retreat). Likely impacts to the seven types of ESHA in the City due to SLR and coastal hazards are qualitatively analyzed and summarized below.

Carpinteria Bluffs

The Carpinteria Bluffs and adjacent shoreline host many sensitive animal species, including the white-tailed kite and the harbor seal. ESHA may include the Central Coast riparian scrub, coastal sage scrub, and coastal bluff scrub. Nearshore ESHA below the Carpinteria Bluffs, consisting of rocky intertidal habitat interspersed with sandy beach, may be more frequently submerged by SLR, with accelerated bluff erosion and increased depth and duration of coastal flooding. Coastal bluff scrub habiats and bluff face wetland seeps would be directly impacted by accelerated bluff erosion associated with SLR, although such habitats may re-establish after bluff failures and retreat with eroding bluffs, depending on available space to do so. Bluff top habitats including coastal sage scrub, nonnative grassland, eucalyptus groves, Central Coast riparian scrub in Carpinteria Bluffs II, and ephermal wetlands and associated endangered vernal pool fairy shrimp in Carpinteria Bluffs III would all be threatened, with up to 360-460 feet of bluff erosion with 5’ of SLR by 2100, potentially eliminating large areas of these habitats.

Wetlands within Carpinteria Salt Marsh

High salt marsh and transitional ESHA are most vulnerable to SLR. With 1’ of SLR, vegetated high marsh habitat would begin to be more frequently inundated, converting to mudflat habitat with 5’ of SLR by 2100. This could lead to conversion of most low, mid, and high marsh vegetated habitats to subtidal habitats. Because the marsh is confined by the railroad, U.S. Highway 101, and urban development, potential for landward retreat of these habitats is limited. Sediment input from Franklin and Santa Monica Creeks at the east end of the marsh and from beaches at the marsh mouth could increase marsh surface elevations and permit some habitat adaptation in these areas. A transition of this vegetated high marsh ESHA to mudflat or subtidal habitat could affect 14 of the 16 plant species of special concern found in the salt marsh as well as species such as the endangered Belding’s savannah sparrow and others which are dependent upon vegetated marsh ESHA.

Beaches, Dunes, Tidelands, and Subtidal Reefs

Carpinteria beaches, some of which may be considered ESHA, are projected to narrow as SLR increases, even in places where sand dunes (e.g. at the State Beach) back the beach. With between 1’ and 2’ of SLR, dune erosion would accelerate and about 60% of the dry sand beaches could erode or become more frequently submerged, transitioning to intertidal or subtidal beach. With 5’ of SLR by 2100, beaches and dunes would be severely eroded and frequently inundated impacting ESHA, unless the shoreline retreats substantially landward; such retreat would require relocation of State Park campgrounds and parking lots. Loss of beach upper intertidal zone would reduce the connectivity required by species to migrate inland to survive high waves and storm conditions. Depending on shoreline landward retreat, rocky intertidal habitats may become increasingly subtidal, potentially transition to subtidal reefs.

Harbor Seal Rookery and Haulouts

The harbor seal rookery and haulout area could be more frequently inundated by tides and wave action. If coastal bluff erosion is allowed to continue unabated, the seal haulout may migrate landward with the beach; however, if the rate of SLR exceeds the rate of bluff erosion, then the beach and the haulout will be inundated for more of the tide cycle, potentially reducing or eliminating beach used for haul out.

Creek and Riparian Habitats

Carpinteria Creek is the most significant creek ESHA in the City as it is a perennial stream, supports a major rirparian woodland serves as designated Critical Habitat for southern steelhead trout, and its lagoon is a sensitive wetland that harbors an endangered fish species, the tidewater goby. Assuming adequate sediment supply from upcoast Santa Barbara Harbor continues, and maintains a beach in front, then the seasonal lagoon opening and closing should be maintained, if the beach is allowed to migrates landward. The Creeks’ riparian habitats including tall canopy, midstory, and understory -- that serve a wide variety of wildlife including birds may transition to estuarine habitats with increased seawater intrusion under SlR. With 5’ of SLR, riparian habitats south of 8th Street would be impacted by regular tidal inundation up Carpinteria Creek, which would reduce riparian vegetation. The extent of riparian habitat transition to estuarian and associated adjacent upland scrub habitat would likely correspond with extents of tidal inundation, which increases with SLR.

Native Plant Communities

Native plant communities that may be considered ESHA include: coastal sage scrub, oaks, chaparral, native oak woodland, riparian vegetation, and rare plant species. Coastal hazards and 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

The Monarch butterfly roosts within the riparian corridor of Carpinteria Creek are the most susceptible to coastal flooding hazards, and a large flood event could uproot trees and disturb habitat. The Monarch butterfly roosts in the Venoco buffer parcels along the Carpinteria Bluffs may eventually become vulnerable to coastal cliff erosion as SLR increases.

Adaptation Strategies

Range of Strategies:

Protect – Expand flood plains, augment sand dunes, and perform regular beach nourishment with sand and/or cobbles to sustain beach and dune systems, maintain seal haul out area, and reduce erosion and loss of terrestial habitats. Consider fixing the landward ocean boundary through the use of shoreline protective devices and/or increased floodwalls.

Accommodate – Use excess sediment to elevate vulnerable portions of Carpinteria Salt Marsh and protect Carpinteria Lagoon.

Manage – Coordinate with State Parks to allow beach, dune, and bluff ecosystems to migrate landward where possible or when unavoidable. As the Carpinteria Salt Marsh is largely surrounded by the UPRR, flood control levees, and concrete lined channels, consider allowing salt marsh habitat to migrate landward toward the City’s Salt Marsh Park and Aliso School. Additionally, floodplain setbacks along creek corridors could be expanded. Incorporate phased upgrading of existing walkways to raised boardwalks in order to support ESHA while maintaining use and public access.

Trade-offs: Green protection measures through floodplain setbacks, beach and dune nourishment may require frequent maintenance with higher levels of SLR, but may benefit habitats by maintaining floodplains and beach width. Gray protection using shoreline protection or floodwalls could reduce terrestrial blufftop and wetland habitat vulnerabilities but could negatively impact riparian, beach, and dune habitats and natural processes by resulting in a loss of beaches over time.

Potential Next Steps

Policy:

- For ESHA policy development affecting Carpinteria Creek, maintain hydrologic connectivity upstream and coordinate with the County, other agencies and landowners to enourage replacement/expansion of riparian woodlands in areas not impacted by SLR.
- Coordinate with the County, coastal cities, BEACON and local legislators to create sustainable funding mechanism for potential beach nourishment programs.

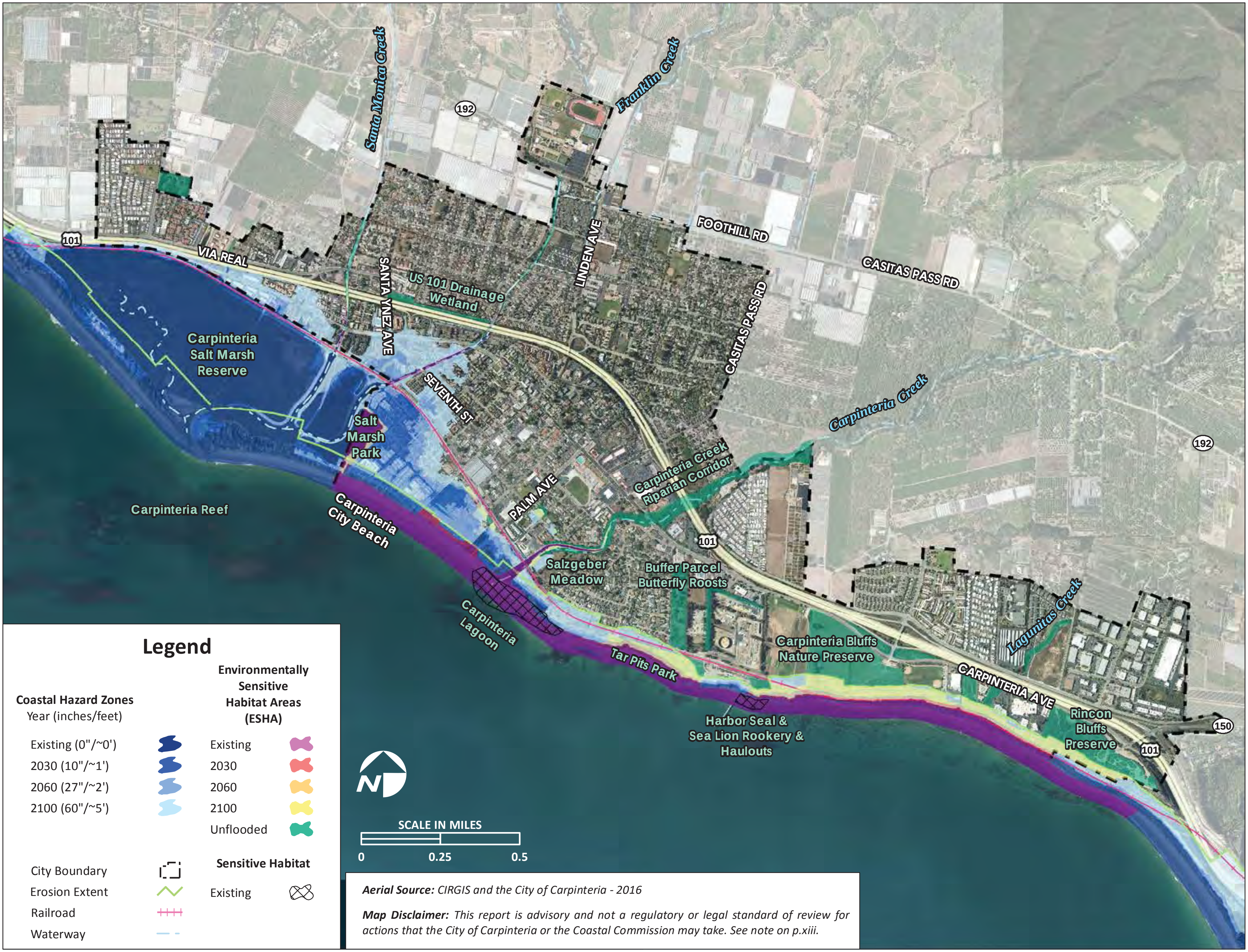
Projects:

- Improve habitat mapping in the City and vicinity.
- Restore and maintain terrestrial habits impacted by SLR (e.g., coastal bluff scrub).
- Allow more sediment from local watersheds to enter the Carpinteria Salt Marsh and littoral cell in order to provide additional material for evolutions of ecosystems.
- Support development and implementation of regional programs for beach nourishment and dune creation/ restoration.

Monitoring:

- Monitor indicators reflective of SLR (e.g., long-term trends in water levels, marsh accretion rates).
- Evaluate and identify meaningful tipping points to ensure appropriate timing and implementation of adaptation strategies.

Figure 1-11. Environmentally Sensitive Habitat Areas (ESHA)



Aerial Source: *CIRGIS and the City of Carpinteria - 2016*

Map Disclaimer: *This report is advisory and not a regulatory or legal standard of review for actions that the City of Carpinteria or the Coastal Commission may take. See note on p.xiii.*