RESOLUTION NO. 15-55

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF GOLETA, CALIFORNIA, APPROVING THE CITY OF GOLETA COASTAL HAZARDS VULNERABILITY AND FISCAL IMPACT DRAFT REPORT

WHEREAS, the risk of coastal hazards is significant for people living on the south coast of the Santa Barbara County, including the City of Goleta, due to the potential loss of life, property damage, and potential loss of natural and cultural resources; and

WHEREAS, in consideration of coastal hazards risks, the City of Goleta retained consultant Revell Coastal, LLC to assist with the development of the Coastal Hazards Vulnerability and Fiscal Impact Draft Report; and

WHEREAS, public outreach was coordinated via one public workshop on August 12, 2015, for the purpose of providing the public with information, receiving input on the development of the Coastal Hazards Vulnerability and Fiscal Impact Draft Report, and establishing climate adaptation strategies and Local Coastal Program recommendations; and

WHEREAS, future implementation of the Coastal Hazards Vulnerability and Fiscal Impact Draft Report will protect life and safety, enhance community values, and sustain natural, cultural, visual, and recreational resources; and

WHEREAS, on December 1, 2015, the City Council considered the Coastal Hazards Vulnerability and Fiscal Impact Draft Report and oral and written testimony from interested persons.

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF GOLETA AS FOLLOWS:

SECTION 1. Recitals
The City Council hereby finds and determines the foregoing recitals, which are incorporated herein by reference, are true and correct.

SECTION 2. Approving of Coastal Hazards Vulnerability and Fiscal Impact Draft Report
The City Council has reviewed the Coastal Hazards Vulnerability and Fiscal Impact Draft Report, attached as Exhibit 1, and hereby finds that the Coastal Hazards Vulnerability and Fiscal Impact Draft Report adequately addresses the risk of coastal hazards and is consistent with the City's General Plan / Coastal Land Use Plan. The City Council hereby

approves the Coastal Hazards Vulnerability and Fiscal Impact Draft Report.

SECTION 3. Documents
The documents and other materials which constitute the record of proceedings upon which this decision is based are in the custody of the City Clerk, City of Goleta, 130 Cremona Drive, Suite B, Goleta, California, 93117.

SECTION 4. California Environmental Quality Act
Approving of the informational Coastal Hazards Vulnerability and Fiscal Impact Draft Report is not a project subject to CEQA.

SECTION 5. Certification
The City Clerk shall certify to the passage and adoption of this resolution and enter it into the book of original resolutions.

PASSED, APPROVED AND ADOPTED this 1st day of December, 2015.

Paula Perotte

PAULA PEROTTE, MAYOR

ATTEST:

DEBORAH S. LOPEZ
CITY CLERK

APPROVED AS TO FORM:

TWG

TIM W. GILES
CITY ATTORNEY

STATE OF CALIFORNIA)
COUNTY OF SANTA BARBARA) ss.
CITY OF GOLETA)

I, DEBORAH S. LOPEZ, City Clerk of the City of Goleta, California, DO HEREBY CERTIFY that the foregoing City Council Resolution No. 15-55 was duly adopted by the City Council of the City of Goleta at a regular meeting held on the 1st day of December, 2015, by the following vote of the Council:

AYES: MAYOR PEROTTE, MAYOR PRO TEMPORE FARR, COUNCILMEMBERS ACEVES, BENNETT AND VALLEJO.

NOES: NONE

ABSENT: NONE

(SEAL)

DEBORAH LOPEZ
CITY CLERK

EXHIBIT 1

Coastal Hazards Vulnerability and Fiscal Impact Draft Report

Draft

2015 City of Goleta
Coastal Hazards Vulnerability Assessment and Fiscal Impact Report

Prepared by:

City of Goleta
130 Cremona Drive, Suite B
Goleta, California 93117

With Assistance from:

Revell Coastal
125 Pearl Street
Santa Cruz, CA 95060

November 2015

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Acronyms/Abbreviations

BASH	Bird Air Strike Hazards
BEACON	Beach Erosion Authority for Clean Oceans and Nourishment
CCC's	California Coastal Commission's
CEC	California Energy Commission
CIP	Capital Improvement Program
City	City of Goleta
CoSMoS 3.0	Coastal Storm Modeling System of the USGS
EMHW	Extreme Monthly High Water level
ESHAs	Environmentally Sensitive Habitat Areas
FEMA	Federal Emergency Management Agency
FIRMs	Flood Insurance Rate Maps
GHADs	Geologic Hazard Abatement Districts
IPCC	Intergovernmental Panel on Climate Change
JPA	Joint Powers Authority
LCP	Local Coastal Program
LUFTs	Leaking Underground Fuel Tanks
NAVD	North American Vertical Datum 1988
NRC	National Research Council
PDO	Pacific Decadal Oscillation
SE	Safety Element
TDR	Transfer of Development Rights
ToT	Transient Occupancy Tax
UCLA	UC Los Angeles
UCSB	University of California, Santa Barbara
US-101	U.S. Highway 101
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

Executive Summary

ES.1 Purpose

The development of a coastal hazards vulnerability assessment is the process whereby a community collaboratively seeks to understand the threat of climate-induced coastal hazards, such as sea level rise. It identifies the community's values, determines whether these values are vulnerable to damage or loss from coastal hazards, and develops a course of action for protecting those values.

The **2015 City of Goleta Coastal Hazards Vulnerability Assessment and Fiscal Impact Report** (report) provides a science-based assessment that includes extensive field data gathering, compilation of existing data and information, and the participation of stakeholders such as citizens, business owners, local organizations, and community leaders.

The purpose of this report is to enhance community planning by identifying coastal hazards and associated vulnerabilities that are in balance with fiscal resources. This information will assist the City in making more informed decisions regarding land use and development standards from the project level (e.g., coastal development permits, land use permits) to the plan level (e.g., Old Town Revitalization Plan, Community Wildfire Protection Plan, etc.).

ES.2 Definitions

Planning Horizon: The planning horizon is the future time that forecasts of climate impacts are made and the time that an organization will look into the future when preparing a strategic plan.

Vulnerability Assessment and Sector Profiles: A vulnerability assessment is the process of identifying, quantifying, and prioritizing (or ranking) the vulnerabilities in a system. There are a variety of vulnerable "sectors" within the City, ranging from building structures, oil and gas, coastal armoring, water supply, and transportation.

Fiscal Impact Analysis: A fiscal impact analysis estimates the financial impact on the City within a particular sector to the identified vulnerabilities.

Adaptation: Adaptation means anticipating the adverse effects of climate change and taking appropriate action to prevent or minimize the vulnerabilities and reduce the fiscal impacts.

ES.3 Report Overview

Planning Background

This section describes the purpose of the report, the study area boundary of planning sub-areas, existing conditions, the planning process that was conducted as part of preparation for the report, and the connection with the California Coastal Commission's (CCC's) 2015 Sea Level Rise Policy Guidance Document.

Physical Setting

This section characterizes developed areas, natural resources, creeks, coastal and shoreline areas, and elevation. Further details are provided that elaborate on the unique geology and geomorphology of the Goleta shoreline, including cliff erosion rates and shoreline change rates. A summary of the substantial shoreline alterations largely resulting from historic oil and gas development in combination with historic and current Goleta Slough inlet management practices is provided.

Climate Science

The differences between climate "cycles" and climate "change" is provided for background purposes. Projections of climate-induced impacts created by temperature and precipitation patterns, wildfire, extreme event flooding, and sea level rise is provided. Shoreline structures—including location, age, and condition of each structure—are described. Local geology and uplift are described. Five historic storm events are included in this section, with photos to visually demonstrate the local impacts of historic events that are likely to worsen over time. Federal Emergency Management Agency (FEMA) flood maps and statistics regarding repetitive flood-related losses are described. The regional context details how the Goleta-focused report relates to other regional and state climate and coastal hazards studies.

Vulnerability and Fiscal Impacts by Sector

Hazard projections and vulnerability assessment methodologies and assumptions used to model and map coastal hazards are presented for use in determining future levels of vulnerability for the various planning horizons (i.e., 2010, 2030, 2060, and 2100). The mapping of existing hazards has been based on a 2010 LiDAR topographic survey of the region. Flow pathways for flood hazards were mapped based on surface connections. In low-lying areas with unknown flow pathways, potentially connected hazardous areas are denoted as "potentially connected." Study limitations and data gaps, such as the absence of creek modeling are discussed. Coastal creek flood hazards are presented and include the following:

- Wave run-up (momentum)
- Wave flooding (ponding)
- Barrier beach flooding
- Inundation (tidal)
- Long-term and storm-induced coastal erosion

Potential impacts on urban uses and natural resources are described, based on the five coastal process hazards as the foundation for the vulnerability assessment. Based on the characteristics of the City's coastline and watersheds and input from the City and public, Revell Coastal analyzed eleven sectors in the vulnerability assessment. The sector profiles are presented in Appendix A and are discussed in more detail throughout the report:

A. Land Use and Structures: Old Town Area
B. Land Use and Structures: Coastal Resources Area
C. Coastal Armoring
D. Oil and Gas
E. Hazardous Materials
F. Natural Resources
G. Public Access
H. Transportation
I. Water Supply
J. Wastewater
K. Utilities

The fiscal impact analysis resulting from future projected sea level rise and coastal storm vulnerabilities is described, starting with the methodology, assumptions, and limitations of the analysis. Ranges of cost estimates are detailed for potential losses to infrastructure, property, buildings, economic activity, and tax revenues; as well as cleanup costs.

Adaptation Strategies by Sector

An overview of the process used to identify the adaptation strategies is presented, followed by a discussion of the proposed strategies that are intended to address Goleta-specific hazards and vulnerable assets. The interplay of maladaptation, challenges, and secondary impacts is presented to provide further context in the decision-making process. The focus is on the areas of protection, accommodation, and retreat consistent with CCC policy guidance.

Implementation

Factors to consider in order to establish priorities are detailed and include project costs, grant availability, community support, regional participation, and likelihood of effectiveness. Specific focus is on planning and financing mechanisms that the City can employ as part of implementation.

Policy and Regulatory Recommendations

This section makes recommendations based on findings of the report toward informing General Plan and Local Coastal Program policies, regulations, and future capital improvement projects in the probable event that climate change and sea level rise affect the City of Goleta (City) community and environment.

Monitoring

A timeline for implementing strategies is included, and monitoring criteria is outlined to identify thresholds of impacts and to guide future implementation. Further optional studies are suggested for the City.

ES.4 Key Findings

The following are key findings identified as a result of analyses in this report:

- Existing hazards are primarily caused by the barrier beach closure of the Goleta Slough and existing FEMA creek flooding hazards.
- Three neighborhoods face flooding impacts: the Winchester Canyon neighborhood located north of Highway 101; the Aero Camino neighborhood located just south of the 101; and the Placencia neighborhood located in the southern portion of Old Town, east of Highway 217.
- Coastal erosion will likely accelerate above historic erosion rates along the Coastal Resources Area once the existing timber seawall becomes derelict over time or is removed.
- The Goleta Slough and Devereux Slough may physically connect with one another upon experiencing 5 feet or more of sea level rise by 2100.
- Climate change impacts on future creek flooding extents, including changes to precipitation and sea level rise, have not been modeled and therefore remain a significant data gap in the vulnerability assessment, especially considering the extent of existing creek flood hazards mapped by FEMA.

Vulnerabilities by Planning Horizon

The following is a summary of the resulting vulnerabilities organized by Planning Horizons for purposes of planning, implementation, monitoring, and adaptation:

2010 (Existing) Vulnerabilities

- The Bacara Resort and Spa Beach House, in addition to the coastal public access to Haskell's Beach, is vulnerable to all existing hazards, including: creek flooding, coastal erosion, and coastal flooding. The estimated replacement and relocation costs are approximately $420,000.
- The two active Lease 421 oil wells are threatened by existing coastal hazards.
- The existing coastal armoring is severely outdated and derelict, and the structure will continue to erode and become a nuisance over time. The cost of removing this structure is approximately $1 million. The City's financial liability is approximately 25 percent of this amount, or equates to approximately $250,000.
- The City faces a serious potential threat from oils spills, both from active and inactive wells. The costs of mitigating these issues are high. The estimates range from $7.9 million to $63.2 million for capping and/or recapping the existing wells. The cost of an oil spill cleanup effort is significantly higher and equates to $257 million, based on the recent 2015 Refugio oil spill costs.
- The low-lying Placencia neighborhood and nearby roads are already susceptible to substantial flooding during closed Goleta Slough conditions and creek flooding.
- FEMA has mapped 640 acres, or 12 percent, of the City in an existing 100-year creek flood hazard zone.

2030 Vulnerabilities

(<1 foot of sea level rise)

- Most hazards in Goleta over the next 30 years will be determined by the extent that the Goleta Slough is managed from both inlet (open versus closed) and sediment management.
- Barrier beach flood hazards primarily affect structures and land uses in the Old Town Area, specifically in the Palencia neighborhood, Aero Camino, and the neighborhoods between Fairview Avenue and Highway 217.
- The Goleta West Sanitary District Pump Station and the Goleta Sanitary District Firestone Pump Station could be affected by stormwater and coastal flooding (pending a closed Goleta Slough).
- The City could lose 3,684 feet of coastal trails at the Ellwood Mesa Open Space/Sperling Preserve from coastal erosion, which would cost over $600,000 to restore.

2060 Vulnerabilities

(~ 2 feet of sea level rise)

- The Bacara Resort and Spa has six buildings that are potentially threatened by erosion around 2060. These buildings contain 139 guest rooms and one restaurant; the cost of replacing these structures is approximately $50 million. Assuming that the 139 rooms are permanently closed and not replaced elsewhere on the property, this implies a loss of $2,935 per day (or $88,058 per 30-day month) in Transient Occupancy Tax (ToT) revenues during high season and $2,051 per day/$61,530 per 30-day month during low season.
- Although the City does not have direct liability for the Leaking Underground Fuel Tanks (LUFTs), these may become an issue by 2060 (approximately 2 to 3 feet of sea level rise). The costs of mitigating are relatively low ($125,000) before hazardous materials leak into the groundwater. However, delays in requiring cleanup until after the sites have been flooded dramatically increase costs and impacts on the City to approximately $1.5 million per tank.

2100 Vulnerabilities
(~ 5 feet of sea level rise)

- By 2100, there is the potential for Goleta Slough and Devereux Slough to connect, causing the Storke Ranch development to become increasingly vulnerable.
- By 2100, the Sandpiper Golf Club will likely need to modify up to six holes on the course because of coastal erosion.
- Damages to structures reach a threshold, with the largest flood damages to the light-manufacturing sector ($9.3 million) in the Old Town Area.

Economic and Fiscal Impact Analysis Summary

The most serious economic and fiscal impacts facing the City are (by estimated dollar value of losses) the following:

- Oil spills may equate to $257 million in remediation costs.
- Oil well costs include an estimated $7.9 million to $63.2 million for capping and/or recapping the existing wells.
- Costs related to LUFTs may be between $750,000 and $10.5 million, depending on whether the tanks are leaching due to long duration floodwaters.
- Cleanup costs from one storm flood event can cost between $0.5 million and $4.5 million, depending on the storm intensity, duration, flood depths, and flood extents.
- Longer term, the risk of flood damage to private and public property increases between 2060 and 2100 to an estimated $14 million, with the majority being $9.3 million within the light manufacturing sector in Old Town Area.
- The City could adapt the road elevations using a thicker layer of asphalt (approximately 4 to 6 inches) every 10 years as part of routine resurfacing, which would reduce road flooding. The estimated costs are as follows:
    - 2030: ~$500,000
    - 2060: ~$2.2 million
    - 2100: ~$12.5 million
- To remove the derelict timber seawalls from the Coastal Resources Area, it is estimated that the City would be liable for approximately $243,440–$286,400. Other landowners would be liable for their portion (e.g., 421 road seawall equates to approximately $329,290–$387,400; Sandpiper equates to approximately $342,040–$402,400).

ES.5 Adaptation Strategies for Implementation

The following are considerations and a list of specific adaptation strategies that the City could implement to address the climate-induced hazards and related vulnerabilities:

- Recognizing the interrelated jurisdictional boundaries, it will be essential that the City participate in continuing regional dialogs related to oil spill response, coastal management, and climate change adaptation. Goleta cannot adapt to the identified vulnerabilities on its own because both of the major sloughs lie just outside the City's jurisdictional boundary. Goleta should cultivate and be engaged in regional partnerships such as Goleta Slough Management Committee and Beach Erosion Authority for Clean Oceans and Nourishment (BEACON).
- Inlet management remains key to reducing vulnerabilities. If managed for open tidal conditions, the number of vulnerable structures decreases from 129 structures to 14. This enables hybrid approaches with

structural elevation or acquisition to be cost-effective solutions.

- Coastal armoring removal and phased relocation of public access and trails will provide the best long-term protections for certain environmentally sensitive habitat areas (ESHAs) and coastal-dependent recreation in the City.

ES.6 Policy and Regulatory Recommendations

This vulnerability assessment is advisory and is not a regulatory or legal standard of review for actions that the City or the CCC may take under the California Coastal Act. This assessment provides the best available science, and is part of an ongoing process to understand and prepare for coastal hazards. The following represents the overall recommendations based on the analyses completed in this report:

- Adopt Hazard Zone Overlays based on the completed hazard mapping. The Hazard Zone Overlay would trigger the following:
  - Real estate disclosures for coastal and climate-induced hazards.
  - Triggers for a site-specific hazard report.
  - Building code revisions such as movable foundations.
  - Changes to building heights to accommodate additional freeboard elevation.
- The current cliff erosion setback policy contained in the General Plan/Local Coastal Land Use Plan: Safety Element Policy 2.1 takes a conservative approach to calculating any potential development setback. This should be improved to account for an acceleration of historic erosion rates from sea level rise and the derelict existing coastal armoring. The policy should consider that there is a natural failure distance of cliff erosion that constitutes an "existing hazard." In Goleta that distance is about 15 to 25 feet and should be used as a trigger to develop and implement a phased relocation or other suitable adaptation strategy.
- Develop rolling easements along the oceanfront cliff edge for all public trails.
- Promote outreach and education by providing signage depicting historic flooding depths and elevations.
- Encourage a balanced approach for Goleta Slough management of water levels and sediment.
- Develop a Repetitive Loss Clause Program to allow properties to be downzoned over time to accommodate increased coastal flooding and related impacts.
- Participate in establishing a regional Joint Powers Authority (JPA) with California Office of Spill Prevention and Response, State Lands Commission, Coast Guard, County of Santa Barbara Energy Division, and the City. This JPA would form a round table for oil and gas responses and lessons learned.

ES.7 Monitoring

As appropriate, development projects, coastal development permits, Local Coastal Programs, and other planning updates should incorporate an adaptive management framework with regular monitoring, reassessments, and dynamic adjustment in order to account for uncertainty. Examples include monitoring the following:

- Physical environment to identify when the City is nearing thresholds for escalating impacts from coastal hazards.
- Beach profiles and elevations around coastal armoring structures to determine

impacts on elevations on the narrower beaches in front of the structures. These should be compared with adjacent control sites.

- Structural monitoring to identify when there is an impact on beach elevations (and thus ecology and ESHAs) and lateral access.
- Sea level rise trends from local tide stations.
- Inland extent of inundation and duration of flooding.
- Biological monitoring of sensitive and endangered species.
- Habitat monitoring to understand relationships between habitats/elevation and duration of inundation.
- Support monitoring of specific climate variables that affect habitat location.
- Current climate science related to precipitation, wildfire, and temperature.
- Hydrology data, including water levels in the sloughs and stream flows in the creeks.
- Pre- and post-storm monitoring: erosion extents, high water marks, and inland locations of flooding.

ES.8 Data Gaps for Next Steps

Next steps for the City include a variety of actions, including continued coordination with other relevant partners and research institutions, such as the University of California, Santa Barbara, based on the recommended adaptation strategies and implementation mechanisms contained in this report. The following are representative of a starting point for the City:

- Initiate a coastal confluence modeling effort. This project would consider climate impacts of sea level rise and precipitation on creek flood extents. This report's vulnerability assessment understates the extents of this increasing flood risk because it currently relies on existing FEMA flood extents for a 100-year event.
- Analysis of habitat (i.e., ESHA) evolution and adaptive capacity.
- Mapping and removal plan for existing and potential relocation of oil and gas pipeline and related infrastructure locations.
- Mapping and removal plan for chemicals in LUFTs and dispersal mechanisms.

ES.9 Positive Findings

Although climate change and its related impacts present challenges for the future, it is not without hope. Some positive findings are as follows:

- School and emergency services are outside of the coastal hazards zones.
- Wildfire risk is projected to be reduced in the future, based on publicly available completed peer-reviewed climate modeling.
- The City has adequate time to implement these adaptation strategies.
- The City has relatively few structures threatened by erosion.
- The City's property tax base is reasonably safe.

ES.10 Sector Profile Results

Sector profiles that summarize the findings and recommendations that can be used in future decision-making are included in Appendix A. Each sector has its own profile, complete with a vulnerability map and 2-page description of findings for ease of communication.

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1. Planning Background

1.1 Introduction

The California Coastal Act requires local governments in the state's Coastal Zone to create and implement Local Coastal Programs (LCPs). Each LCP consists of a Coastal Land Use Plan (General Plan) and an Implementation Plan (Zoning Code). Using the California Coastal Act, the California Coastal Commission (CCC) and local governments managed coastal development, including addressing the challenges presented by coastal hazards like storms, flooding, and erosion. Sea level rise and the changing climate present new management challenges with the potential to significantly threaten many coastal resources. One of the CCC's priority goals is to coordinate with local governments, such as the City of Goleta (City), to complete a LCP in a manner that addresses sea level rise.

In order to address sea level rise and associated hazards in the City's LCP project, the City and its consultant prepared this **2015 City of Goleta Coastal Hazards Vulnerability and Fiscal Impact Report** (report). The purpose of this report is to provide technical analysis using climatic modeling and fiscal impact analysis to support the City's effort to incorporate a range of coastal and climate change hazards into the City's planning and regulatory processes. This information will assist the City in making more informed decisions regarding land use and development standards from the project level to the plan level.

1.2 Location

The City is located in Southern California on the South Coast of Santa Barbara County, approximately 100 miles northwest of Los Angeles and 10 miles west of the City of Santa Barbara. The City is situated along U.S. Highway 101 (US-101), the major coastal highway linking the northern and southern portions of the state. Goleta lies within a narrow coastal plain of exceptional natural beauty between the Santa Ynez Mountains and the Pacific Ocean. A portion of the City, including its 2-mile Pacific shoreline, is within the California Coastal Zone. Incorporated in February 2002, the City approved its General Plan on October 2, 2006, with the last amendment approval occurring in 2009.

The Coastal Zone and City boundaries are shown in Figure 1-1, *City of Goleta Overview*, along with neighboring jurisdictions. The adjacent jurisdictions include the following: City of Santa Barbara (Airport), County of Santa Barbara, and the University of California, Santa Barbara (UCSB). The Coastal Zone in Goleta can largely be separated into distinct landscapes. To the west, the Ellwood Mesa rises along the coast, with most of the Coastal Zone remaining rural open space in public ownership, converted from historic oil and gas development (Figure 1-1 and Photo 1-1). To the east and inland, the more residential and urbanized portions of the City are encompassed in the five watersheds that drain into the low-lying Goleta Slough.

Photo 1-1. 1930 Oblique of Ellwood Mesa (Photo: Spense Collection UCLA 10/30/30)

1.3 Existing Conditions

The Goleta coast is situated within the Santa Barbara Sandshed (watershed + littoral cell), which extends 145 miles from the Santa Maria River in the north and around Point Conception, where the north-south–trending U.S. West Coast takes an abrupt turn to a west-east–trending shoreline orientation into the Southern California Bight (Figure 1-1).

Point Conception in the northwest and the Channel Islands to the south create a narrow swell window that shelters much of the south-facing coast of Santa Barbara County from extreme wave events. Winds and wave heights vary seasonally. The focus of waves into the Santa Barbara Channel drive an almost unidirectional longshore sediment transport from west to east in which beaches narrow during the winter and spring (November to April) and widen during the summer and fall (May to October). The sand found on the beaches of Goleta move along the coast of southern Santa Barbara and Ventura Counties to the Point Mugu submarine canyon in the south. Extensive coastal armoring along this south-facing coast reflects the recurrence of historic coastal hazards.

Because of the many creeks running from the mountains to the coast through the City, the CCC has appeal jurisdiction in many areas in addition to the typical Coastal Zone. The unique

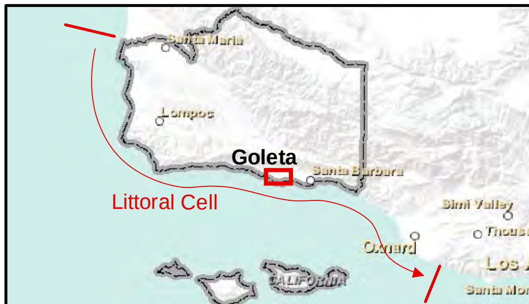
Figure 1-1. City of Goleta Overview

City Boundary

Coastal Zone Boundary

CITY OF GOLETA

REVELL COASTAL
Surf. Sand. Sustainability.



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Goleta Coastal Zone boundary is partially attributed to revisions in the California Coastal Act pertaining to the Devereux Lagoon and Goleta Slough areas, with approximately 170 acres being excluded and 245 acres added to the Coastal Zone. While Coastal Zone restrictions may not mean the end for urban growth in Southern California, sea level rise and other climate-related projections could lead to changes in land use and zoning regulations that require adaptability in new development. For instance, changes in building height restrictions and rolling easement language can allow for development to occur while anticipating future hazards, such as storm surges. Significant upwelling along the coast of Southern California provides nutrient-dense waters, contributing to unique and abundant marine biodiversity.

As climate change shifts temperature, precipitation, and vegetation ranges, species that previously inhabited this area may face increasing difficulty in finding suitable habitat. Species with restricted ranges are acutely sensitive to changes in abundance, distribution, and timing of growth or life stages and will require intervention to continue living in these altered biological systems. For marine species, ocean acidification is an additional stressor (Climate Change Indicators Report 2013).

Episodic, cool winter storms and hot, dry summers characterize the Mediterranean climate of this region. Precipitation is variable, but averages about 28 inches in the mountains and 15.7 inches across the coastal plains. Rainfall primarily occurs in the winter months, with actual rainfall amounts varying widely depending on tropical moisture in the subtropical Pacific. El Niño conditions can increase this subtropical moisture; many of the wettest years on record occurred during El Niño years.

1.4 Planning Sub-Areas

Coastal Resource Area

The City's coastline is located in this Coastal Zone area. This planning sub-area consists of beaches, mesa top grassland, eroding cliffs, and two wetlands. It also contains the Ellwood Mesa Sperling Preserve, the Coronado Butterfly Preserve, and the Ellwood On-Shore Facility. This area provides habitat for sensitive species, opportunities for recreation, coastal access, and the only coastal resort, the Bacara Resort and Spa.

Northwest Residential Area

This area enjoys scenic views of adjacent open spaces, creeks, the ocean, and agricultural lands. There is an elementary school, a high school, and a private school in the area, along with the Winchester neighborhood. There are also several parks and open space areas, such as Evergreen Park, Bella Vista Park, and Winchester Open Space.

Southwest Residential Area

The western portions of this area are partially in the Coastal Zone. The area borders the Ellwood Mesa Open Space area and subsequently has a variety of protected scenic views. The area as a whole primarily consists of residential areas and contains Girsh Park.

Old Town

Old Town, situated along the primary thoroughfare (Hollister Avenue), is the historic center of the City and characterizes the small-town character of the City. It consists of commercial, industrial, light manufacturing, residential, and open space areas. The industrial area and a mobile home park are within the Coastal Zone. Like the Central Area, it borders the City of Santa Barbara's airport property.

1.5 Goleta Local Coastal Program

In 2014, the City initiated the LCP. The intent of this report is to meet Steps 1–4 of the CCC policy guidance (Figure 1-2).

Figure 1-2. California Coastal Commission Guidance for Including Sea Level Rise into Local Coastal Programs (Source: CCC 2015)

1.6 The Planning Process

LCP Stakeholder Meeting

The City hosted an LCP stakeholder meeting on February 11, 2015. This meeting was targeted at property owners and related community members that have an interest in land use and natural resources within the Coastal Zone.

California Coastal Commission Staff Consultation

The City has been in consultation with the CCC throughout 2015 regarding the City's draft Coastal Land Use Plan and related elements. Several of the elements (Safety and

Conservation) contain sea level rise, coastal hazards, and climate adaptation policy language. The elements have been drafted and reviewed by the CCC's technical staff, including its Coastal Engineer, Lesley Ewing. Upon adoption of this report, the final draft policies will be submitted to the CCC for consideration.

Coastal Hazards Public Workshop

As part of the development of the report, City staff has engaged the public, decision-makers, and various City departments. On August 12, 2015, a public workshop was held to provide an overview of the draft report results and related adaptation strategies. Staff sought and received input on the coastal hazards areas that would be most impacted and what possible adaptation strategies could be effectively applied and at the most appropriate time. The community desired a separation of sectors (e.g., coastal armoring, water supply, oil and gas) to better summarize the most relevant issues.

City Departmental Briefing

On August 12, 2015, a City departmental meeting was held with both directors and staff in attendance to review the draft report results. The City sought and received input regarding strategies and findings as they related to each of the departments' prioritization of strategies. It was determined that flooding and emergency management was the highest priority to City staff.

Planning Commission and City Council Briefings

Planning Commission briefings occurred on February 23, April 13, June 22, and October 12, 2015. City Council briefings occurred on February 17 and September 15, 2015. The presentations provided the opportunity for an in-depth overview of the sea level rise/coastal hazards, hazard mapping, vulnerability assessment, fiscal impact analysis, and possible climate adaptation strategies for the City. Some of the discussion focused on the CCC's adopted 2015 Sea Level Rise Policy Guidance and the need to incorporate those results and steps into the LCP to garner CCC support.

1.7 2015 California Coastal Commission Sea Level Rise Policy Guidance

In August 2015, the CCC adopted the Sea Level Rise Policy Guidance to aid jurisdictions in preparing for sea level rise in LCPs, Coastal Development Permit, and regional strategies. The document outlines specific issues that policymakers and developers may face as a result of sea level rise, such as extreme events, challenges to public access, vulnerability and environmental justice issues, and consistency with the California Coastal Act. The policy guidance document also lays out the recommended planning steps to incorporate sea level rise into the legal context and planning strategies to reduce vulnerabilities and inform adaptation planning (Figure 1-2).

The policy guidance has a strong emphasis on incorporating coastal hazards and sea level rise into LCP planning and using soft or green adaptation strategies. The following are specific steps that are outlined in the document:

Step 1. Establish the Projected Sea Level Rise Ranges

Consistent with the CCC policy guidance, the City is evaluating a worst-case scenario: the 60.2 inches by 2100 scenario projected by the National Research Council (NRC) for South of Cape Mendocino. With regional subsidence and uplift taken into consideration, Goleta can expect between 0.04 and 10.2 inches of sea level rise by 2030, between 2.8 and 27.2 inches by 2060, and between 10.6 and 60.2 inches by 2100 (Table 1-1). The City has selected 2010, 2030, 2060, and 2100 as the most relevant planning horizons because these time horizons align with the City's future General Plan buildout (2030) as well as consistency with the County of Santa Barbara and UCSB's time horizons and availability of coastal hazards modeling results. 2010 represents the most recently flown LIDAR for the Santa Barbara coastline and therefore is the baseline for this analysis.

Table 1-1. Sea Level Rise Scenarios by Planning Horizon without Vertical Land Motion (adapted from NRC 2012)

Year	Low SLR	Medium SLR	High SLR*
2030	0.04 inches	3.5 inches	10.2 inches
2060	2.8 inches	11.8 inches	27.2 inches
2100	10.6 inches	30.7 inches	60.2 inches

Step 2. Identify Potential Impacts from Sea Level Rise

Based on the 2015 Santa Barbara County South Coast Modeling and Vulnerability Assessment Report, the potential hazards for the City include dune erosion, cliff erosion, coastal flooding, wave run-up, tidal inundation, and storm erosion. Given the boundaries and setting of the City, the two most dominant hazards are 1) the flooding associated with a closed lagoon and 2) coastal erosion. It should also be noted that the influence of sea level rise on creek flood extents is unknown. We based our initial analysis on the existing Federal Emergency Management Agency (FEMA) flood maps and recommend future work to accomplish modeling of the climate impacts on coastal creek flood extents.

Step 3. Assess the Risks and Vulnerabilities to Coastal Resources and Development

The following sectors were determined to experience some form of existing or future risk and related vulnerability to sea level rise (e.g., dune erosion and/or coastal flooding):

A. Land Use and Structures: Old Town Area
B. Land Use and Structures: Coastal Resources Area
C. Coastal Armoring
D. Oil and Gas
E. Hazardous Materials
F. Natural Resources
G. Public Access
H. Transportation
I. Wastewater
J. Water Supply
K. Utilities

Step 4. Identify Adaptation Measures and LCP Policy Options

Consistent with the CCC policy guidance, the City has included adaptation measures such as a repetitive loss clause program, setback requirements, real estate disclosures, phased removal, and hazard overlays. Results from this report will be used to further refine these policies. The City is also actively seeking ways to generate financial incentives and generate revenues to support risk reduction and removal of nuisance structures.

Step 5. Draft New LCP for Certification with the California Coastal Commission

Following additional public outreach and the resulting revisions, the City will incorporate these adaptation strategies, via policy and regulatory language, into the Draft LCP for submittal and final plan certification by the CCC.

Step 6. Implement, Monitor, and Revise as Necessary

The science and models can be further refined, necessitating an updated report. As adaptation measures become increasingly common, certain strategies may stand out against others as being more feasible to implement with minimal economic costs and legal issues.

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2. Physical Setting

2.1 Geology

Complicated tectonics shape Goleta's coastline with varying levels of uplift and subsidence. This faulting results in a diverse backshore with uplifted marine terraces of varying thicknesses underlain by the Monterey Formation, which is a calcareous deposit subject to minor landslides (Minor et al. 2009). The majority of the Coastal Resources Area cliffs are composed of Monterey Formation with steeply dipping cliffs. This geologic unit is relatively steep and not as conducive to catastrophic rotational landslide failures seen elsewhere in Santa Barbara County (e.g., the Mesa). Several creeks at Bell Canyon and Tecolote Creek have incised these marine terraces. Offshore, the Monterey Formation remains the dominant geology off of the Ellwood Mesa; however, just east of the City, multiple submarine landslides have been mapped at the mouth of many of the creek drainages, whereby highlighting the risk of a localized tsunami hazard generated from nearby submarine landslides.

The faulting is also responsible for the two major sloughs adjacent to the City boundary. Both Devereux and Goleta Sloughs lie outside the City boundary but clearly fall within the City's Sphere of Influence, as City policies could influence water, sediment, and habitat resources in these systems. These wetland systems also pose flood hazard risks and affect water and sediment transport across the landscape. Sea level rise will affect the beach elevations, which would in turn affect the extents of inland flood extent.

2.2 Geomorphology

Geomorphological information for the study area was collected through a combination of 1) field data collection completed by Dr. David Revell and funded for this specific LCP update, 2) review of existing scientific literature; and 3) consultation with Steve Campbell, P.G. and other local experts, including Dr. Larry Gurrolla and Dr. Edward Keller.

Beach sediments in the region are primarily composed of bedrock platforms of the underlying Monterey Shale Formation with a base layer of cobbles and a thin veneer of beach sand. Cobbles and bedrock are often seasonally exposed in the wintertime. Sand comes primarily from stream delivery of watershed-derived sediments and some cliff erosion. Beaches and shoreline position have oscillated through time, but generally show a relatively stable width and position.

Beach elevations are a result of sea level, tides, and waves. These elevations also vary seasonally. During the late summer and fall, beach berm crest elevations and toe of cliff elevations are around 10 to 11 feet North American Vertical Datum 1988 (NAVD). These field-surveyed elevations are consistent with other beach profile surveys collected by the U.S. Geological Survey (USGS), Beach Erosion Authority for Clean Oceans and Nourishment (BEACON), and Coastal Frontiers. Field-surveyed measurements of the geomorphology have identified that toe elevations are slightly lower in front of the remnant shoreline armoring than on natural beaches.

Beach slopes, which affect wave run-up, were also measured and show a range between 0.07 and 0.12, moderate beach slopes. These slopes are consistent with other field-surveyed beach profiles by USGS, BEACON, and Coastal Frontiers. No bedrock platform slopes, which underlie the beaches, were exposed at the time of the field survey; therefore, measurements of these platform slopes remain uncertain.

Bar-built estuaries such as those found near the inlets to Tecolote Creek and the beach berm crest in front of these creek mouths largely control Bell Canyon Creek. Cobbles comprise the majority of the beaches fronting these lagoons (Photo 1-2). During the dry season and low wave energy time period (typically summer and fall), the beach will naturally close the estuary, which results in a bathtub-like filling of the lagoon. During the rainy season (typically winter and spring), the creek will naturally breach the beach and flow into the ocean, lowering the estuary water levels. As the flood extents are related to the elevation of the beach berm crest, any climate-related changes to either sediment supply or increase in wave run-up elevations will alter the beach berm crest elevations and potentially increase the flood depths and spatial extents. Changes in these flood extents will largely depend on management actions of the Goleta Slough that are largely outside the jurisdictional control of the City.

Photo 2-1. Cobble and Sand Beach Fronting the Bell Canyon Creek (Photo: D. Revell)

Cliff heights vary along the City coastline and range from 60 to 100 feet NAVD88, according to the field study. In general, the highest cliffs are at the west end of the Ellwood Mesa where the Bacara Resort and Spa is located and shorten as one moves east toward the Devereux Slough.

The size of the landslides in the sea cliffs largely depends on the height of the cliff and dip (angle of internal bedding) of the rock unit. Along the cliffs in the City, the dip generally ranges from 55 to 75 degrees, although there are some slopes as shallow as 45 degrees. As the cliffs are relatively steep, the large rotational landslides seen along Hope Ranch and More Mesa, located in Santa Barbara County, are not as likely in the City of Goleta.

Cliff erosion rates are often reported in “average annual retreat”; however, cliffs rarely fail in an average sense. Instead, characteristic behavior includes a cliff failure of some distance with the material from the failure accumulating at the base of the cliff. However, many of the calculations for setbacks require reporting of “average annual rates” of erosion. These have been updated from previous studies and are broken out into “cliff erosion rates” and “shoreline erosion rates.” Future land use policy should consider that there is a natural failure width that constitutes an “existing hazard.” In Goleta that distance is about 15 to 25 feet.

2.3 Cliff Erosion Rates

Historic long-term cliff erosion rates were calculated along the Coastal Resources Area along the Ellwood Mesa. These rates were based on multiple shorelines, including those from USGS (Hapke and Reid 2007), and updated with a 2010 cliff edge derived from recent LIDAR data. Linear regression rates of erosion rates were calculated between 1933 and 2010 and were found to range between 0 inches per year and 11.4 inches per year. Caution must be taken when using these rates as the toe or base of the sea cliffs in this area is largely protected by the remnants of oil and gas infrastructure, namely a timber seawall that was backfilled and has protected the toe of the cliffs from wave attack. This timber wall is in relatively poor condition, as documented in the Beach Hazards section in the General Plan and other field mapping conducted for the LCP. Therefore, it is likely to fail in the next decade (Photo 2-2). Once the timber wall and artificial fill are eroded, then the erosion rates of the cliff will likely increase to a more normal background rate. This background rate is anticipated to accelerate over time as sea level rise increases the duration of wave attack at the toe and the cliff face. Modeling currently in process as part of the Santa Barbara County Coastal Resilience Project should assess the accelerated rate of cliff retreat.

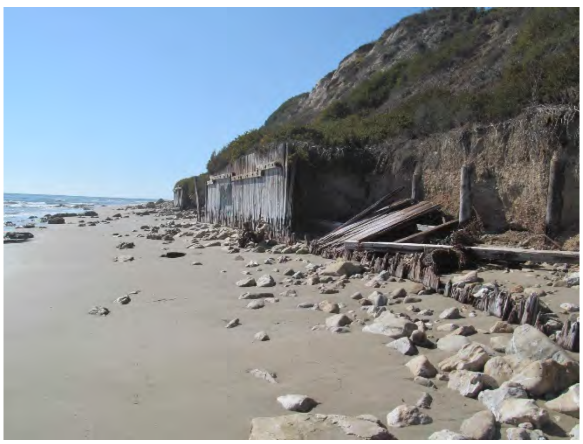

Photo 2-2. Condition of 1930s-Era Coastal Armoring along Goleta Coastline

2.4 Shoreline Change Rates

Multiple historic shoreline change rates were calculated along the Coastal Resources Area, using historic aerial photo analysis to document changes in beach widths. Overall, the beaches along this area showed oscillations through time with no overall trend in narrowing and no strong trend of erosion in any of the shoreline reference features (Revell and Griggs 2006, Revell 2007, Barnard et al. 2009).

For the time period between 1929 and 2005, the back of the beach shoreline changed between 2.7 inches/year of erosion and 11.4 inches of accretion. The mean sea level shoreline demonstrated additional variability, as one would expect, with ranges from 9 inches/year of erosion to 6.3 inches/year of accretion. After including shoreline position information from the 1871 topographic sheet, the Mean Sea Level shoreline showed accretion of between 0.7 and 8.3 inches per year. These patterns of shoreline changes are consistent with findings along much of the Santa Barbara Channel beaches. In summary, beaches oscillate based on occurrences of large erosional wave events, sediment deposition following flood events, and periods of accretion during extended periods of time with reduced wave energy (Revell and Griggs 2006, Revell 2007, Barnard et al. 2009).

2.5 Human Alterations to the Shoreline

Historic Uses

The coastline along the City experienced substantial alterations largely resulting from historic oil and gas development dating back to the 1920s. Most notably are the remnants of an old timber sheet pile wall that was built on the beach and backfilled to provide driving access to the host of oil piers that once lined this coastline.

Survey work measuring the back of beach toe elevations in front of the remnant seawalls constructed during previous oil industry activities showed that these elevations were slightly lower than the elevations of unarmored sections of coast. The armored back of beach elevations were consistently around 9.5 to 10 feet NAVD, which is 0.5 to 1.5 feet lower than the unarmored beaches along the City’s shoreline. These are consistent with impacts of structures that interact with wave run-up more frequently and disrupt the normal wave run-up depositional process (i.e., active erosion).

The poor condition and advanced age of these structures indicate that failure is imminent and that once these walls fail and the road fill is eroded, cliff erosion rates will escalate beyond historic levels of erosion that are calculated and reported in average annual erosion rate methods above. The actual timing of the failure of these structures and the erosion of the road fill will depend on the sequence of large storm events and the availability of continued sediment supply from up-coast sources.

The management implication of these human alterations' influence on historic erosion trends is that additional setbacks may be required should additional bluff top development be considered. The countywide modeling work will consider the acceleration of erosion rates from sea level rise and attempt to document a natural rate of erosion. Presently the City's Coastal Bluff setback requires using 1.3 feet/year of erosion, which is greater than that documented in the historic shoreline change analysis. Therefore, setback policies remain a conservative estimate of future coastal erosion impacts.

Inlet Management

Presently, all of the sloughs and lagoons within the City form at the mouth of Tecolote and Bell Canyon Creeks. During the summer, reduced wave energy and stream flow cause the sand bars to close and remain closed for many months. This is the natural functioning of these unique bar built estuary ecosystems, which typically breach once substantial precipitation causes them to open. Regionally, however, inlet management of Goleta Slough has changed. For much of the last 30 years the inlet has been mechanically reopened within 2 weeks of closure by the Santa Barbara County Flood Control District to reduce localized flooding, maintain dissolved oxygen levels in the Slough, reduce Bird Air Strike Hazards (BASH), and to minimize viable mosquito breeding habitat (Photo 2-3). In 2012, however, the U.S. Fish and Wildlife Service (USFWS) stopped this inlet opening management practice over concerns for endangered species, notably the Southern Steelhead trout, and the Tidewater Goby. Ongoing studies and consultation with resource agencies and the City of Santa Barbara Airport leave this inlet management question presently unresolved.

Photo 2-3. Goleta Slough Inlet Breaching, 2014 (Photo: Patrick Bermond, City of Santa Barbara)

3. Climate Science

3.1 Climate Cycles

Climate change is not to be confused with climate cycles, which also operate independently of human-induced climate change. Some of these climate cycles occur at long time periods and are related to the orbit of the earth around the sun, the tilt of the earth on its axis, and precession (subtle shift) of the earth's orbit. These Milankovitch cycles occur at approximately 41,000, 120,000, and 400,000 years and are responsible for the Ice Ages observed in the geologic record.

Some of these climate cycles are shorter; the most commonly known cycle is the El Niño/La Niña cycle, which is related to changes in equatorial trade winds and shifts in ocean temperatures across the Pacific Ocean. An El Niño brings warmer water to the Eastern Pacific, and this shift in ocean temperatures elevates sea level rise by about a foot above predicted tides in the Santa Barbara Channel. These warmer ocean temperatures can increase evaporation, resulting in more atmospheric moisture and often substantially more precipitation. The 1982–1983 and 1997–1998 El Niños have caused both river and coastal flood damages across the Santa Barbara County region. The January 1983 wave event is considered to be the largest storm recorded in the Santa Barbara Channel.

One other climate cycle that impacts the Goleta area is the Pacific Decadal Oscillation (PDO), which is an approximately 25–30-year cycle that changes the distribution of sea surface temperatures across the Pacific. Its effects were first noticed by fishery researchers in Washington (Mantua et al. 1997). The result of this ocean temperature shift is largely a shift in the jet stream. During the warm phase, the jet stream changes the storm track toward the south, affecting both the wave direction (increase in wave energy into the Santa Barbara Channel) and precipitation. At present, the index has been on the cool side, which tends to lead to less precipitation in Goleta. One other implication of the PDO is that the rate of sea level rise is reduced in the Eastern Pacific (off the U.S. West Coast). Recent PDO research indicates that a shift in the PDO would likely result in much more rapid rise in sea levels off the U.S. West Coast than has been seen in the last three decades (Bromirski et al. 2011).

3.2 Climate Change

Human-induced climate change is a consequence of increased greenhouse gas emissions from the burning of fossil fuels that accumulate in the atmosphere and insulate the earth from outgoing long-wave radiation. As this atmospheric emissions blanket gets thicker, more heat is trapped in the earth's atmosphere, warming the earth and triggering a series of climate changes related to different feedback mechanisms. Once set in motion, many of the climate change feedbacks take centuries to millennium to stabilize.

Globally, sea levels are rising as a result of two factors related to increasing temperature caused by human-induced climate change. The first factor is the thermal expansion of the oceans. As ocean temperatures warm, the water in the ocean expands and occupies more volume, resulting in a sea level rise. The second factor contributing to eustatic (global) sea level rise is the additional volume of water added to the oceans from the melting of mountain glaciers and ice sheets. It is predicted that if all of the ice were to melt on earth, ocean levels would rise by approximately 220 feet above present-day levels. The rate at which it rises will largely depend on the feedback loop between the melting of the ice, which changes the land cover from a reflective ice surface, and the open ocean water, which absorbs more of the sun's energy and increases the rate of ice melt.

3.3 Climate-induced Impacts

Temperature

Temperature increase, one of the primary impacts of climate change, is caused by the increase in greenhouse gases in the atmosphere, which traps more heat. Temperature changes can cause health risks associated with increases in extreme heat days, increase the length of warm period heat waves, increase the length of droughts, and force existing habitats and species to move to more suitable, cooler habitats.

Rainfall patterns will change and vary regionally, with winter and spring rainfall in the northern U.S. expected to rise and rainfall in the Southwest, including California, to decrease, particularly in the spring. Even as overall precipitation in the Southwest is projected to decrease, the number of heavy rainfall events is anticipated to increase (Walsh et al. 2014).

Future temperature projections for the Goleta Valley show that average annual temperatures are expected to rise by between 2.2° and 3.2°F by 2030, 3.9° and 4.9°F by 2060, and 4.5° and 5.3°F by 2100 (Figure 3-1). The projected increase in temperature in the Goleta Valley would not be uniform throughout the year. The wintertime (January) and summertime (August) temperatures are projected to rise at different rates than the average annual changes. January temperatures are projected to rise between 1.9° and 2.1°F by 2030, 3.4° and 3.7°F by 2060, and 3.6° and 5.9°F by 2100. In contrast, August temperatures are projected to rise between 2.1° and 3.4°F by 2030, 3.4° and 5.5°F by 2060, and 6.3° and 8.1° by 2100. In summary, temperature projections show an increase in temperature throughout the year with the summer (August) showing the greatest increase up to 8.1° by 2100.

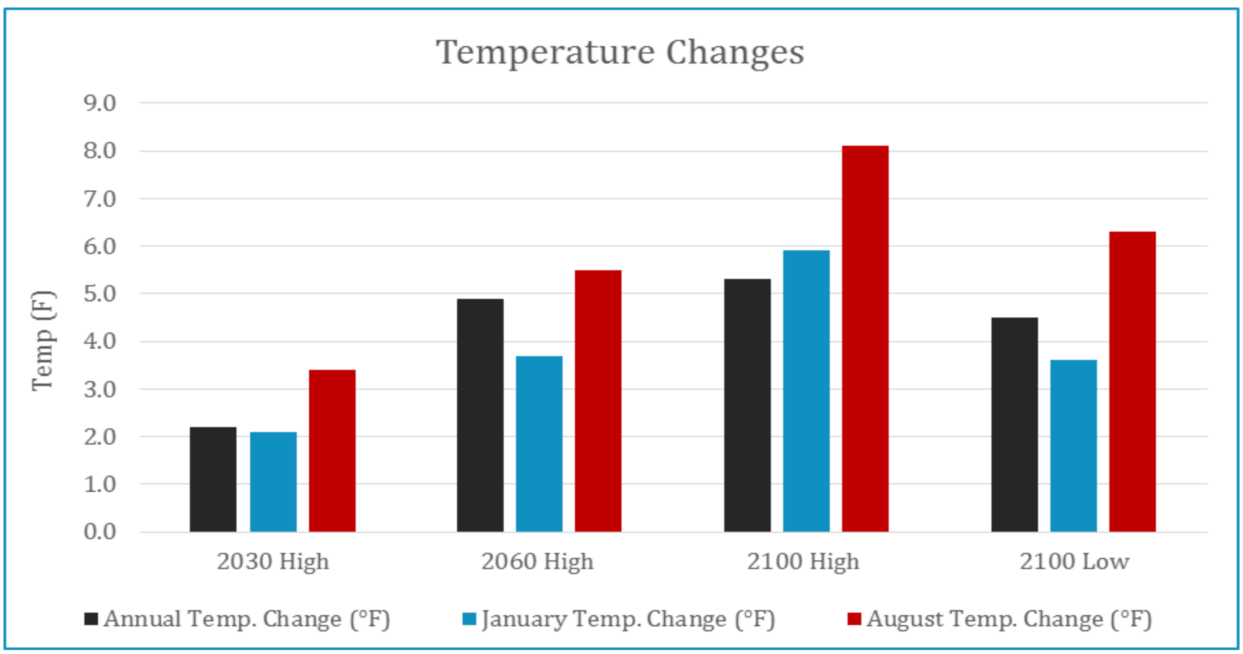

Figure 3-1. Projected Temperature Changes in Goleta (Source: Cayan et al. 2009)

Extreme heat in Goleta is defined as a day between April and October that temperatures are above 79°F (Figure 3-2). The historical average for the time period from 1961 to 1990 was 4 days between April and October with an average length of the extreme heat waves of 1 day. By 2030 models project between 17 (low scenario) and 25 (high scenario) days per year with the duration of the heat waves increasing up to 6 consecutive days a year. By 2060, a projection of extreme heat days ranges from 27 to 42 days between April and October with an estimated increase in the length of heat waves up to 7 consecutive days. By 2100, projections of extreme heat waves increase up to between 35 and 87 days between April and October with further increase in the length of the heat waves up to 20 consecutive days.

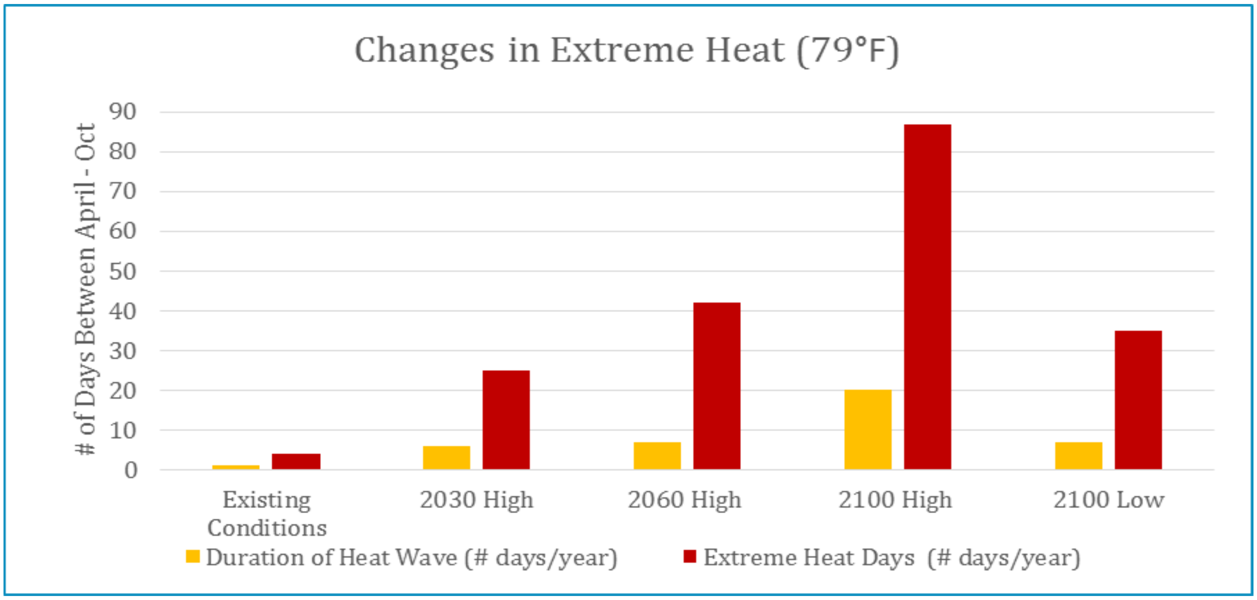

Figure 3-2. Projected Extreme Heat and Duration of Heat Waves (Source: Cayan et al. 2009)

Precipitation and Wildfire

Another climate change impact will likely be in precipitation; the amount of moisture in the atmosphere can either increase or decrease based on the amount of temperature changes affecting evaporation and changes in humidity. Precipitation and temperature also affect the wildfire risk. Increased precipitation increases plant growth, thereby adding more fuel, and increases in extreme heat can reduce vegetative growth (Figure 3-3). Changes in both precipitation and wildfire are relative to percent changes from the time period between 1961 and 1990.

However, the precipitation variable (and thus the changes in wildfires that are dependent on precipitation) is one of the least certain of the climate change impacts. Models can vary widely, and this is an area of active research. Results in this section come from modeling completed in 2009. Ongoing active research at Scripps Institution of Oceanography and UCSB continue to investigate these two climate change variables and are expected to be available as part of the Coastal Ecosystem Vulnerability Assessment, funded by California Sea Grant and expected to be available by the end of 2016.

Precipitation in the Goleta Valley is projected to experience a long-term decline through 2100. By 2030, the precipitation projections range from an increase of 1.6 percent to a decrease in 5.6 percent. By 2060, precipitation is projected to decline between 12.8 percent and 24.0 percent. By 2100, the precipitation is projected to decline between 6.7 percent and 24.0 percent. In general, the pattern is for declining amounts of annual precipitation, longer droughts, and more extreme events.

One positive climate change projection is that wildfires in the Goleta Valley are projected to experience a long-term decline from the historic period of 1961 and 1990. By 2030, wildfire is projected to decrease between 10 percent and 15 percent. By 2060, the wildfires are projected to decline between 20 percent and 25 percent, and finally by 2100 the wildfires are projected to decline by 20 percent to 30 percent. While this finding is a bit counterintuitive, the decline in precipitation is likely to reduce the amount of vegetative growth, which reduces the fuel load available for wildfires.

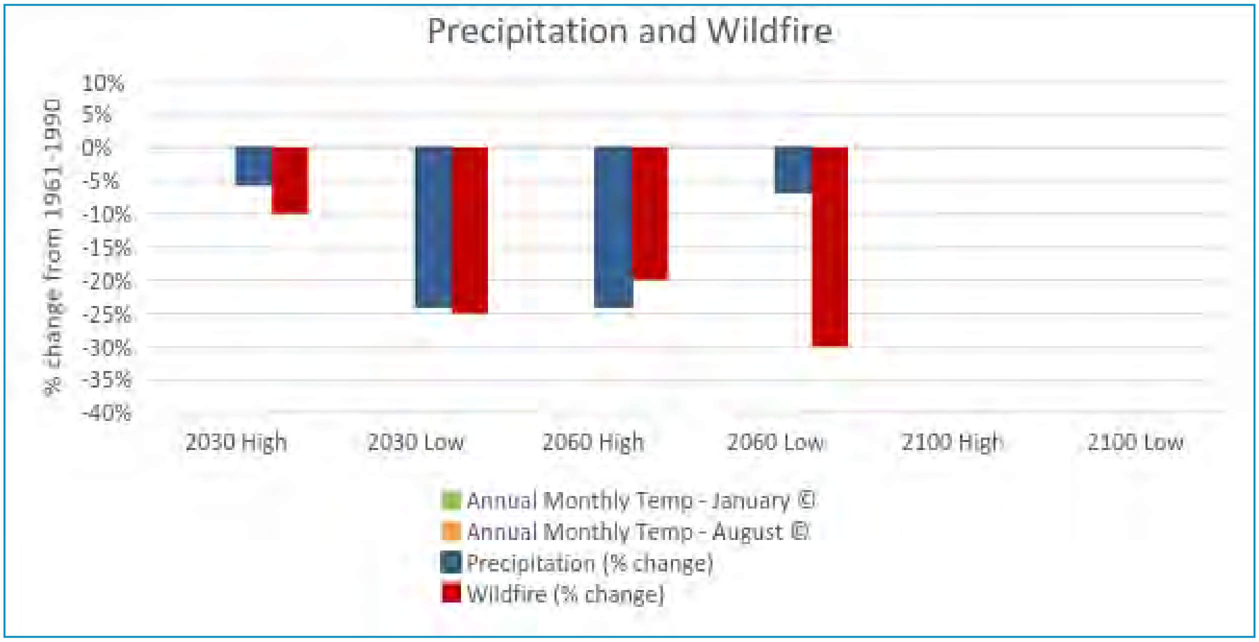

Figure 3-3. Precipitation and Wildfire

Sea Level Rise

Sea level rise can increase flood risks in low-lying coastal areas and areas bordering rivers. A 5-foot increase in water levels caused by sea level rise, storms, and tides is estimated to affect 499,822 people, 644,143 acres, 209,737 homes, and $105.2 billion of property value in coastal areas (Climate Central 2014).

The time scales for sea level rise are related to complex interactions between the atmosphere and the oceans and the lag times associated with the stabilization of greenhouse gases in the atmosphere with the dissolution of those gases into the ocean. The Intergovernmental Panel on Climate Change (IPCC) has published scientific evidence that demonstrates that, due to the greenhouse gases already released into the atmosphere, the sea levels will be rising for the next several thousand years. Given this long-term perspective, it is not a question of if sea level rise will happen, but when it will happen.

Sea level rise scenarios used in this analysis were selected consistent with the CCC's 2015 Sea Level Rise Policy Guidance (CCC 2015) and consistent with the science published by the National Research Council (NRC 2012) for areas south of Cape Mendocino (where the faulting and vertical land motion change) (Table 1-1). One specific difference in the Goleta Valley is the use of local vertical movement measurements that have been documented by geology researchers at UCSB (Gurrolla et al. 2014).

Relative Sea Level Rise

Sea level rise is not the same everywhere around the world. Because of local differences in tectonic uplift; subsidence caused by oil, gas, and groundwater extraction; and saltwater intrusion, the land itself is moving vertically. The difference between the local land motion and the global rise of sea level gives the relative sea level rise that will determine the magnitude of local sea level rise impacts. Vertical land motion in some studies would identify this relative rate from local tide gages. However, the nearest Santa Barbara Tide Gage, which reports the local sea level rise rate at a rate of approximately 0.73 (+/-1.2) millimeters per year, has a sporadic historical record (Figure 3-4). Since the tide gage was installed in the mid-1970s, nearly every major El Niño has broken the gage and consequently left a 7- to 10-year data gap, rendering the relative sea level rise calculations from the tide gage suspect.

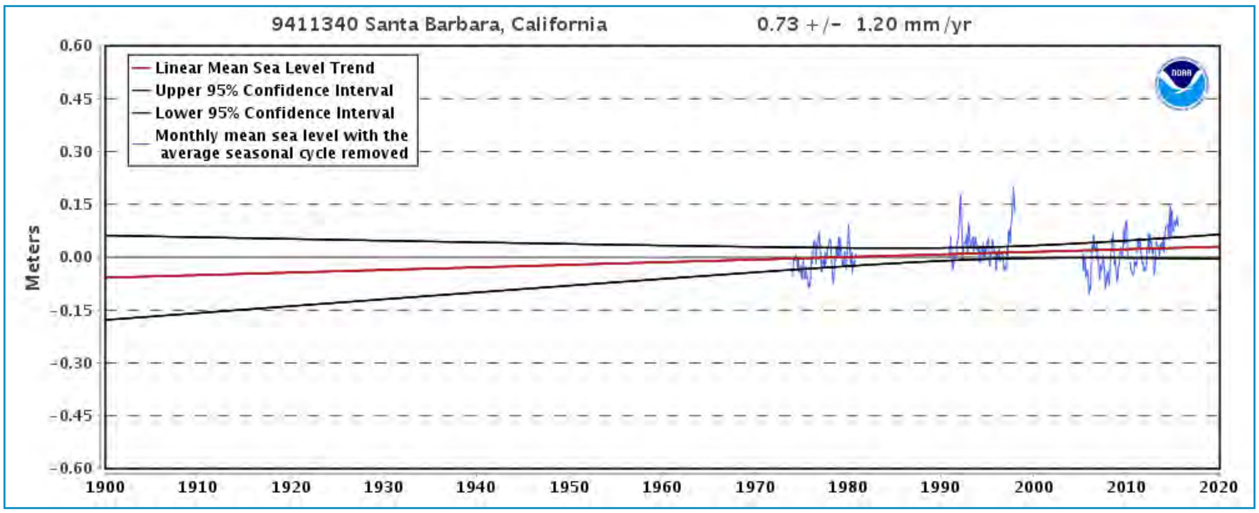

Figure 3-4. Tide Record and Sea Level Rise Trend from the Santa Barbara Tide Gage (NOAA Station 9411340)

Locally along the Goleta coastline, there are differences within the City due to the complex faulting in and around the City. Along the western portion of the City, specifically along the Ellwood Mesa, the land is uplifting at approximately 1.6 millimeters per year, based on radiocarbon dating of shells found in the marine terraces (Gurrolla et al. 2014). This relative rate decreases the overall impact of sea level rise and coastal erosion hazards (Table 3-1).

Table 3-1. Goleta Specific Values, Including 1.6 Millimeters per year Uplift along Ellwood Mesa

Year	Low SLR	Medium SLR	High SLR*
2030	-1.3 inches	2.2 inches	8.5 inches
2060	-0.3 inches	8.7 inches	24.1 inches
2100	4.9 inches	25.0 inches	54.5 inches

In contrast, along the Goleta Slough, the land is subsiding at a rate of approximately 1.5 millimeters per year. This equates to the relative rate of local sea level rise being greater than that of the global rate (Table 3-2).

Table 3-2. Goleta Specific Values, Including 1.5 Millimeter per Year Subsidence at Devereux and Goleta Slough

Year	Low SLR	Medium SLR	High SLR*
2030	1.2 inches	4.7 inches	11.4 inches
2060	5.8 inches	14.8 inches	30.2 inches
2100	15.9 inches	36.0 inches	65.5 inches

3.4 Future Climate Projections: Scientific Overview

Substantial research in California is currently underway to effectively downscale climate change models and to project various human-induced climate change impacts at a local scale. By analyzing the outputs of these downscaled models, the City can better understand the range of likely climate impacts specific to Goleta. Several of the key climate change impacts are likely to include increased temperature, decreased precipitation, increased wildfire, and sea level rise.

For each of these impacts, downscaled global climate model results are summarized based on a medium high future emissions scenario ("business as usual") and a medium low scenario ("substantial reduction in global greenhouse gas emissions") to provide a range of future projections specific to Goleta. All of this research is summarized from available climate data acquired from climate impacts studies funded by the California Energy Commission (CEC). For more detail in any specific parameter, please see the cited information. In addition, new climate models are being developed and results should be available in the future. These should be reviewed and incorporated into the City's vulnerability/adaptation process as appropriate. The climate model results presented below are a summary of the climate change impacts from statewide-downscaled models completed in 2009 and available publicly from Cal Adapt.

3.5 Other Regional Scientific Initiatives

Currently, there are a wide variety of scientific investigations studying and modeling the impact of climate change and downscaled global models on the regional Goleta Valley. The studies discussed below demonstrate the most promise and focused applicability to the City of Goleta.

2009 Coastal Regional Sediment Management Plan for Santa Barbara

In 2009, BEACON completed an update of the Coastal Regional Sediment Management Plan, which identified what is known about sand supplied to the coast between Point Conception and Point Mugu, including new understanding of erosion hot spots and shoreline armoring. Recommendations from this plan include new ways to manage sediment, including development of an opportunistic sand placement program, sand rights policies, and changes in regional governance structure, which would support better use of coastal sediments.

2014 Adopted UC Santa Barbara's Long Range Development Plan

The UCSB Long Range Development Plan supports development of UCSB property, while carefully considering consistency with the California Coastal Act. The plan provides policies incorporating climate change/adaptation and associated impacts along the shoreline, such as loss of critical ecosystem areas, interruption of shoreline processes, loss of public access, and degradation of scenic resources.

2015 Santa Barbara County South Coast Coastal Resiliency Phase 1 Project Modeling (by ESA)

This modeling effort projects the impacts of coastal erosion and coastal flooding for the south coast of Santa Barbara County, extending from Jalama Beach County Park to Rincon Point. A technical methods report presents technical documentation of the methods used to map erosion and coastal flood hazards under various future climate scenarios. The climate-change–exacerbated coastal hazard modeling considered sea level rise, wave climate, and precipitation. This study and model outputs provide the hazard identification to support the City's vulnerability assessment.

Ongoing Goleta Slough Management Committee

The Goleta Slough Management Committee's purpose is to work cooperatively with regulatory agencies, property owners, and public interest groups to provide for a healthy Goleta Slough, considering the Slough's ecosystem and recognizing a mixture of land uses. Between 2011 and 2015, the committee completed a sea level rise vulnerability and adaptation plan for the Goleta Slough. The work was funded by the California Coastal Conservancy and included some habitat evolution modeling. It also evaluated at-risk regional infrastructure, such as the Santa Barbara Airport, and considered the implications of inlet mouth management into the future.

2015 Goleta Slough Inlet Management Study

This study modeled the impact of different sea level rise and management scenarios on the function of the Goleta Slough Inlet. The goal of the project was to primarily look at the impact of management changes, restoration, and storage volume on the opening and closing dynamics of the Goleta Slough. The study found that an increase in volume of the slough (a.k.a. tidal prism) is an expected result of sea level rise. This could create tidal wetlands in areas that are currently blocked from tidal action, resulting in a more frequent open lagoon mouth. This increase in lagoon volume could reduce the need for mechanical breaching and provide an increase in ecosystem services provided by the wetlands. Lesser amounts of sea level rise (around 1 foot) would result in more frequent closed conditions, while high sea level rise (3 to 5 feet) may maintain an open inlet for much of the year.

2015 The Nature Conservancy's Coastal Resiliency Mapping Tool

The Coastal Resiliency Mapping Tool by The Nature Conservancy has been developed for geographies around the world to visualize the extent and magnitude of sea level rise and coastal hazards. The web mapping application (maps.coastalresilience.org/California) provides an interactive visualization tool. Extensive work on a web mapping application was included as part of the City of Goleta's Coastal Hazard Mapping and Vulnerability Assessment Public Workshop on August 12, 2015. This tool allows users to explore the risks of different scenarios of coastal hazards—such as sea level rise, storm surges, and inland flooding—at a variety of spatial scales.

2016 Coastal Ecosystem Vulnerability Assessment

Consistent with the CCC's emphasis on crafting regional approaches to sea level rise, the Santa Barbara Coastal Ecosystem Vulnerability Assessment coordinates efforts among researchers from Scripps, UCSB, and others to address impacts on ecological resources within Santa Barbara County. The specific ecosystem-based approach is focusing on wetlands and beaches and watersheds to better understand the regional habitat vulnerability. This project was initially estimated for completion in time to be included in this study, but delays by the researchers indicate that it will likely be the end of 2016 before research results are made available.

2016 FEMA Pacific Coastal Flood Mapping

FEMA is currently updating the Pacific Coastal flood maps for FEMA Region IX. The California Coastal Analysis and Mapping Project is conducting updates to the coastal flood hazard mapping with best improved science, coastal engineering, and regional understanding. Specific to the Southern California Bight (the area between Point Conception and the U.S.–Mexico border), the project incorporates regional wave transformation modeling and new run-up methods and will be revising the effective flood insurance rate maps for coastal flood hazard zones. This will include revised VE (wave velocity), AE (ponded water), and X (minimal flooding) zones. The anticipated completion date is 2018.

2016 CoSMoS 3.0

The Coastal Storm Modeling System of the USGS (CoSMoS 3.0) is focusing coastal hazard modeling on the area between Point Conception and the U.S.–Mexico border. The hope is to provide region-specific, consistent information on coastal storm and sea level rise scenarios. The model uses downscaled global climate models and considers factors such as long-term coastal shoreline change, stream inputs, dynamically downscaled winds, and varying sea level rise scenarios to produce hazard projections, accounting for various planning horizons and risk tolerance. It is intended to support policy and planning through usage in vulnerability assessments, hazard mitigation plans, and LCPs and by providing data for other shoreline change or hazard models within the region. The anticipated deliverable is summer/fall 2016.

Ongoing Ocean Meadows Restoration

This restoration project aspires to remove the former Ocean Meadows golf course and restore the upper portion of the Devereux Slough by excavating substantial fill from the former golf course and restoring the south parcel (adjacent to the Ellwood Mesa). This project is focused on restoring the Ellwood-Devereux coastal wetland not only to serve as contiguous habitat and public recreational space, but also to provide additional ecosystem services, such as flood and storm surge protection.

3.6 Coastal Hazards

Historic Storm Impacts

Coastal and creek flood hazards have historically occurred across Goleta. Significant wave events in 1943, 1982–83, 1997–98, 2002, 2007, and 2014 have demonstrated that the coast is a dynamic and hazardous environment (Photo 3-1). The 1982–83 event is considered the largest wave event in the Santa Barbara channel, with waves reported to be 24 feet at 22 seconds (Seymour 1996).

Photo 3-1. Goleta Beach Wave Overtopping during the 1997–1998 El Nino (Photo: M. Morey)

In addition, creek flooding combined with high tides has caused substantial flood damages, particularly in the area around Old Town Goleta (Photo 3-2). During the flood of 1861–62, the overgrazed hillsides burned by fire shed sediment and raised the elevation of Goleta Slough in places up to 14 feet; this forever changed the navigability of the slough. Finally, the change in Goleta Slough inlet management has resulted in increasing flooding and duration of inundation at the low-lying areas around the Placencia neighborhood (Photo 3-3).

Photo 3-2. The Santa Barbara Airport, 1969 (Photo: Santa Barbara Historical Society)

Photo 3-3. Flooding in the Placencia Neighborhood 2014 (Photo: T. Feyram)

FEMA repetitive loss data shows that there are 5 parcels that have multiple claims against the National Flood Insurance Program. These parcels are located in Old Town; the San Jose Creek Channel Improvement Project will likely better protect some of them in the short-term.

Existing Coastal Hazards

Coastal erosion and coastal flooding are caused by large storm waves coupled with high tides. These types of coastal processes cause vulnerabilities in the western Coastal Resource Area. Current coastal erosion could cause a cliff failure between 15 and 20 feet, given the local geology. FEMA is currently remapping the Pacific Coast flood maps with final results expected in 2018. Given the current mapped 1 percent run-up elevations of the FEMA VE zone (velocity/wave run-up) at 9–12 feet (annual beach elevations range from 9 to 11 feet), it should be anticipated that the insurance rate maps would increase in elevation for existing conditions.

Given the unique City limits and Coastal Zone boundary, Goleta has an additional flood risk resulting from beach closure of the Goleta and Devereux Slough during the low wave energy summer and fall months. This closed inlet forms a natural dam that can back up water and cause flooding even during the dry summers or drought conditions (Photo 3-4).

Photo 3-4. Barrier Beach Flooding Caused by a Sandbar across Goleta Slough Inlet, February 18, 2014 (Photo: A. Bermond)

Existing Creek Flooding

Historic flooding is known to occur around the City (Photo 3-5). Existing creek flood hazards have been mapped by FEMA as part of the National Flood Insurance Program. This program requires very specific technical analysis of watershed characteristics, topography, channel morphology, hydrology, and hydraulic modeling to map the extent of existing watershed–related flood hazards. These maps, representing existing 100-year flood hazards (1 percent annual chance of flooding) are known as the Flood Insurance Rate Maps (FIRMs) and determine the flood extents and flood elevations across the landscape. The effective date of the existing FIRM map for Goleta was December 12, 2012 (Maps # 06083C1341G, 06083C1342G, 06083C1361G, and 06083C1362G). The City has invested in the San Jose Creek Channel Improvement Project, which is altering the existing channel configuration to increase the flood conveyance capacity. Once completed, this channel improvement will reduce the flood risk through portions of Old Town Goleta (Figure 3-5). At the time of publication, the FEMA flood maps have not been officially updated. However, to best represent the City's creek flood risk, the flood modeling results associated with the channel improvement were acquired from Bengal Engineering and merged with the existing FEMA map. This combined map was used in the vulnerability assessment to identify existing vulnerabilities.

Photo 3-5. Intersection of Fairview and Hollister during the 1997–1998 El Niño Flooding

Currently, there are 640 acres (about one square mile) within the FEMA-designated 100-year floodplain within Goleta. This is approximately 12 percent of the entire area of the City. Base flood elevations based on a 1 percent annual recurrence probability for creek hazards range from 10 to 40+ feet across the City. Table 3-3 below shows the range of FEMA-modeled creek flood hazard zones. The City has only five parcels that have repetitive loss claims with the National Flood Insurance Program. These parcels all flooded from creek hazards in the 1995 flood, with others during the 1998 El Niño, and a February 2000 stream flood event. All of these parcels are all located in Old Town.

Table 3-3. Base Flood Elevations from the FEMA Maps for Creeks in Goleta City Limits

Drainage	Base Flood Elevation (NAVD88)
San Jose Creek/Goleta Slough	13–17+ feet
Devereux Creek/ Upper Devereux Slough	17–20 feet
Bell Canyon/Tecolote Creek	10–22 feet
Storke Ranch	14–15 feet

Figure 3-5. Existing FEMA 100 Year Flood Hazard

City Boundary

Coastal Zone Boundary

Existing FEMA 100-Year Flood

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4. Vulnerabilities and Fiscal Impacts by Sector

4.1 Introduction

This report used several primary data sources:

- Coastal hazards modeling analysis results (ESA 2015).
- FEMA effective flood maps (FEMA 2010).
- Spatial and locational data available from the City, County of Santa Barbara, Environmental Systems Research Institute (ESRI), and The Nature Conservancy (TNC 2015) (and Figure 4-1).

Projections of future climate change impacts came from a variety of sources including: Cal Adapt, UC Los Angeles (UCLA), UCSB, and Scripps Institution of Oceanography.

Projections of future coastal hazards and sea level rise were modeled as part of a separate project completed during the Santa Barbara County South Coast Coastal Resiliency Project Phase 1 (ESA 2015). Substantial research in California is currently underway to effectively downscale climate change models and to project various human-induced climate change impacts at a local scale.

4.2 Vulnerability Assessment Methodology

The modeling work for the 2015 Santa Barbara County South Coast Coastal Resiliency Phase 1 Project included modeling of the following coastal processes:

- **Coastal King Tide Flooding:** Based on an expected monthly recurrence.
- **High Tide Coastal Flooding:** Based on the largest El Niño storm on record (January 1983), this included storm surge and large waves with sea level rise.
- **Barrier Beach Flooding:** Based on beach elevations that control water levels in the lagoons.
- **Wave Impacts:** Wave impacts similar to the historic January 1983 storm with sea level rise.
- **Short-Term Coastal Erosion:** Short-term coastal erosion based on a 1 percent annual chance storm wave event.
- **Long-Term Coastal Erosion:** Long-term coastal changes caused by erosion related to sea level rise and historic trends in erosion.

Coastal Erosion

Erosion was modeled for the respective backshore types—dune-backed or cliff-backed shorelines. The coastal dune erosion hazard modeling considered a short-term response based on the erosion from a 100-year storm wave event. For long-term dune erosion, two components—erosion from sea level rise and erosion caused by historic trends in shoreline change (as a proxy for sediment supply)—were combined and mapped separately. In modeling for both types of dune erosion, inland extents were projected using a geometric model of dune erosion originally proposed by Komar et al. (1999) and applied with different slopes to make the model more applicable to sea level rise (Revell et al. 2011). This method is consistent with the FEMA Pacific Coast Flood Guidelines for storm-induced erosion (FEMA 2005).

Cliff erosion was modeled using a model that accelerates historic erosion rates based on the increase in duration of wave attack at various elevations on the cliff. In addition, an erosion factor of safety was included and represented in the standard deviation of the historic erosion rates for each the geologic unit then multiplied by the planning horizon.

Coastal Storm Flooding

The coastal storm flood modeling was consistent with FEMA's Pacific Coastal Flood Guidelines (FEMA 2005). The high tide coastal storm flood modeling was integrated with the coastal erosion hazard zones. Every 10 years, erosion projections were made and the coastal storm flood model considered areas that were eroded during this time period and thus exposed to wave flooding through enhanced hydraulic connectivity. For the coastal storm flooding, the storm of record was used—a large historic storm event that occurred during the strong El Nino winter of 1982–1983 on January 27, 1983, during which wave heights reached 25 feet at 22 seconds (Seymour 1996, ESA PWA 2012, ESA 2015).

Barrier Beach Flooding

The barrier beach flooding was modeled based on beach geomorphic characteristics interpreting the barrier beach crest elevation. Seasonally, the beaches close all of the lagoons and estuaries along the Goleta Coast. During the closed mouth time, the lagoons fill up to the berm crest elevations from a combination of waves overtopping the beach and freshwater flows from the watersheds. Just before rains usually happen, the barrier beach flooding reaches its maximum height. The four lagoon systems affecting the City are Tecolote Creek, Bell Canyon, Devereux Slough, and Goleta Slough, which were modeled using beach berm crest elevations of 12 feet NAVD for Tecolote Creek, Bell Canyon, and Devereux Slough and 11 feet NAVD for Goleta Slough (based on reduced wave exposure at Goleta Beach).

Coastal Wave Impact

Wave impact modeling assessed the inland extent of wave velocity and inland extents of flooding using the method of Hunt (1959) and supported in the Shore Protection Manual (USACE 1984). This method calculated the dynamic water surface profile, the nearshore depth limited wave, the wave run-up elevation, and inland extent at the end of each representative profile. This hazard represents a future FEMA velocity wave impact zone (a.k.a. V-Zone).

Coastal Inundation

Tidal inundation modeling represents the Extreme Monthly High Water level (EMHW) or what areas are projected to get wet once a month. This modeling is similar to a king tide. This monthly elevation was averaged from maximum monthly water levels at the Santa Barbara Tide Gage (EMHW = 6.53 feet NAVD88)

Figure 4-1. Existing and Future Coastal Hazards

Flood Hazard Zones

	Surface Connected	Potentially Connected
Existing		
2030 (10.2")		
2060 (27.2")		
2100 (60.2")		

Existing FEMA 100-Year Flood

Hazard Modeling by ESA 2015

City Boundary

Coastal Zone Boundary

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and then applied to each of the sea level rise scenarios.

Combined Hazards

For each planning horizon, projected hazards were combined into a single layer using a process called "spatial aggregation" (ESA PWA 2012). This layer represents the overlap in all of the hazard zones and shows how many of the various sea level rise and wave condition scenarios impact specific areas. For example, an area mapped under three scenarios indicates that the area was hazardous during that planning horizon for all scenarios.

The localized coastal hazard modeling methodology relies on a detailed parcel-level backshore characterization that includes backshore type, geology, and local geomorphology (i.e., elevations, beach slopes). The backshore characterization was analyzed at approximate 100-yard spacing and then statistically represented at an approximate 500-yard alongshore distance. Calculations of wave run-up and tides are combined into a total water level elevation, which then drives coastal erosion and shoreline response models (Pacific Institute 2009, Revell et al. 2011). Climate change impacts—assessed using a series of sea level rise, wave climate, and precipitation scenarios—projected potential future coastal erosion and flooding hazards (ESA PWA 2012). Projected impacts were evaluated at four planning horizons: existing (2010), 2030, 2060, and 2100. All hazards were mapped on the California Coastal LIDAR Digital Elevation model (available from the National Oceanic and Atmospheric Administration Digital Coast website).

Modeling Assumptions

As with all modeling, assumptions had to be made to complete the work. Below are some of the more important modeling assumptions made in the ESA PWA 2015 work.

Coastal Erosion and Flood Hazard Projections Do Not Consider Existing Coastal Armoring

The coastal hazard projections did not consider the influence of the existing water outfall structures and coastal armoring on changes to coastal erosion and coastal flood hazard projections.

Projections of Potential Erosion Do Not Account for Uncertainties in the Duration of a Future Storm

The erosion projections assume that the coast would respond to the combination of high tides and large waves inducing wave run-up. Instead of predicting future storm-specific characteristics (waves, tides, and duration), the potential erosion projection assumes that the coast would erode under a maximum high tide and storm wave event with undefined duration.

Modeling Does Not Consider Future Changes to Precipitation and Runoff from the Watersheds with the Joint Occurrence of River and Coastal Flooding

The coastal confluence flood modeling has not been completed for the City, so the influence of changes in precipitation and higher water levels from sea level rise in Goleta Slough on the overall extent of river flooding has not been analyzed.

Mapping of these flood hazards using existing topography and geomorphic interpretation of the top of the beach (i.e., the beach berm crest) elevations show that Devereux Slough and Goleta Slough may become a singular wetland system and the resulting waters could flood portions of Old Town Goleta, Central Area, and the Southwest Residential Areas. Refer to Figures 4-1 and 4-2).

For purposes of analysis, the City's General Plan/Coastal Land Use Plan land uses were categorized into five typical land use types for ease of communicating climate-induced impacts and related vulnerabilities: 1) residential, 2) industrial, 3) commercial, 4) infrastructure, and 5) agriculture/open space. An example of agriculture/open space includes those areas such as the Ellwood Mesa Open Space/Sperling Preserve and the Sandpiper Golf Club. The Bacara Resort and Spa is categorized under commercial. Other land uses ranging from industrial, infrastructure, and residential are located within Old Town.

4.3 Economic and Fiscal Impact Analysis Methodology

The economic and fiscal impact analysis prepared for this project is designed to identify the potential costs of adaptation, mitigation, and increased public safety and health services that the City would be responsible for in the case of a storm being exacerbated by sea level rise or due to coastal erosion. This analysis will also include the potential loss in (Transient Occupancy Tax) revenues from the Bacara Resort and Spa. The analysis contained in this report also considered other economic and tax revenue losses for the City, but concluded that these losses would be both minimal/temporary as well as difficult to quantify accurately.

This study identified existing land, buildings, and infrastructure (roads, trails, water/power lines, etc.) within the erosion and flood zones for 2030, 2060 and 2100. It also identified the potential for hazardous waste or oil spills/leakages and estimated the cost of mitigation. In order to estimate the costs of replacement or mitigation, this analysis relied on various sources discussed in more detail below.

For land and structures subject to property tax (generally land/structures not owned by a governmental entity), this report used the County of Santa Barbara Parcel Database, which contains detailed information on the size of the parcel (in square feet) as well as the size of the structure (also in square feet). In California, Proposition 13 caps any increase in the assessed value of the land/structure at 2 percent a year, until the parcel is resold.

The cost of infrastructure replacement was estimated based on interviews with experts/engineers. Where this information was not available, reasonable metrics (e.g., the cost of replacing overhead power lines) were found from reputable sources, generally in Southern California.

Changes in Tax Revenues

The primary changes in tax revenues from the City could come from a number of different sources. First, the City would experience a loss in property tax revenues if property is lost to erosion or flooding. Although it was anticipated that estimating this loss in property taxes would be substantial, this study did not find any private parcels in the erosion hazard zone aside from the Bacara Resort and Spa and the Sandpiper Golf Club (discussed below). There are, however, a number of structures within the flood hazard zone. The operating assumption is that these structures and property will be repaired and that the assessed value will not fall, nor will property tax revenues.

The Bacara Resort and Spa provides a significant contribution to the City in the form of Transient Occupancy Tax (ToT) revenues. Information was obtained from the Bacara Resort and Spa on the average revenue per room and the average occupancy rate in high and low season. Six buildings, including 139 rooms and a restaurant, at the Bacara Resort and Spa are within the 2060 erosion zone. Therefore, it is likely that these buildings will either be lost or relocated within the next 50

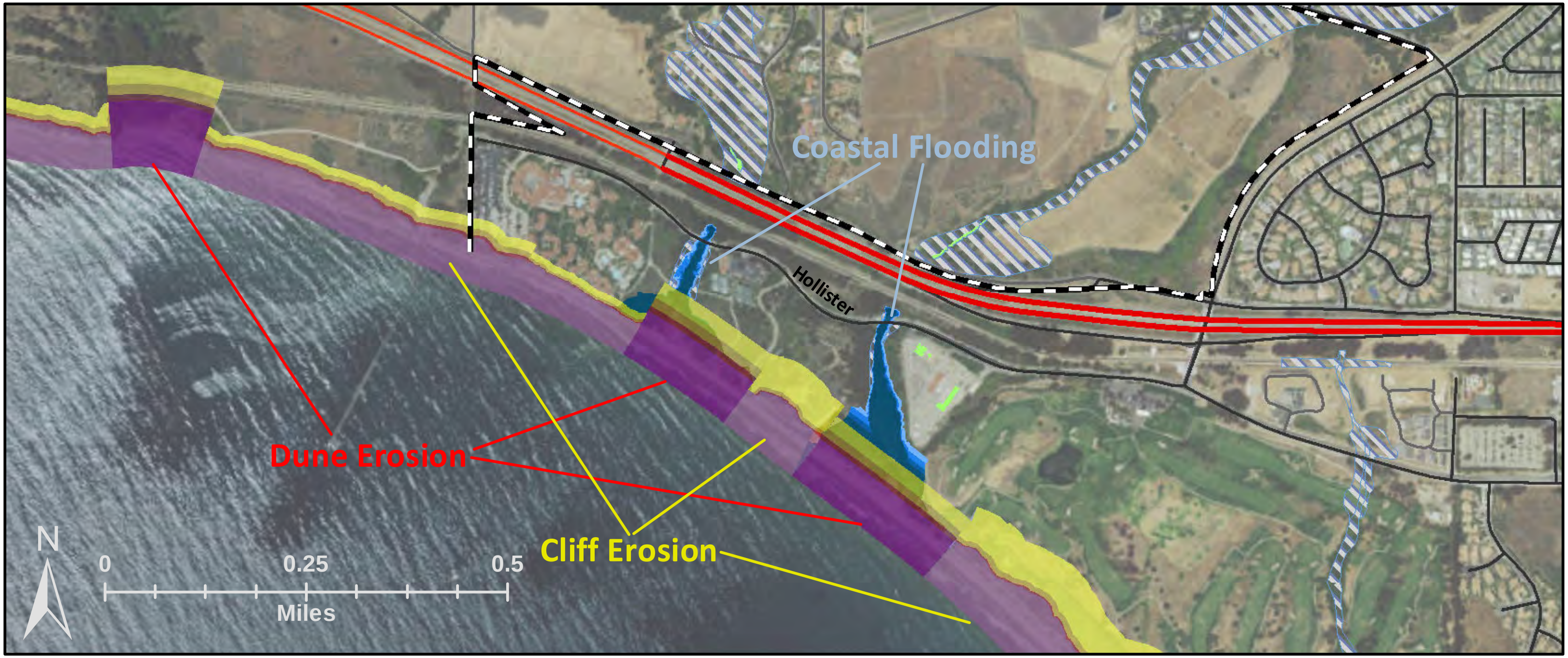


Figure 4-2. Flood and Erosion Hazard Zones

Flood Hazard Zones

	Surface Connected	Potentially Connected
Existing		
2030 (10.2")		
2060 (27.2")		
2100 (60.2")		

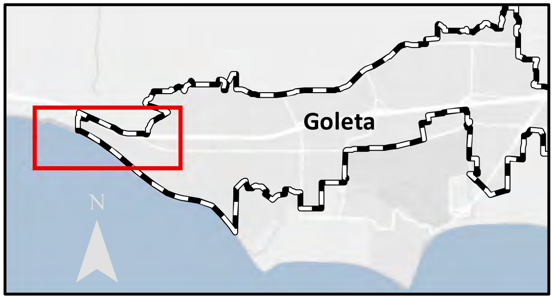
Existing FEMA 100-Year Flood

Hazard Modeling by ESA 2015

City Boundary

Cliff Erosion Hazard Zones
- Existing
- 2030
- 2060
- 2100

Dune Erosion Hazard Zones
- Existing
- 2030
- 2060
- 2100



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years. The loss of ToTs was estimated from these 139 rooms during high and low season per day and per month. It is uncertain when, or how long, these buildings would be closed.

Metrics

Table 4-1 below summarizes the metrics used to estimate various losses in this report. As discussed above, this study obtained these values in three main ways:

1. The County Parcel Data was updated to accurately reflect the market value of the parcel/structures and the replacement value of the structure in the City.
2. City officials and experts from the private sector (Bacara, utility districts, etc.) were interviewed to obtain accurate estimates of adaptation costs.
3. Standard metrics from reliable sources were used to estimate other costs (e.g., cost of replacing aboveground power lines).

The timing of these adaptation costs by parcel was identified using GIS analyses based on the timing of impacts mapped in the flood and erosion zones. In some cases it was necessary to make judgment calls. For example, the 2060 erosion map shows a thin gap between the buildings and the bluff (<25 feet), and it was determined that around this timeframe the buildings would need to be relocated.

Table 4-1. Fiscal Impact Analysis Metrics

Item	Cost/Value	cost basis
LUFTs—no groundwater intrusion	$125,000	Per tank
LUFTs—groundwater intrusion	$1,500,000	Per tank
2005 Goleta flood costs	$500,000	Goleta
1998 Goleta flood costs in 2015 dollars	$4–5,000,000	1998 flood adjusted
Capping oil well on land	$100,000	Per well
Capping oil well in water	$800,000	Per well
Oil spill costs	$257,000,000	Total cost
Trails	$170	Per linear foot
Road improvement	$135	Per linear foot
Coastal armoring	$170–$200	Per linear foot
Manhole cover retrofits	$150	Per manhole
Wastewater lift station	$150,000	Per lift
Property tax parcel	Updated using HPI	Sale price
Buildings/structures	Size of building	$/square foot
Flood damages to buildings	Current market value	Depth damage curves
Aboveground power lines	$10	Per linear foot
Belowground power lines	$30	Per linear foot
Bacara Resort Buildings	$0	Per room
Bacara Boathouse	$419	Per boathouse
Bacara ToTs—low season	$42	Per room
Bacara occupancy rate—high season	83%	
Bacara occupancy rate—low season	58%	
Bacara average revenue per room	$353	Per room

Adaptation Costs

Table 4-2 below contains the estimates of the adaptation costs for the City as well as other public and private agents. The table identifies who has responsibility/liability for each cost. In some cases (e.g., leaking underground fuel tanks [LUFTs]), the liability falls on the owners, but the City may nevertheless have to assume liability if the owner fails to mitigate (e.g., the operating entity is bankrupt). In other cases, the City is liable (e.g., flood costs), but it may be able to obtain funds from other sources for emergency flood cleanup (e.g., FEMA or a state agency). In some cases (e.g., 2100 and the Sandpiper Golf Club), it was not possible to estimate costs, but these costs would be significant. The table estimates costs for a one-time event (e.g., a major coastal flood) within the planning horizons of 2030, 2060, and 2100. The total potential adaptation costs are $370 million (not discounted by time horizon). However, the most significant cost is the potential cleanup cost of an oil spill.

Table 4-2. Estimated Adaptation Costs

Category	Item	City Responsibility	Event-Driven Costs	2030 Cost	2060 Cost	2100 Cost
Hazardous materials	LUFTs—no leaching	City potentially responsible			$125,000	$625,000
Hazardous materials	LUFTs—with leaching	City potentially responsible			$1,500,000	$7,500,000
Oil and gas—coastal storm	Capping wells— in water	City potentially responsible	$63,200,000			
Oil and gas—coastal storm	Capping wells—on land	City potentially responsible	$7,900,000			
Oil and gas—coastal storm	Oil spill	City potentially responsible	$257,000,000			
Wastewater	Manhole covers	Sanitary Districts responsible		$2,100	$4,350	$12,300
Wastewater	Two lift station retrofits	Sanitary Districts responsible	$300,000			
Recreation trails	Eroded trails	City responsible		$626,280	$1,175,380	$1,945,310
Roads	Flooding	City partially responsible		$––	$––	$––
Southern California Edison utilities	Aboveground lines	Southern California Edison responsible		$3,220	$3,600	$6,370
Southern California Edison utilities	Belowground lines	Southern California Edison responsible		$15,930	$20,130	$49,080
Stormwater	Manhole covers	City responsible		$4,350		
Flood cleanup	2005 Flood	City partially responsible	$500,000			
Flood cleanup	1998 Flood	City partially responsible	$4,500,000			
Coastal armoring	Seawall removal cost already completed	City partially responsible	$225,000			

Category	Item	City Responsibility	Event-Driven Costs	2030 Cost	2060 Cost	2100 Cost
Coastal armoring	Seawall construction	City partially responsible	$264,920			
Land use	Property flood costs	Private owners responsible		$1,000,000	$1,500,000	$14,000,000
Land use	Bacara Bath House	Bacara responsible		$421,000		
Land use	Bacara 6 buildings	Bacara responsible			$52,500,000	
Bacara ToTs	High season	Loss to City			$88,058/ month	
Bacara ToTs	Low season	Loss to City			$61,530/ month	
Total by Time Horizon			**$333,889,920**	**$2,072,880**	**$59,828,460**	**$24,138,060**

Finally, Table 4-3 presents the likely, partial, and possible liabilities for the City at various time horizons. For flood cleanup costs, our analysis assumes one 1998-level flood and one 2005-level flood. If the City experiences more of these types of floods, especially a costly flood similar to the 1998 flood, the costs could be much higher. The second row in Table 4-3 estimates costs that the City is likely to be partially responsible for (i.e., road improvement costs as well as the costs of seawall removal and new construction.) The third row in Table 4-3 presents the *potential* liability for the City. This analysis assumes that the City could be liable for up to 20% of the costs of cleaning up an oil spill. The City also faces a serious potential liability in the 2060 and 2100 planning horizons for LUFTs.

Table 4-3. Estimated City Liability for Vulnerabilities

City Responsibility	Event-Driven Clean-Up Costs	2030 Cost	2060 Cost	2100 Cost	Total (Undiscounted)
City responsible	$500,000	$630,630	$1,175,380	$1,945,310	$4,251,320
City partially responsible	$4,750,000	$471,052	$2,193,387	$12,490,707	$19,905,146
City potentially responsible	$264,900,000	--	$1,625,000	$8,125,000	$274,650,000

This analysis examined the economic losses associated with increased erosion and storm events caused by sea level rise. Although forecasting future events is always fraught with uncertainty, it makes sense for the City to start planning now for these events. In some cases, relatively inexpensive preventative measures, such as mitigating hazardous waste in underground storage tanks or sealing manhole covers, could save the City millions of dollars.

The analysis indicates that, in dollar terms, the most serious issues facing the City are (in order): 1) oil spills, 2) LUFTs, and 3) flood cleanup costs. In terms of private and public property, the City has limited exposure until 2060, when parts of the Bacara Resort and Spa become threatened. Longer term, the risk of flood damage to private and public property increases between 2060 and 2100.

4.4 Sector Profile Results

The results of the vulnerability assessment and fiscal impact analysis are summarized in Appendix A. Further details on the fiscal impact results are provided below and are categorized by Sector Profile for consistency:

A. Land Use and Structures: Old Town Area

B. Land Use and Structures: Coastal Resources Area

C. Coastal Armoring

D. Oil and Gas

E. Hazardous Materials

F. Natural Resources

G. Public Access

H. Transportation

I. Wastewater

J. Water Supply

K. Utilities

Land and Structures: Old Town Area

Since the rate of housing inflation in Goleta has exceeded 2 percent for many years, the original sales price of the parcel—land and structure(s)—is adjusted to reflect current market conditions using a housing price index created from local housing sales data. The replacement cost of the structure was estimated per square foot using FEMA's Hazard Guidance files (2006).

Flood damages to structures were estimated by applying the U.S. Army Corps of Engineers (USACE) depth damage curves, which estimate damages as a percent of the total value of the structure. USACE's method also allows one to estimate the average damage to the contents of the structure (e.g., furniture, appliances).

The study team spoke with officials from the City about flooding costs. The costs of cleanup vary considerably depending on the extent of the flooding, the winds associated with the storm, and other factors. These costs generally include the costs of removing debris from downed trees, power lines, etc. Since costs vary widely, this study used the actual costs from two recent significant flood events in Goleta in 1998 and 2005. The 1998 El Niño event was an extreme event, while the flooding that occurred in 2005 was a relatively small flood event. Road damages and cleanup costs alone could range from $30,000 to $100,000 per mile, depending on the type of road and amount of debris associated with the flooding.

Land and Structures: Coastal Resources Area

Bacara Resort and Spa

The most significant property examined was the Bacara Resort and Spa, which has a Bath House plus six additional buildings (including a restaurant and 139 hotel rooms) within the coastal hazards zones. This analysis indicates that these buildings may have to be abandoned and/or moved by 2060 because of coastal erosion; the Bath House is presently exposed to all of the hazards. One can estimate the cost of replacing these buildings using standard industry metrics (see HVS Consultants 2014). The potential loss in ToTs revenues was estimated based on data provided by the Bacara Resort and Spa on average room occupancy in high and low season and the average yield per room. The ToT rate for the City of Goleta is 12 percent. However, the City has an arrangement with Santa Barbara County in which the County receives 40 percent of ToT revenues.

Sandpiper Golf Club

The Sandpiper Golf Club and the neighboring Ellwood Mesa Open Space/Sperling Preserve will also experience a small amount of shoreline erosion. However, the golf course will not be seriously affected until 2100, when some reconfiguration of the course (cost not estimated here) would be necessary.

Ellwood Mesa Open Space/Sperling Preserve

The Ellwood Mesa Open Space/Sperling Preserve will also lose some land. The primary loss here would be to coastal trails. This analysis estimated the cost of replacing these trails based on estimates of the cost of the Ellwood Coastal Trails Restoration Project (Santa Barbara Trails Council 2015).

Coastal Armoring

Cost estimates for removing the timber seawall were obtained from Cushman Contracting Corporation (www.cushmancontracting.com), based on an estimated cost of $150,000–$175,000 to remove 900 linear feet of timber wall from the California State Lands Commission Beach Hazards Removal Project completed in 2014. An approximate range for removal would be $170–$200 per linear foot.

Oil and Gas

A number of oil wells exist onshore and offshore of the City. While most of these wells no longer operate, these wells can still represent a danger if they are damaged by coastal erosion or flooding. Nearby Summerland is currently facing similar issues and trying to resolve slow leakage from old poorly capped wells. Data was obtained from the City on the cost of capping or recapping wells and the cost of a potential oil spill cleanup based on the recent costs for the Refugio Oil Spill.

Hazardous Materials

Several LUFTs, mostly consisting of current or abandoned gas stations, that contain hazardous materials that could leak were identified. Not only could increased erosion and coastal flooding exacerbate the risk of these tanks leaking, but increased exposure to high ground waters could also spread the contaminants much more widely. This study compiled data from the U.S. Environmental Protection Authority and other sources on the mitigation costs for LUFTs. These costs vary depending upon whether the hazardous materials have leached into the groundwater or onto adjacent properties.

Natural Resources

Habitat resources occur in each of the subareas, including the western Coastal Resources Sub-Area, Storke Ranch wetlands, Phelps Road vernal pools, Rancho Goleta Lake, the southern portion of the Southwest Residential Sub-Area, and along streams. Two creeks, Bell Canyon Creek and Tecolote Creek, drain to the ocean via coastal estuaries; the other creeks drain into either Devereux or Goleta Sloughs, just south of the City boundary. There are also a lot of important considerations that fall outside of the realm of municipal budgets. For example, fiscal impacts of development on adjacent jurisdictions, local businesses, and natural resources are not accounted for in most fiscal impact models. Therefore, no fiscal impact analysis was conducted on this sector.

Public Access

The Ellwood Mesa Open Space/Sperling Preserve contains a number of hiking trails. Some of these trails are quite close to the coast and lie within the projected coastal erosion hazard zones. Data from the Ellwood Coastal Trails Restoration Project Conceptual Funding Plan (Santa Barbara Trails Council 2015) was used to estimate the cost of trail replacement per linear foot. There would also be some loss in recreation from flooding. However, the City does not have any data on current usage and assumed that hikers could substitute other trails/activities during flood events.

Transportation

Although a number of roads in Goleta are subject to flooding, none of the roads are in the erosion hazard zone. Consequently, data on the costs of clearing debris and other hazards was collected. However, potential costs related to increased traffic or commuting times were not estimated. Since the affected roads are minor, secondary roads, these costs should not be significant unless the flooding persisted for many days.

Wastewater

Wastewater infrastructure is operated and maintained by the Goleta Sanitary District and the Goleta West Sanitary District. This study identified two lift stations that were vulnerable (discussed later), as well as a number of manhole covers that need to be retrofitted. This study also examined the City's stormwater system and determined that there are no issues related to flooding/erosion, although severe floods would overload the stormwater system.

Water Supply

The revenue environment has remained stable and is supported by rate adjustments needed to address the costs of providing ongoing water service to Goleta Water District customers. In addition to a 2015 rate increase, relatively dry weather resulted in an increase in water consumption by 6.9 percent compared to consumption in 2013. When consumption reduction methods are implemented during various drought stages, Goleta Water District will consider implementing an accompanying rate change to maintain fiscal health, in full compliance with state law. This rate adjustment, combined with possible use of Goleta Water District reserves, would mitigate the financial impact of reduced water sales and revenues. Moreover, the rate adjustment would provide a conservation incentive to customers through price signals during shortage conditions (2010 Urban Water Management Plan Update).

Utilities

A number of power lines, both above- and belowground are in the erosion and flooding hazard zones. For lines lost because of erosion, this study estimated the cost of replacement based on standard industry metrics provided by Southern California Edison and others. For above- and belowground lines, it was determined that coastal flooding was not an issue. However, aboveground power lines may be vulnerable to strong winds associated with coastal storms. Future wind hazards were not analyzed as part of this vulnerability study.

5. Adaptation Strategies by Sector

5.1 Introduction

Adaptation to climate change involves a range of small and large adjustments in natural or human systems that occur in response to already experienced or expected climate changes and their impacts. Adaptation planning involves a wide range of policy and programmatic measures that can be taken in advance of the potential impacts, or reactively, depending on the degree of preparedness and the willingness to tolerate risk. Good adaptation planning should improve community resilience to natural disasters.

Adaptation measures that reduce the ability of people and communities to deal with and respond to climate change over time are called maladaptation. An example of this is the levee system for the City of New Orleans. While the levees provided short-term adaptation and allowed communities to remain in areas below sea level, they actually increased the long-term vulnerability—both by providing a false sense of security and underestimating the impact that storm events could cause.

This is the first focused endeavor by the City to identify possible responses to the identified vulnerabilities through adaptation strategies based on preparedness, avoidance, and/or protection from the risks projected to occur over time. Good adaptation stems from a solid understanding of the City's specific risks and the physical processes responsible for causing the risk, now and in the future.

5.2 Adaptation Planning

Adaptation planning requires considering each vulnerable sector and taking effective and timely action to alleviate the range of consequences. One adaptation measure may reduce the risk to one sector but cause issues in another sector or lead to unintended secondary consequences. Good adaptation planning considers these secondary impacts and how the different adaptation measures that could be used to alleviate vulnerability in one sector interact with the other measures in developing a sustainable community adaptation strategy.

Risks can be addressed by reducing vulnerability or exposure. First, the City has to choose what level of risk it is willing to tolerate. Increasing infrastructure resilience, transferring the risk, negating the risk through technological change or retreat, or revising policies can accomplish this.

As not all issues can or should be addressed at once, it is important that risks be prioritized to maximize the use of the City's resources while avoiding a costly emergency response. Many of these adaptation strategies take substantial time to implement. As a result, advanced planning and fundraising is key. Factors to consider when prioritizing projects include: public health and safety, available funding sources, legal mandates, planning consistency, capacity and level of service, cost-benefit relationship, and public support. Risks that present the most serious consequences and are projected to occur first should raise a project's level of priority. (See Figure 5-1.)

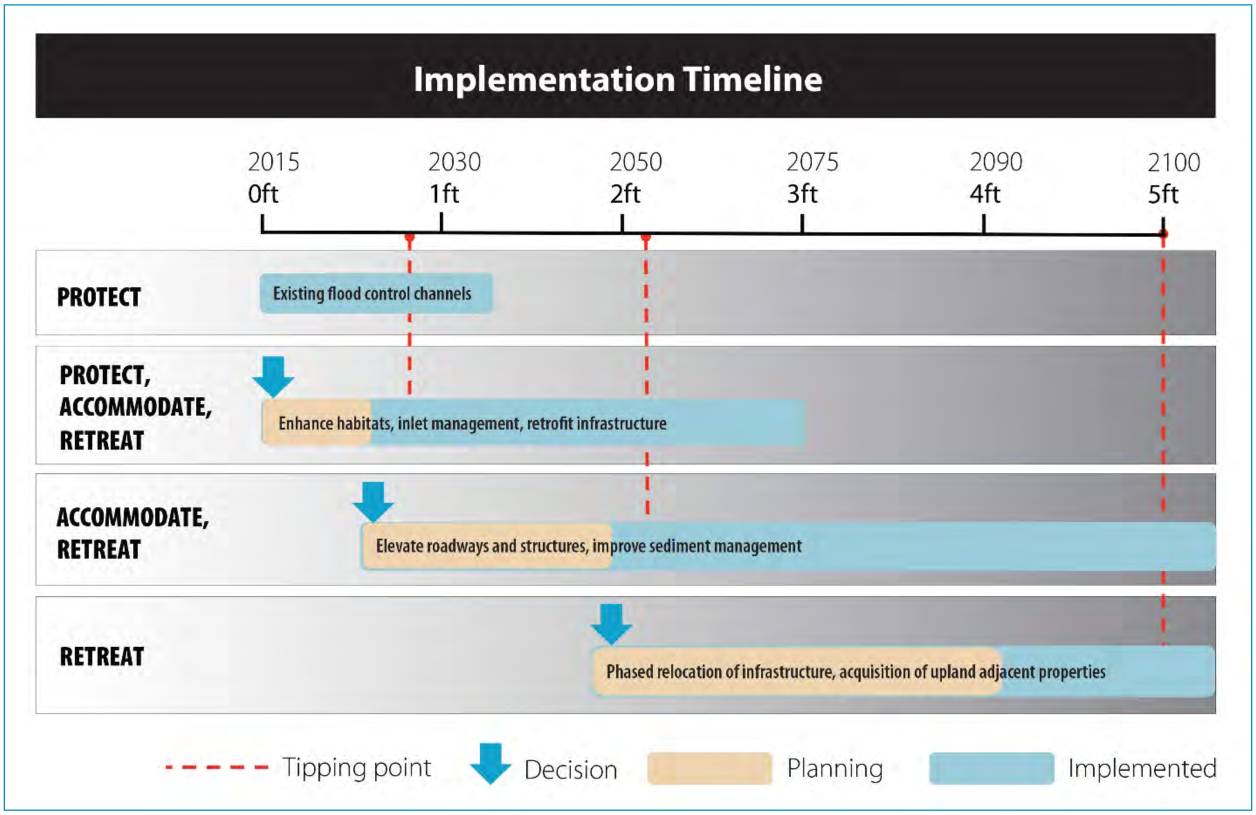

Figure 5-1. Implementation Timeline and Sea Level Rise Accommodation

This report should increase the City's understanding of the vulnerabilities associated with coastal hazards and is supporting the education of the community to encourage decision-makers to consider these impacts without creating further vulnerabilities or liabilities. As this is the beginning of the City's process of developing its adaptation response, many early initiatives are exploratory in nature and aim to identify appropriate changes or actions to respond to the impacts of concern.

Reviewing current City programs associated with risk reduction is the first step to identify immediate adjustments to alleviate or eliminate risks. Where adjustments to current practices will not sufficiently address the risks, then more substantial actions will be identified and should be implemented.

Of utmost importance to the successful implementation of an adaptation strategy is communicating the issues and proposed responses to the community. Studies repeatedly show that a knowledgeable community that understands how to respond to extreme events is far more resilient to the impacts. An informed community is also more likely to implement its own programs and decisions that reflect its members' knowledge of the projected changes and enable them to contribute to developing a prosperous, livable, and affordable City in the face of climate change.

5.3 Maladaptation

Maladaptation is a trait that is (or has become) more harmful than helpful, in contrast with an adaptation, which is more helpful than harmful.

One of the most significant concerns with maladaptation is that it reduces incentives to adapt while simultaneously diminishes the capacity to adapt in the future. Maladaptation occurs when efforts intended to “protect” communities and resources result in increased vulnerability, often realized indirectly or too late after a direction has been set. For instance, previously unaffected areas can become more prone to climate-induced hazards if the system that is being altered is not sufficiently understood. Likewise, if too much focus is placed on one time period—either the future or the present—effects on the other can be ignored, resulting in an increased likelihood of impacts from climate-induced hazards. Avoiding maladaptation is critical to a successful climate adaptation strategy. To do so, the City must first be able to make informed decisions based on an accurate vulnerability assessment, and to determine its own level of tolerance. Flexibility and a precautionary approach are key to avoiding maladaptation in the adaptation planning process.

5.4 Challenges

Adaptation planning does come with its challenges. A single jurisdiction like Goleta cannot adapt to climate changes on its own. A successful process requires regional dialog and partnerships to identify, fund, and implement solutions. Challenges range from acquiring the necessary funding for adaptation strategies, communicating the need for adaptation to elected officials and local departments, and gaining commitment and support from federal government agencies to address the realities of local adaptation challenges. Lack of resources and limited bridges between local, state, and federal agencies make it difficult for cities to make significant gains in adaptation.

When identifying appropriate adaptation responses, the City should consider taking a precautionary approach by using the following seven principles:

1. Strategy should not increase greenhouse gas emissions.
2. Strategy should support the protective role of ecosystems and their sustaining physical processes.
3. Strategy should avoid disproportionately burdening the most vulnerable.
4. Strategy should avoid high-cost strategies unless holistic economic work (including ecosystem services, recreation, and damages) demonstrates a strong net benefit over time.
5. Strategy should incentivize adaptation (e.g., reward early actors).
6. Strategy should increase flexibility and not lock the community into a single long-term solution.
7. Strategy should reduce decision-making time horizons to better incorporate new science.

5.5 Secondary Impacts

Almost all adaptation strategies have secondary impacts associated with them. Some of these are minor issues, such as short-term habitat impacts following removal of oil and gas infrastructure or undergrounding of overhead power lines. Others can be quite confounding and expensive, such as the burial of beaches under rocks following construction of revetments, or a retrofit to a critical infrastructure component.

Many communities have relied on setbacks in an effort to reduce hazard risk, and some are currently experimenting with establishing setback lines that are based on modeled predictions of where the new coastline will be. Setbacks alone could be considered maladaptive because they eventually lead to structures being at risk. Therefore, it is important to have elements of retreat, such as movable foundations or locations for transfer of development. Further, triggers for action, such as relocation, should take the place or work in conjunction with regulatory setback policies.

Sediment management is another option to combat erosion by building wider beaches and higher sand dunes or increasing wetland accretion. However, sediment management can be costly, and ongoing sand supplies for large projects can become scarce. Research investigations by USGS and UC Santa Cruz were unsuccessful at locating substantial offshore sand deposits that would support large nourishment projects along the Goleta coast (Barnard et al. 2009). Secondary impacts from sediment management vary depending on the volume, frequency, and method of placing, but they can substantially degrade sandy beach ecosystems, limiting recreational use and suffocating rocky intertidal habitats.

Shoreline protective devices (e.g., coastal armoring, flood control levees) can also adversely affect a wide range of other coastal resources and uses that the California Coastal Act protects. They often impede or degrade public access and recreation along the shoreline by occupying beach area or tidelands and by reducing shoreline sand supply. Protecting the back of the beach ultimately leads to the loss of the beach as sea level rise and coastal erosion continue on adjacent unarmored sections. Shoreline protection structures therefore raise serious concerns regarding consistency with the public access and recreation policies of the California Coastal Act. Such structures can also fill coastal waters or tidelands and harm marine resources and biological productivity, which is in conflict with California Coastal Act Sections 30230, 30231, and 30233. They often degrade the scenic qualities of coastal areas and alter natural landforms, which is in conflict with Section 30251. Finally, by halting disrupting landscape connectivity, structures can prevent the inland migration of intertidal and beach species during large wave events. This disruption will prevent intertidal habitats, saltmarshes, beaches, and other low-lying habitats from advancing landward as sea levels rise over the long-term.

5.6 Protect, Accommodate, and Retreat

Adaptation generally falls into three main categories: protect, accommodate, and retreat.

The Protection Approach

Protection strategies employ some sort of engineered structure or other measure to defend development (or other resources) in its current location without changes to the development itself. Protection strategies can be further divided into “hard” and “soft” defensive measures. A gray (hard) approach would be to engineer a seawall or revetment, while a green approach may be to nourish beaches or build sand dunes. Although the California Coastal Act clearly provides for potential protection strategies for “existing development,” it also directs that new development be sited and designed to not require future protection that may alter a natural shoreline. It is important to note that most protection strategies are costly to construct, require increasing maintenance costs, and have secondary consequences to recreation, habitat, and natural defenses. Many of these are forms of maladaptation, especially if applied as a long-term solution.

The Accommodation Approach

Accommodation strategies employ methods that modify existing or design new developments or infrastructure to decrease hazard risks and therefore increase the resiliency of development to the impacts of sea level rise. On an individual project scale, these accommodation strategies include actions such as elevating structures, performing retrofits, or using materials to increase the strength of development such as to handle additional wave impacts; building structures that can easily be moved and relocated; or using additional setback distances to account for acceleration of erosion. On a community-scale, accommodation strategies include many of the land use designations, zoning ordinances, or other measures that require the above types of actions, as well as strategies such as clustering development in less vulnerable areas or requiring mitigation actions to provide for protection of natural areas.

The Retreat Approach

Retreat strategies relocate or remove existing development out of hazard areas and limit the construction of new development in vulnerable areas. These strategies include creating land use designations and zoning ordinances that encourage building in less hazardous areas or gradually removing and relocating existing development. Acquisition and buy-out programs, transfer of development rights programs, and removal of structures where the right to protection was waived (i.e., via permit condition) are examples of strategies designed to encourage retreat.

The Hybrid Approach

For purposes of implementing the California Coastal Act, no single category or even specific strategy should be considered the "best" option as a rule. Different types of strategies will be appropriate in different locations and for different hazard management and resource protection goals. The effectiveness of different adaptation strategies will vary across both spatial and temporal scales. In many cases, a hybrid approach that uses strategies from multiple categories will be necessary, and the suite of strategies chosen may need to change over time. Nonetheless, it is useful to think about the general categories of adaptation strategies to help frame the discussion around adaptation and the consideration of land use planning and regulatory options in the City.

The Do Nothing Approach

There are a number of options for how to address the risks and impacts associated with sea level rise. Choosing to "do nothing" or following a policy of "non-intervention" may be considered an adaptive response. However, in most cases, the strategies for addressing sea level rise hazards will require proactive planning to balance protection of coastal resources with development.

5.7 Sector Profile Results

Adaptation strategies have been identified based on the specific risks and vulnerabilities identified in the vulnerability results and the applicable California Coastal Act requirements. Adaptation strategies typically involve policy modifications for land use plans and regulatory permit conditions that focus on avoidance or minimization of risks and the protection of coastal resources.

Adaptation strategies may include requiring proposed projects to anticipate longer-term impacts in design, considering how much critical infrastructure will be able to withstand the increasing exposure without being put in danger, or rezoning hazardous areas as open space. Other adaptation strategies may build adaptive capacity into the plan so that future changes in hazard risks can be effectively incorporated into long-term resource protection. In most cases, especially for LCP land use and implementation plans, multiple adaptation strategies will need to be employed. This section provides an overview of the three general categories of adaptation planning measures, ranging from soft "nature based" or "green" measures to "hard" or "gray" engineering measures.

The recommended adaptation strategies are summarized in Appendix A. Further details on the individual strategies are provided below.

A. Land Use and Structures: Old Town Area

B. Land Use and Structures: Coastal Resources Area

C. Coastal Armoring

D. Oil and Gas

E. Hazardous Materials

F. Natural Resources

G. Public Access

H. Transportation

I. Wastewater

J. Water Supply

K. Utilities.

Retreat (Relocation/Removal)

Retreat refers to the gradual removal or relocation of structures away from unstable erosion-prone areas. Retreat allows shore migration and mitigates coastal hazards by limiting, altering, or removing development in hazardous areas. This measure can be implemented in a number of ways through policy option. Retreat can be phased in combination with some of the other land use measures described below.

Applicability to Goleta Sectors: Land Use and Structures, Oil and Gas, Hazardous Materials, Water Supply, Public Access, Natural Resources, Coastal Armoring, Transportation, Wastewater, and Utilities

Applicability to Goleta Sub-Areas: Coastal Resources Area, Southwest Residential Area, Central Area, Northeast Residential, Northeast Community Center, and Old Town Area

Transfer of Development Rights Program

This program involves transferring development rights from parcels near hazardous areas, such as the coast, to parcels that are further away from the hazard and can therefore accommodate development better, such as a more inland location. Often there is an incentive for this relocation such as increased density or relaxation of building heights. This strategy can be used to incentivize and encourage private property development away from hazardous areas.

Applicability to Goleta Sectors: Land Use and Structures

Applicability to Goleta Sub-Areas: Coastal Resources Area, Southwest Residential Area, Northwest Residential, Central Area, Central Resource Area, Northeast Residential, Northeast Community Center, and Old Town Area

Fee Simple Acquisition

Simple acquisition is the purchase of vacant or developed land in order to prevent or remove property from the danger of coastal hazards such as erosion or flooding. One such example of this adaptation strategy is to purchase properties at risk and to demolish structures and restore habitats and physical processes, as has been done in Pacifica, California. A hybridized version of this adaptation strategy may be a public acquisition program in which an entity purchases the hazardous property and then leases the land back to the previous landowner with the deed restriction and understanding that when the structure or parcel is damaged that the lease may expire.

Applicability to Goleta Sectors: Land Use and Structures, Public Access, and Natural Resources

Applicability to Goleta Sub-Areas: Coastal Resources Area, Southwest Residential Area, Northwest Residential, Central Area, Central Resource Area, Northeast Residential, Northeast Community Center, and Old Town Area

Rolling Easements

The term "rolling easement" refers to a policy or policies intended to allow coastal lands and habitats, including beaches and wetlands, to migrate landward over time as the mean high tide line and public trust boundary moves inland with sea level rise. Such policies often restrict the use of shoreline protective structures, limit new development, and encourage the removal of structures that are seaward (or become seaward over time) of a designated boundary. This boundary may be designated based on such variables as the mean high tide line, dune vegetation line, or other dynamic line or legal requirement. In some cases, implementation of this can be through a permit condition (such as the "no future seawall" limitation) or purchased at a substantial discount (such as purchasing the land between the MHW boundary and the dune vegetation line or MHW boundary plus 5 feet so the policy can adjust with sea level rise).

Applicability to Goleta Sectors: Land Use and Structures, Oil and Gas, Public Access, Natural Resources, and Coastal Armoring

Applicability to Goleta Sub-Areas: Coastal Resources Area, Central Area, Central Resource Area, and Old Town Area

Conservation Easements

A conservation easement is a legally enforceable agreement attached to the property deed between a landowner and a government agency or a non-profit organization that restricts development or certain uses "for perpetuity," but allows the landowner to retain ownership of the land. The allowable uses for this easement could be structured to allow flooding or erosion processes to occur.

Applicability to Goleta Sectors: Land Use and Structures, Public Access, and Natural Resource

Applicability to Goleta Sub-Areas: Coastal Resources Area, Southwest Residential Area, Northwest Residential, Central Area, Central Resource Area, Northeast Residential, Northeast Community Center, and Old Town Area

Structural Adaptation

Structural adaptation is the modification of the design, construction, and placement of structures sited in or near coastal hazardous areas to improve their durability and/or facilitate their eventual retreat, relocation, or removal. This is often done through the elevation of structures, specific site placement, and innovative foundation construction. These can be implemented through revisions to the Building Code.

Applicability to Goleta Sectors: Land Use and Structures, Oil and Gas, Water Supply, Transportation, Wastewater, and Utilities

Applicability to Goleta Sub-Areas: Coastal Resources Area, Southwest Residential Area, Central Area, Central Resource Area, and Old Town Area

Habitat Adaptation

Also called "living shorelines," habitat adaptation reduces vulnerabilities by supporting the physical processes that support habitat creation. The maintenance of these physical processes allows habitats to evolve and is compatible with anticipated climate changes to environmental parameters. This measure and related policies are intended to maintain landscape connectivity, which can provide habitats room to transgress and evolve. For a more active adaptation approach, salt-tolerant vegetation could be planted and sediment (e.g., dunes or mud) added to the system to mimic natural sedimentary processes. Examples include sediment management, oyster reefs, and horizontal levees.

Applicability to Goleta Sectors: Land Use and Structures, Water Supply, Public Access, and Natural Resources

Applicability to Goleta Sub-Areas: Coastal Resources Area, Southwest Residential Area, Central Area, Central Resource Area, and Old Town Area

Real Estate Disclosures for Coastal Hazards

This strategy requires that upon any real estate transaction, buyers of properties in the coastal hazards zones are made aware of the potential hazards to their property. This disclosure informs buyers that they may face such hazards as erosion, coastal flooding, inundation, wildfire, or flooding as a result of climate-induced impacts, such as sea level rise. It is important to note that a disclosure for creek flooding already exists if a property is required to carry flood insurance

Applicability to Goleta Sectors: Land Use Structures, Oil and Gas, and Hazardous Materials

Applicability to Goleta Sub-Areas: Coastal Resources Area, Southwest Residential Area, Central Area, and Old Town Area

Zoning and Building Code Revisions

This approach involves agencies incorporating flexibility into building codes to help adapt to changes in climate. This includes limiting development in flood-prone areas, increasing building heights, using movable foundations, or requiring materials and foundations that are resistant to hazards such as fires or extreme wind. Updating height restrictions by freeboard elevation, which would allow buildings to be raised for flood protection purposes, and revising the grading ordinance to reflect sea level rise projections are two examples.

Applicability to Goleta Sectors: Land Use and Structures

Applicability to Goleta Sub-Areas: Coastal Resources Area, Southwest Residential Area, Northwest Residential, Central Area, Central Resource Area, Northeast Residential, Northeast Community Center, and Old Town Area

Coastal Hazard Zoning Overlays

This measure identifies areas that are vulnerable to a set of specific hazards. Within each hazard zone, there can be a restriction on the types of development (e.g., residential), a basis for setback lines, or triggers for site-specific technical analyses or studies (e.g., geologic report triggers, slope stability analysis).

Applicability to Goleta Sectors: Land Use and Structures

Applicability to Goleta Sub-Areas: Coastal Resources Area, Southwest Residential Area, Northwest Residential, Central Area, Central Resource Area, Northeast Residential, Northeast Community Center, and Old Town Area

Downzoning for Coastal Hazards

Downzoning is the process by which an area of land is rezoned to a usage that is less dense and less developed than its previous usage. This is typically done to limit sprawl and overgrowth of cities; however, it can also be applied in cases where hazards are present in order to lessen the amount of damage during a flood or similar event. One example is the downzoning of the

Ellwood Onshore Facility, which was downzoned upon City incorporation in 2006 from industrial to open space, and is now legally non-conforming. The site is to be remediated and restored following termination of oil and gas activities.

Applicability to Goleta Sectors: Land Use and Structures, Oil and Gas, Hazardous Materials, and Natural Resources

Applicability to Goleta Sub-Areas: Coastal Resources Area, Southwest Residential Area, Central Area, and Old Town Area

Inlet Management

This measure is most applicable to flooding hazards associated with the seasonal beach closure of the Goleta Slough and Devereux Slough inlet, which results in a bathtub-like filling of the estuaries or sloughs. Inlet management can take many forms, including 1) mechanical breaching by dozer, 2) pre-grading or lowering the beach elevations, 3) performing restoration activities to increase storage volumes and promote tidal scour of the inlet, and 4) more engineered options with siphons and pump systems.

Applicability to Goleta Sectors: Land Use and Structures, Oil and Gas, Hazardous Materials, Water Supply, Public Access, Natural Resources, Transportation, Wastewater, and Utilities

Applicability to Goleta Sub-Areas: Coastal Resources Area, Southwest Residential Area, Central Area, and Old Town Area

Sediment Management

Sediment is nature's natural defense resource. This form of management uses different types of sediment to mitigate the impacts of rising seas. This form of soft protection either augments or alters where sediment accumulates. By replenishing or mimicking natural buffers or elevating land, habitats are less vulnerable to flooding, king tides, and erosion. In the Goleta Slough, several debris basins are actively managed, which alters where sediment would naturally accrete or deposit. Examples include dynamic cobble berms, mud placement into salt marshes, and beach or dune nourishment. Implementation can occur at a variety of scales, including changes in dredged sediment disposal, opportunistic sand placement from upland sources, or offshore mining from the seafloor.

Applicability to Goleta Sectors: Land Use and Structures, Public Access, Natural Resources, Coastal Armoring, Transportation, Wastewater, and Utilities

Applicability to Goleta Sub-Areas: Coastal Resources Area, Southwest Residential Area, Central Area, and Old Town Area

Passive Beach Dewatering

Passive beach dewatering involves the use of tubes placed in the beach, which help to lower the beach groundwater and increase natural sediment accretion. It works on the premise that when waves run up a dry beach, the ocean water will be deposited on the beach as the water infiltrates. During dropping tides this deposition does not work because the beach is saturated, so the sand is picked up off the beach and carried offshore. By drying the beach, natural deposition is increased. This has never been tried in California and thus is a rather scientifically uncertain approach, but it has been successful in other international locations. The characteristics for successful experiments elsewhere have included a high tide range, mixed sand grain sizes, and high sediment transport. Goleta has all of these. As a low cost adaptation option, it may be worth experimenting and monitoring in the near future.

Applicability to Goleta Sectors: Land Use and Structures, Public Access, and Natural Resources

Applicability to Goleta Sub-Areas: Coastal Resources Area

Seawalls or Revetments

A seawall or revetment is a structure separating land and water areas, primarily designed to prevent erosion and other damages caused by wave action. A seawall is usually a vertical structure made of wood or concrete, while a revetment is a pile of rock built at a stable angle with enough weight of the armor stone to withstand erosive wave forces. The City General Plan/Coastal Land Use already precludes future coastal armoring for new development.

Applicability to Goleta Sectors: Not Applicable

Groins

Groins are structures built perpendicular to the beach with the objective of capturing or retaining sand. Sand capture occurs as sand is transported alongshore by the waves. When the sediment being transported alongshore encounters the groin, the currents and sediment are diverted offshore into deeper water where the currents slow down, depositing much of their sediment load. Existing groins in the Santa Barbara channel have been shown to cause down-coast erosion.

Applicability to Goleta Sectors: Not Applicable

Artificial Reefs/Submergent Breakwaters

The artificial reef (submerged breakwater) is a variation of the common shore-parallel emergent breakwater in which the structure crest is below the surface. The artificial reefs can cause waves to break offshore, dissipating the wave energy. While they have some benefits because of their low aesthetic impact, enhanced water exchange, and recreational benefits (e.g., fishing, surfing, diving), they become less effective when the water over the crest deepens. Unfortunately, this is a result of storm wave events and sea level rise.

Applicability to Goleta Sectors: Not Applicable

6. Implementation

6.1 Planning Implementation

City of Goleta Local Coastal Program

The City's LCP has an important role to play in adaptation planning. The Land Use Plan lays out the policy framework for addressing climate change, whereas the Implementation Plan provides site-specific regulatory implementation language. The policies, along with implementing language, can influence the level of consequence from climate change impacts.

2002 California State Lands Commission Beach Hazard Cleanup/Mitigation Plan

The City supports existing and new efforts to identify and properly remove remnant piers, bulkheads, derelict oil well materials, and other beach hazards. The City encourages implementation of the State Lands Commission's Beach Hazards Removal Project, which was approved by the State Lands Commission in May 2002, but not implemented due to state budget limitations. Additionally City funding is required to expedite the planned removal of the existing seawalls and related debris. Portions of the steel-reinforced wooden seawall along the eastern frontage of the Sandpiper Golf Club (east of the shoreline oil piers of State Lease 421) should be removed, as such portions are exposed seaward of the toe of the bluff. This requirement does not apply to the rock revetment that protects the access road to the State Lease 421 Piers, until these wells are properly abandoned and the pier structures are removed.

2012 City of Goleta Community Wildfire Protection Plan

In addition to gathering background information to develop an understanding of the City's fire history, the initial data collection work effort included an evaluation of City policy considerations and management approaches, sensitive environmental resource areas, infrastructure locations, and critical data gaps. The Community Wildfire Protection Plan includes a hazard assessment, risk assessment, and fire hazard mitigation plan. The City approved this plan as a programmatic plan in March 2012. This plan did include discussion of climate-related impacts.

2011 Santa Barbara County Multi-Jurisdictional Hazard Mitigation Plan

The 2011 Santa Barbara County Multi-Jurisdictional Hazard Mitigation Plan was prepared with input from County residents and responsible officials, and with the support of the State of California Governor's Office of Emergency Services and FEMA. This plan will guide the County toward greater disaster resistance in harmony with the character and needs of the County and its communities. It is the County's intent that this plan will be used as a tool for stakeholders to increase awareness of local hazards and risks, while at the same time providing information about options and resources available to reduce those risks.

City of Goleta Capital Improvement Program

The Capital Improvement Program (CIP) allows the City to identify the needs of the community and to prepare a long-term funding strategy to meet those needs. The CIP includes any project that involves needed repairs or improvements to existing infrastructure (streets, parks, city facilities, etc.) and the acquisition or construction of new infrastructure. The City inherited a list of CIPs from the County upon incorporation. This included a portion of the transportation improvement projects identified in the County's Goleta Transportation Improvement Program. It is intended to address infrastructure needs associated with both existing and future development identified in the General Plan. The CIP does not have any discussion of climate change impacts.

6.2 Financing Implementation

FEMA's Hazard Mitigation Assistance

As there is overlap between LCP planning and Local Hazard Mitigation planning, FEMA's Hazard Mitigation Assistance grant programs provide significant opportunities to reduce or eliminate potential losses to the City's assets through hazard mitigation planning and project grant funding. Currently, there are three programs: the Hazard Mitigation Grant Program, Pre-Disaster Mitigation, and Flood Mitigation Assistance.

Geologic Hazard Abatement Districts

Geologic Hazard Abatement Districts (GHADs) provide a potential means for future renovations or improvements to flood control structures, including future alterations that may be necessary because of sea level rise. By accumulating a funding reserve for future maintenance and rehabilitation, a GHAD can provide the financial resources necessary for potential future expansion of flood control structures. Further, because of the relative safety of GHAD revenues (GHADs are typically financed through the collection of supplemental tax assessments), GHADs can borrow from lenders or issue bonds with very attractive credit terms.

Infrastructure Financing Districts

California has recently passed a bill allowing cities and other entities to create enhanced infrastructure financing districts; this allows incremental property tax revenues to be devoted to a specified purpose such as a fund for cleanup, or infrastructure adaptation costs. With the passage of Assembly Bill 313 and Senate Bill 628, the requirements for establishing these districts has been streamlined.

Innovative Structured Fees

Certain structured fees could be established to generate revenues for 1) covering the necessary planning of, technical studies for, design of, and implementation of adaptation strategies or 2) developing an emergency cleanup fund to be able to respond quickly and opportunistically following disasters. Disasters, through a different lens, are opportunities to implement changes. A good example is the Beach Hazard Removal Project, which was activated shortly after the March 2014 storm when the sand on the beach had been removed, naturally exposing many of the legacy oil and gas infrastructure hazards.

Sand Mitigation Fees and Ecosystem Damage Fees

There are two structured fees that the CCC currently uses to address the impacts of coastal armoring—sand mitigation fees and a relatively new ecosystem damage fee. The sand mitigation fee is a fee intended to mitigate for the loss of sand supply and the loss of recreational beaches in front of coastal armoring structures. The ecosystem damage fee is intended to provide mitigation funds to restore the damages to the coastal habitats from the development. These could be to restore rocky intertidal habitat, sandy beach and dune habitat, or wetland habitats.

Rental Surcharge Fees

A new type of fee would be a rental surcharge fee for property owners with armoring and coastal structures that occupy a portion of the public trust beach below MHW. For these structures, there would be an annual lease or rent for the ability to have a structure occupy the public trust resource (i.e., beaches). This rent would increase each time the tidal epoch was updated and MHW moved farther landward as more of the structure occupied more of the beach.

Increase Taxes

The City could also use more traditional mechanisms such as raising the sales tax and devoting a portion to these costs. Since the City recently raised ToTs to 12 percent, an additional increase in ToTs may be more difficult.

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7. Policy and Regulatory Recommendations

7.1 Introduction

The City is recommending updating or adding the following policy and regulatory language into the LCP. Where applicable, the corresponding California Coastal Act Sections have been referenced. Note: The actual implementation of these policies and regulations may vary based on a variety of factors, including applicable policies and location- or project-specific factors that may affect feasibility.

7.2 Minimize Coastal Hazards through Planning and Development Standards[1]

The City should adopt the mapped Coastal Flood Hazard Zones.

The City should adopt the Coastal Flood Hazard Zones as displayed in this report as part of the LCP. Updating land uses and zoning requirements to minimize risks from sea level rise in the identified costal flood hazard zones can better prepare the City for such hazards. The Coastal Flood Hazard Zones would trigger the following:

- Real Estate disclosures for coastal and climate-induced hazards.
- Triggers for a site-specific hazard report.
- Building code revisions, such as movable foundations.
- Changes to building heights to accommodate additional freeboard elevation.

The City should develop a Repetitive Loss Clause Program for properties within the Coastal Flood Hazard Zones.

The City should develop a Repetitive Loss Clause Program as part of the LCP that would assist in the process of properties being rezoned over time to accommodate increased coastal flooding and related impacts. An example of this would be possibly rezoning the Placencia neighborhood. If a building has been severely damaged or repeatedly flooded, the City can designate the property as "substantially damaged" or a "repetitive loss property." The policyholder is then required to rebuild it in a flood-safe way, which usually means elevating or moving the structure. Through the Flood Insurance Reform Act of

[1] The applicable CCC Sections are: 30253, 30235; 30001, 30001.5.

2004 (FIRA 2004), Congress directed FEMA to develop a program to reduce future flood losses. The Severe Repetitive Loss Grant Program makes funding available for a variety of flood mitigation activities. Under this program, FEMA provides funds to state and local governments to make offers of assistance to National Flood Insurance Program–insured severe repetitive loss residential property owners for mitigation projects that reduce future flood losses through:

- Acquisition or relocation of at-risk structures and conversion of the property to open space;
- Elevation of existing structures; or
- Dry flood proofing of historic properties.

The City should require new development to avoid coastal flood hazards in the Local Coastal Program.

In order to minimize the adverse effects of sea level rise, flooding, and storms, it is important to carefully consider decisions regarding areas vulnerable to flooding, inundation, and erosion. The City should avoid permitting any significant new structures or infrastructure that will require new coastal armoring or flood protection from sea level rise, coastal flooding, or coastal erosion during the expected life of the structure. This should include careful long-term consideration of extending routine maintenance of existing levees or other protective measures. In some instances it may be better to rezone or acquire properties that are in hazardous areas. If the City permits development that will require new protection during the expected life of the new project, the City should require that the project proponent:

- Minimizes risks through siting, design and engineering.
- Requires viable funding sources for building, monitoring, and maintaining the new sea level rise protections. This should include a performance bond to repair, maintain, or remove the structures if they become public nuisances.
- Requires that any new development must consider how risk changes over time requires that actions to reduce risk in the short-term do not increase risk in the long-term (no maladaptation).
- Designs protection in a manner that maximizes conservation of natural resources and public access.

The City should require redevelopment strategies contained in the Goleta Old Town Revitalization Plan and Local Coastal Program to reflect sea level rise/coastal flood hazards.

This will require modifying the applicable building codes to enable structures to withstand higher water levels within the City's Coastal Flood Hazard Zones, including the portion within Old Town. For example, development and redevelopment in the City's Coastal Flood Hazard Zones may require additional setbacks, increased base floor elevations, limited first floor habitable space, innovative stormwater management systems, special flood protection measures, mitigation measures for unavoidable impacts, relocation and removal triggers and methodologies, etc. This may require a change in the maximum building height.

The City should update setback regulations in the Local Coastal Program.

The current cliff erosion setback policy contained in the existing Safety Element (SE) Policy 2.1 takes a conservative approach to calculating any potential development setback. This should be improved to account for an acceleration of historic erosion rates from sea level rise and the derelict existing coastal armoring. The policy should consider that there is a natural failure distance of cliff erosion that constitutes an "existing hazard." In Goleta that distance is about 15 to 25 feet and should be used as a trigger to develop and implement a retreat or other suitable adaptation strategy. Additionally, a more appropriate setback would entail a minimum forecast period of 100 years and include consideration of accelerated sea level rise and the size of an erosion event failure distances appropriate for the backshore type and failure mechanism. Variations to this standard could be tiered based on the type and size of proposed development. Some variances may be warranted on some parcels since strict application of setbacks may preclude redevelopment in some cases and trigger takings claims.

The City should incorporate sea level rise into calculations of the Geologic Setback Line.

The City should update geotechnical report requirements for establishing the Geologic Setback Line (bluff setback) to include consideration of bluff failure mechanisms, accelerated retreat due to sea level rise in addition to historic bluff retreat data, future increase in storm or El Niño events, and any known site-specific conditions. Consider approving significant new foundation work only when it is located inland of the setback line for new development, or when it changes the type of foundation to one that is conducive for relocating structures when they become threatened from erosion, and only when it will not interfere with coastal processes in the future.

The City should provide policy and regulatory triggers for relocation and removal of structures in the Local Coastal Program.

The LCP would contain policies for phased removal of existing development (i.e., the Bacara Resort and Spa and Sandpiper Golf Club). These policies should be implemented in the Implementation Plan (i.e., Zoning Code) through a variety implementation mechanisms, such as rolling easements and incentive programs, based on defined triggers. The boundary for said triggers could be based on such variables as the mean high tide line, proximity to the cliff edge, other dynamic line, or legal requirement. These triggers should allow enough time to identify appropriate actions and to plan and implement said actions. The regulatory triggers for relocation or removal of the structure would be determined by changing site conditions, such as when erosion is within a certain distance of the foundation, monthly high tides are within a distance of the finished floor elevation, building officials prohibit occupancy, or wetland buffer area decreases to a certain width.

The City should develop and adopt a Transfer of Development Rights Program within the Local Coastal Program.

The LCP should establish policies to implement a Transfer of Development Rights (TDR) program to restrict development in areas vulnerable to sea level rise and allow for transfer of development rights to parcels with less vulnerability to hazards. A TDR program can encourage the relocation of development away from at-risk locations, and it may be used in combination with a buy-out program. A TDR program could also be used to promote other smart planning principles such as infill development and mixed uses.

The City should protect critical infrastructure contained in the Capital Improvement Program.

The CIP should contain special considerations for critical infrastructure and facilities (e.g., City bridges, roadways) affected by coastal flood hazards. The City should establish measures that require continued function of critical infrastructure, or the basic facilities, service, networks, and systems needed for the functioning of a community. Repair and maintenance, elevation or spot-repair of key components, or fortification of structures where consistent with the California Coastal Act may be implemented through Coastal Development Permits. An additional section should be added to the CIP that identifies the remaining expected life of the infrastructure and how and where any relocation may occur.

The City should retrofit existing transportation infrastructure as necessary and consistent with the Capital Improvement Program.

In instances where relocation is not an option, the City should repair damage and/or retrofit existing structures to better withstand sea level rise impacts. For example, use stronger materials, elevate bridges or sections of roadways, and build larger retention capacity or additional drainage systems to address flooding concerns. Additionally, the City should provide alternate routes, as possible, to allow for access to and along the coast in instances in which sections of roadways may become temporarily impassible as a result of coastal hazards. The City should improve the communication of alternate route information to residents and visitors alike.

7.3 Maximize Protection of Public Access, Recreation, and Sensitive Coastal Resources

The City should protect public recreation resources consistent with the Ellwood-Devereux Coast Open Space and Habitat Management Plan.

Recognizing that sea level rise will cause the public trust boundary to move inland, new shoreline protective devices should not result in the further loss or encroachment on public trust lands. Therefore, the City should allow dune erosion of Access Points E and F and inward migration of public trails (i.e., use of non-permanent materials).

The City should plan for retrofitting or relocating sections of the California Coastal Trail.

This can be accomplished through the use of boardwalks, bridges, and/or other design features to maintain continuity of the California Coastal Trail in sections that are vulnerable to coastal hazards. Some sections will need to be relocated over time. The LCP should identify vulnerable sections of the California Coastal Trail and establish a phased approach to relocate sections of the trail in such a way that is consistent with provisions of the Coastal Act and requires that the trail remains within sight, sound, or smell of the sea.

The City should protect Public Access at Haskell's Beach.

As Haskell's Beach is the only designated Coastal Public Access for the City, the City should design and implement natural (i.e., soft) solutions for protection of public access. The City could establish a program to minimize loss of beach area through an opportunistic beach and cobble nourishment program, or other actions.

The City should develop an opportunistic sand placement program.

Consistent with the initial recommendation in the Coastal Regional Sediment Management Plan, the City should participate in the BEACON regional opportunistic sand management activities and use opportunistic sediment to improve beach and wetland resiliency. This should not be considered an effective long-term erosion mitigation strategy because of the limited volumes of sediment. We assume that the volumes of available opportunistic sand are small; however, there may be future opportunities to obtain larger volumes of sand, which would be incorporated into a larger nourishment alternative.

The City should implement the adopted Community Wildfire Protection Plan.

The purpose of the Community Wildfire Protection Plan is to enhance community wildfire protection by identifying fire hazard treatments, which are in balance with sustainable ecological management and fiscal resources. The fuel management prescriptions for each of Goleta's Vegetation Management Units were developed to guide treatments to achieve a less hazardous fuel profile. Future updates of the Community Wildfire Protection Plan should include updates of climate change projections for precipitation, wildfire, and temperature.

The City should complete and adopt the Monarch Butterfly Inventory and Habitat Management Plan.

The purpose of the Butterfly Habitat Management Plan is to identify low impact habitat improvement strategies to protect long-term monarch butterfly population viability. Fuel treatments in areas near human developments are critical measures in the wildfire protection strategy for both residences and butterfly aggregations and habitat. Trees along grove edges buffer aggregation sites from wind and weather; therefore, it is important to maintain adequate tree density within these edges. Larger trees are not the primary fuel of concern in the spread potential of wildfire; rather, the understory vegetation, dead-downed trees, and fuels creating fire ladders pose the greatest hazard and threat. Future updates of the Monarch Butterfly Inventory and Habitat Management Plan should include updates of climate change projections for precipitation, wildfire, and temperature and implications for species habitat concerns

7.4 Maximize Agency Coordination and Public Participation[2]

The City should continue to build education and community awareness about coastal hazards.

The City should invest in efforts to raise awareness of the limitations of flood insurance and disaster relief and the costs associated with

[2] The applicable CCC Chapter 5 policies; Sections 30006, 30320, 30339, 30500, 30503, and 30711.

response and recovery efforts associated with various anticipated sea level rise impacts, some of which have been identified in this report. Given the high costs estimated to manage the hazards resulting from coastal erosion, we recommend public outreach and citizen initiatives to document the extents of floods and real estate disclosures to educate property owners on the risks of coastal hazards. Additionally, the City will educate the residents, tourists, etc. by providing signage that effectively depicts previous flood depths and elevations.

The City should continue to coordinate with surrounding jurisdictions, the Goleta Slough Management Committee, and the Beach Erosion Authority for Clean Oceans and Nourishment.

Given the limited ability of the City to resolve slough-related hazards and adapt to the impacts of climate change along with the multitude of coastal management, sea level rise planning, research, and guidance efforts occurring in Santa Barbara County, it is critical for the City to continue to share information, coordinate efforts, and collaborate where feasible to leverage existing work efforts. Specifically with the Goleta Slough, continued involvement with the Goleta Slough Management Committee is important to improving consistency. For adaptation issues along the wave exposed Goleta coast, continued involvement with BEACON remains important for sea level rise and related coastal hazards adaptation planning. Both the Goleta Slough Management Committee and BEACON include multiple jurisdictions, so there is the ability to share lessons learned, cooperate on funding applications, and coordinate on multi-agency reviews and decision-making. Finally, the City should encourage a balanced approach for Goleta Slough Mouth management of water and sediment management.

The City should continue to participate in the Santa Barbara County Local Multi-Hazard Mitigation Plan.

The purpose of the Santa Barbara County's Multi-Hazard Mitigation Plan is to significantly reduce deaths, injuries, and other disaster losses attributed to natural- and human-caused hazards. This plan can continue to be used as a tool for all stakeholders to increase public awareness of local hazards and risks, while at the same time providing information about options and resources available to reduce those risks. Additionally, the plan will provide continued Inter-Jurisdictional Coordination of Mitigation-Related Programming to support funding proposals for mitigation initiatives. The City may wish to develop its own Local Hazard Mitigation Plan, which would make it eligible for direct implementation and disaster preparedness funds.

The City should continue to coordinate with surrounding jurisdictions and entities responsible for oil and gas response activities.

Oil and gas issues are contentious and expensive. An oil spill poses one of the most significant potential fiscal impacts to the City. Recent experiences from the Refugio Oil Spill and the Summerland Leaking legacy wells highlight the shortcomings and regulatory hurdles that interfere with responding quickly to an oil spill. The City should instigate and support an oil and gas roundtable that would discuss oil and gas response and share lessons learned. Such a forum would include the State Lands Commission, the Office of Oil Spill Prevention and Response, the Coastal Guard, and regional jurisdictions. Such a forum could establish itself as a Joint Powers Authority and seek to cooperate on a regional environmental document to streamline permitting for a rapid response of legacy wells.

8. Monitoring

8.1 Introduction

The importance of monitoring is critical in order to develop the appropriate feedback loop to incorporate the results of the coastal hazards vulnerability assessment and fiscal impact analysis in order to assist decision-makers. Upon certification of the City's LCP, adaptation strategies will be implemented through the certified implementing ordinances and related processes and actions (e.g., local review of CDPs, proactive action plans). Additionally, an important component of successful adaptation is to secure funds for implementation, regularly monitor progress and results, and update any policies and approaches as needed. Sea level rise projections should be re-evaluated and updated as necessary. Therefore, the City is recommending the following:

- Monitor physical environment to identify when the City is nearing thresholds.
- Study beach profiles to understand variability in sand supply and erosion.
- Monitor beach elevations around coastal armoring structures to determine impacts on elevations on the narrower beaches in front of the structures. Compare with elevations at adjacent unarmored control sites.
- Conduct structural monitoring to identify when there is an impact on beach elevations (and thus ecology and ESHA) and lateral access.
- Monitor sea level rise trends from local tide stations.
- Monitor inland extent of inundation and duration of flooding at key locations (e.g., Placencia neighborhood).
- Conduct biological monitoring of sensitive and endangered species.
- Conduct habitat monitoring to understand relationships between habitats/elevation and duration of inundation.
- Support monitoring of specific climate variables that affect habitat location.
- Stay current on climate science related to precipitation, wildfire, and temperature.
- Monitor hydrology data, including water levels in the sloughs and stream flows in the creeks.
- Monitor pre-and post-storm monitoring—erosion extents, high water marks, and inland locations of flooding.

8.2 Optional Studies

Based upon input from Revell Coastal, the City is recommending the following optional studies to further expand the City's knowledge base as well as better inform future decision-making. They are as follows:

- Model future creek flooding that incorporates climate impacts to precipitation and sea level rise.
- Estimate economic and engineering cost estimates for select adaptation strategies.
- Analyze and map the social vulnerabilities and related environmental justice issues.
- Conduct hydrodynamic urban flood models to identify the flow pathways leading to flooding.

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9. Conclusion

The City's economy and quality of life are intrinsically linked to the coastline, environmental sensitive habitats, public access, and recreational opportunities. Because of the City's unique geographic location, geomorphology, and dependence on coastal resources, the City is particularly valuable to the effects of climate-induced coastal hazards and their associated impacts, ranging from coastal flooding to dune/cliff erosion. This report assesses the City's vulnerability to current and future sea level rise and presents recommendations that will reduce the level of risk. This information will assist the City in making more informed decisions regarding land use and development standards from the project level (e.g., coastal development permits, land use permits) to the plan level (e.g., Old Town Revitalization Plan, Community Wildfire Protection Plan, etc.).

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11. Acknowledgments

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Appendix A. Sector Profile Results

This appendix contains sector profiles that summarize the findings and recommendations that can be used in future decision-making. Each sector has its own profile, complete with a vulnerability map and 2-page description of findings for ease of communication. The vulnerability maps contain a combination of the existing FEMA creek flood maps and the projected future coastal hazards. The only exception will be Water Supply and Utilities, due to confidentiality of infrastructure locations of such, they are without maps. They are as follows:

A. Land Use and Structures: Old Town Area

B. Land Use and Structures: Coastal Resources Area

C. Coastal Armoring

D. Oil and Gas

E. Hazardous Materials

F. Natural Resources

G. Public Access

H. Transportation

I. Water Supply

J. Wastewater

K. Utilities

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Land Use and Structures - Old Town Area

Land Use and Structures: Overview

There are **5** land use categories that occur within the Old Town Area which includes Old Town and portions of the surrounding City, including: (1) residential, (2) industrial, (3) commercial, (4) infrastructure, and (5) recreation/open space.

Existing Conditions

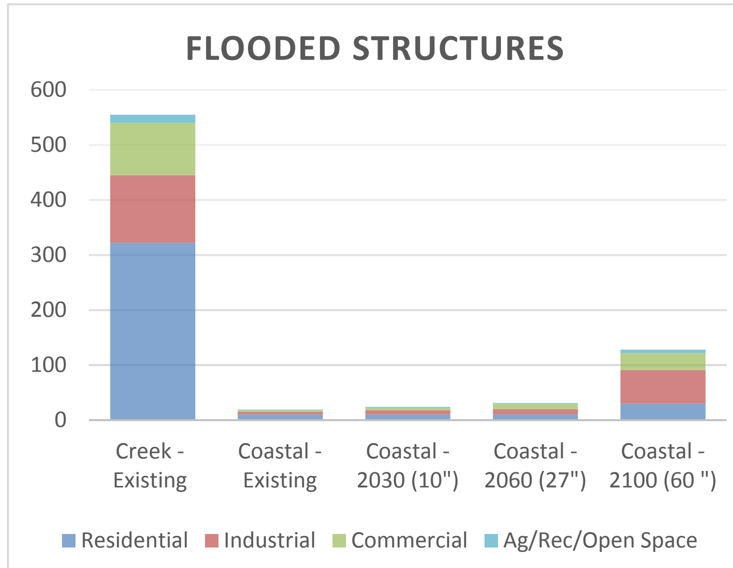
__Description__: Old Town is recognized as a unique asset and historic center of Goleta. Future development and redevelopment actions are required to respect the current diversity of uses while maintaining Old Town's unique character.

__Vulnerabilities:__ Land use and structures are primarily subject to existing creek flooding and coastal flooding associated with a closed Goleta Slough Mouth. This barrier beach flooding mainly impacts structures and land uses in the Palencia neighborhood, Aero Camino, Storke Ranch, and the neighborhoods between Fairview Ave and Highway 217. For details on the locations of the impacted neighborhoods, refer to Figure A.

__Measures of Impact__:

- Parcels by land use
- Structures by land use (flooding)
- Square footage of structures by land use (adaptation)

Vulnerabilities: Flooding of Structures



Fiscal Impacts

__Damages:__ Caused primarily by barrier beach flooding.

Residential damages are relatively small in comparison to those of the light-manufacturing sector located within Old Town, which by the year 2100 includes 50 industrial businesses that may contain specialized equipment with replacement costs higher than estimated by FEMA.

Damages	2010	2030	2060	2100
Residential	$0.2 M	$0.3 M	$0.4 M	$1.4 M
Industrial	$0.2 M	$0.5 M	$0.7 M	$10.0 M
Commercial	$0.1 M	$0.2 M	$0.4 M	$2.6 M
Total	$0.6 M	$1.0 M	$1.5 M	$14.0 M

__Cleanup costs:__ could range between $0.5 million and $4.5 million depending on the magnitude and extent of the flooding.

Cost to Elevate	2010	2030	2060	2100
Residential	$1.9 M	$1.9 M	$1.9 M	$9.6 M
Industrial	$1.2 M	$30.0 M	$31.0 M	$130.0 M
Commercial	$0.7 M	$2.7 M	$3.9 M	$48.5 M
Total	**$3.8M**	**$35.0 M**	**$37.0M**	**$188.4 M**

Adaptation Strategies

__Range of Strategies:__ Includes "No Action" and clean up, policy, and regulations, as well as retreat, accommodate, and protection strategies as defined by the California Coastal Commission.

Retreat - Includes policy and/or regulatory options (e.g., downzoning, transfer of development, FEMA repetitive loss clause, and rolling easements) as well as purchase of the vulnerable properties.

Accommodate - Includes elevating structures and inlet management. The reduction in vulnerabilities associated with inlet management supports some hybrid approaches, but management of the Goleta Slough inlet is outside the City's authority.

Elevating - In the short term (approximately 2030) elevating buildings less than 1 foot to avoid flood cleanup costs at a cost of approximately $3.8 million makes more economical sense considering damages and cleanup costs from a large flood event (approximately $5.1 million). Over the medium and long term time horizons (2060, 2100), elevating structures more than 2 feet appears to be maladaptive. **By 2100, estimated damages and cleanup costs could be approximately $18.5 million following a major storm event versus the cost to elevate all of the vulnerable structures at an estimate cost of approximately $188.4 million.**

Inlet Management - With inlet management, the number of structures exposed by 2100 drops from 129 to 14. Furthermore, inlet management __with elevation of__ at risk structures equates to about $5.1 million; whereas inlet management __with purchase of__ at risk parcels would cost an estimated $3.6 million in 2015 dollars.

Protect - The construction of levees to prevent flooding within the most vulnerable neighborhoods is a "gray" protection approach, whereas a "green" protection approach would consist of contoured transitional slopes to accommodate flooding.

__Secondary Impacts:__ Retreat and elevation strategies have few secondary impacts. Inlet management could impact ESHA and listed species. Gray protection options would result in a loss of ESHA wetlands over time Green protection strategies may benefit wetlands by increasing wetland transition slopes.

Findings and Recommendations

__Findings:__

- Existing creek hazards (FEMA) are the highest hazard in the City. Coastal flooding will be exacerbated by SLR, however future climate impacts on creek flooding not available.
- Coastal flooding damages to structures in Goleta could increase dramatically by 416% between the time horizons of 2060 and 2100.
- Adaptation costs to elevate and accommodate coastal flooding by 2100 ($175 million) exceed damages ($14 million) and cleanup (approximately $5 million) by an order of magnitude.
- The Storke Ranch neighborhood becomes exposed around 2100, when Goleta and Devereux Sloughs come together.
- Coastal flooding impacts the light manufacturing sector the greatest between 2 and 5 feet of SLR during the time period of 2060 to 2100.

__Recommendations:__

- Conduct coastal confluence modeling to better assess future vulnerabilities associated with stream flood hazards exacerbated by sea level rise to provide projections of future flood extents and depths.
- Engage in regional inlet management discussions with the City of Santa Barbara and the County of Santa Barbara.
- Establish a repetitive loss policy to trigger eminent domain in combination with a Transfer of Development (TDR) Program. Once a property had multiple flood insurance claims the policy would take effect.
- Adjust building codes to allow for increased building heights by additional freeboard based on sea level rise projections for parcels projected to be impacted by flooding after 2060.

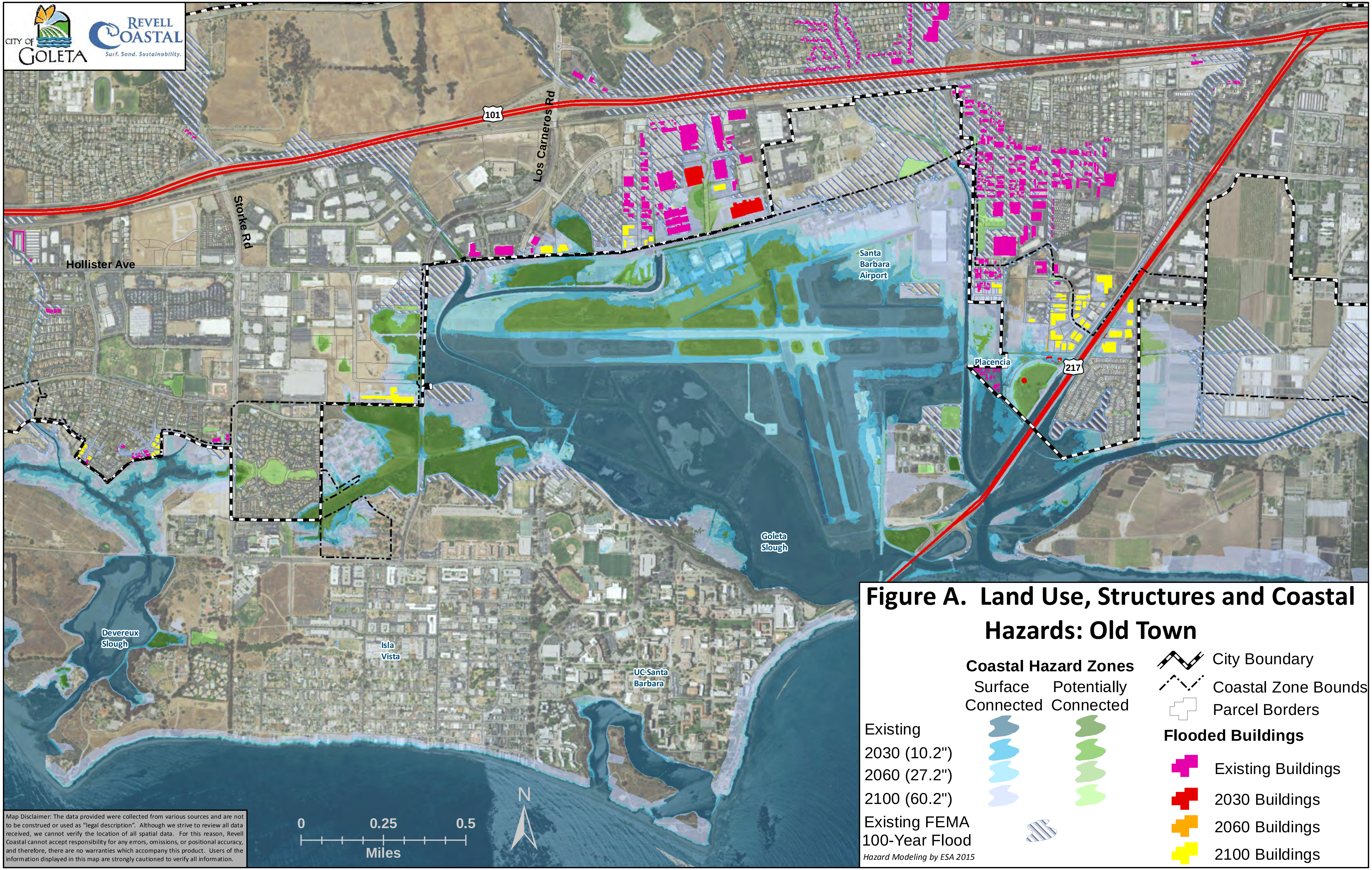


Figure A. Land Use, Structures and Coastal Hazards: Old Town

Land Use and Structures - Coastal Resources Area

Overview

There are **5** land use categories that occur within the Coastal Area including: (1) residential, (2) industrial, (3) commercial, (4) infrastructure, and (5) agriculture/open space.

Existing Conditions

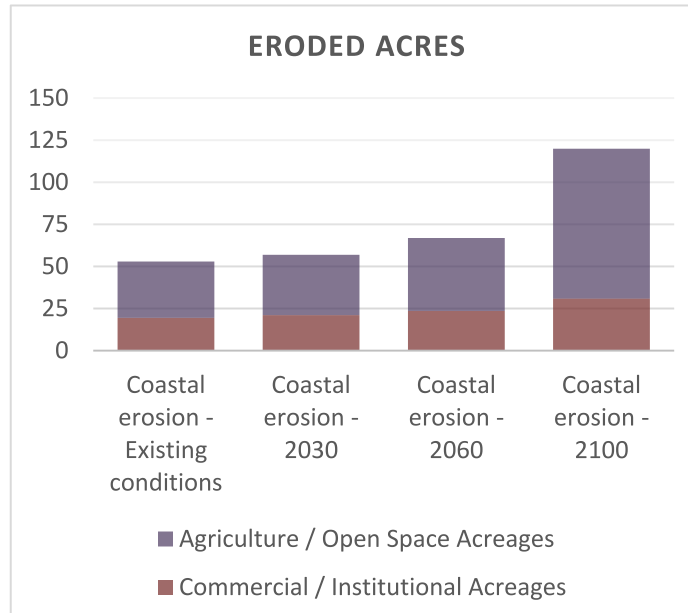
Description: This area includes Goleta's Pacific shoreline and only coastal resort (Bacara Resort and Spa), as well as open space resources such as the Ellwood Mesa Open Space/Sperling Preserve, which supports active and passive recreation, including public access and coastal-dependent recreational uses. The area's significant environmental values and resources are protected and being restored to a natural condition. Sandpiper Golf Club and the Ellwood On-shore Facility (EOF) are also located along the coast.

Vulnerabilities: Coastal erosion directly impacts 6 buildings (139 rooms and hotel facilities) along the coastline on the Bacara Resort and Spa property and approximately 6 greens and their associated holes within the Sandpiper Golf Club property. Please refer to Figure B.

Measures of Impact:

- Parcels by land use
- Acres by land use (coastal erosion)

Vulnerabilities—Flooding of Structures



Fiscal Impacts

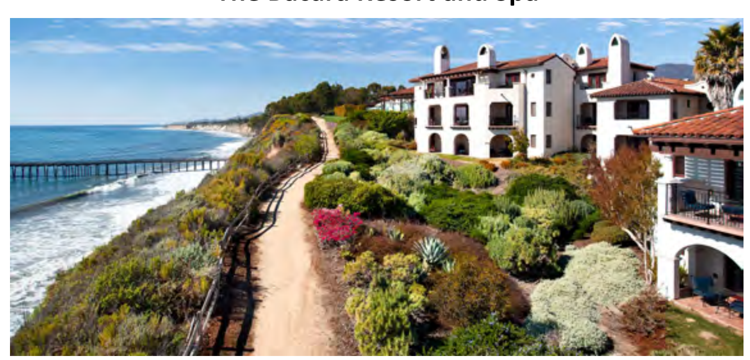
Damages: Commercial and recreation open space related structures are subject to coastal erosion damages.

The Sandpiper Golf Club will not be substantially affected until 2100, after which various greens and their associated holes will need to be reconfigured (costs not estimated for this project).

Six buildings at the Bacara Resort and Spa, which equates to 139 guest rooms at hotel facilities, will potentially be impacted from erosion with 2 to 3 feet of SLR (2060). Room closures may result in loss of transparency occupancy tax (ToT) revenues. This equates to approximately $2,935 per day ($88,058/month) during high season and approximately $2,051 per day ($61,530/ month) during low season.

Public vs Private: The erosion damages/replacement costs will be borne by private parties. However, the City could lose ToT revenues from the Bacara resort.

The Bacara Resort and Spa



Adaptation Strategies

Range of Strategies:

Retreat - This can be accomplished by condemning existing buildings and relocating them further back into the property. The cost for retreating luxury hotel rooms ranges from $239,100 to $518,400 per room. Thus, the cost of moving/replacing these structures is approximately in the range of $33 million to $72 million for 139 rooms. Retreat and reconstruction for the Bacara Resort Beach House located at Haskell's Beach is estimated at approximately $421,000.

Accommodate - Retrofit foundations so cliff erosion can continue and buildings either be moved back from the edge once erosion gets within a set distance or remain on pile supported foundations.

Protect – A "gray" approach would be to armor cliffs (i.e., seawall) to prevent coastal erosion. Coastal armoring is presently banned in the City General Plan policies. The "green" approach would be to nourish the adjacent beaches with sand and cobbles to reduce wave exposure and erosion.

Secondary Impacts:

Retreat strategies would present a few secondary impacts. The accommodation strategies may have some minor impacts to public access and aesthetics depending on the rates of erosion and/or relocation of structures. Gray protection options (currently not allowed in City General Plan/Local Coastal Plan policies) would result in a loss of beach over time, impacting ESHA, recreation, and requiring increasing maintenance costs to both the City and to Bacara Resort and Spa. Green protection strategies would have short to medium impact on ESHA and public access and relatively high long term maintenance costs.

Findings and Recommendations

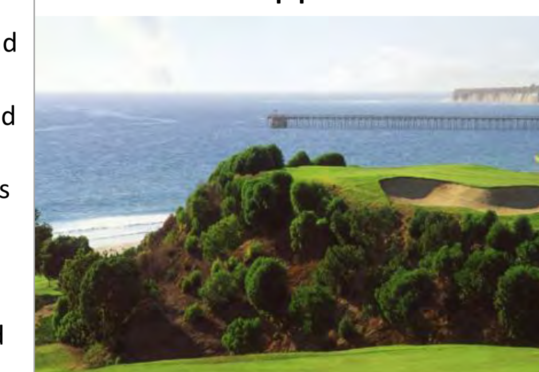
Findings:

- Presently, the Bacara Resort Beach House is vulnerable to all of the coastal and creek hazards.
- By 2060, erosion may impact or threaten 6 buildings with 139 guest rooms and a restaurant at the Bacara Resort.
- Closure of these buildings may result in substantial losses to City ToT revenues equating to approximately $2,935/day ($88,058/month) during high season and approximately $2,051/day ($61,530/month) during low season.
- Erosion affects the same 6 parcels across the entire City.
- By 2060, Sandpiper Golf Club would be impacted and by 2100 probably would need to realign course.
- Substantial increases in damages occur after 2 feet of sea level rise between 2060 and 2100.

Recommendations:

- Any future build out at Bacara in alignment with their approved CDP should designate relocation sites.
- Consider revising building code to accommodate movable foundations and elevate building heights.
- Require any abandonment or relocation to remove derelict or threated structures.
- Refer to Public Access Sector Profile for additional recommendations regarding beach access, trails, and Beach House facilities.
- Refer to Oil and Gas Sector Profile for additional recommendations regarding 421 piers and other oil and gas facility recommendations.

The Sandpiper Golf Club



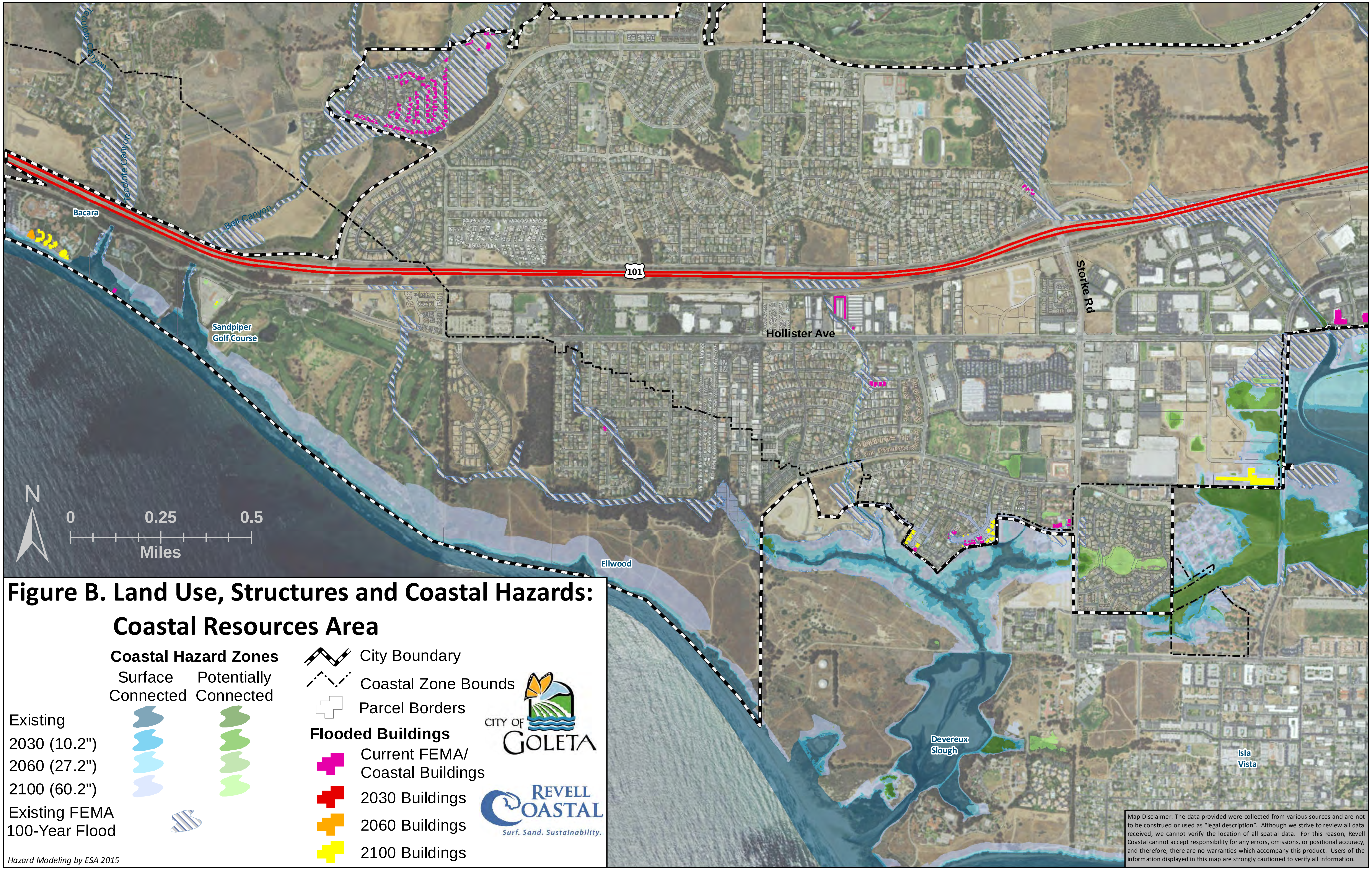


Figure B. Land Use, Structures and Coastal Hazards: Coastal Resources Area

Coastal Armoring

Overview

The coastline along the Coastal Resource Planning Sub-Area has remnants of a timber sheet pile seawall. This structure, related to historic oil and gas extraction, was built on the beach and backfilled to provide driving access to the host of oil piers that once lined this coastline.

A sea wall/revetment-supported access road remains in place to protect an access road to the last two remaining active oil/water injection piers associated with the 421 Lease Piers below Sandpiper Golf Course. Following the February 2014 storm event, the Beach Hazards Removal Program permitted by the State Lands Commission (CSLC) and City was partially implemented and removed approximately 900 linear feet of these derelict armoring hazards.

Measures of Impact

To quantify the impact of coastal hazards and climate change on coastal armoring, the following measures of impacts have been identified:

- Length of structures
- Cost of removal

For details on the locations of the coastal armoring structures, refer to Figure C.

Existing Conditions

Historical

City of Goleta Shoreline 10/30/1930
Photo: Spense Collection at UCLA

Present

Presently **all** of the coastal armoring in the City is exposed to coastal erosion and coastal flooding. This translates to all of the future vulnerabilities remaining the same across all time horizons.

<u>Coastal Erosion and Coastal Flooding</u>

- 1,613 feet of revetment
- 2,914 feet of remnant timber seawall
- 854 feet of remnant H beams
- 5,381 feet of total armoring

<u>Ownership</u>

- 421 Road – 1,937 feet
- Sandpiper Golf Club – 2,012 feet
- CSLC/City – 1,432 feet

Vulnerabilities

2030

<u>Coastal Erosion and Coastal Flooding</u>

- 1,613 feet of revetment
- 2,914 feet of timber seawall
- 4,527 feet of total armoring

Sea level rise will result in continued failure of coastal armoring and escalating erosion.

2060

<u>Coastal Erosion and Coastal Flooding</u>

- 1,613 feet of revetment
- 2,914 feet of timber seawall
- 4,527 feet of total armoring

Sea level rise will result in continued failure of coastal armoring and escalating erosion.

2100

<u>Coastal Erosion and Coastal Flooding</u>

- 1,613 feet of revetment
- 2,914 feet of timber seawall
- 4,527 feet of total armoring

Sea level rise will result in continued failure of coastal armoring and escalating erosion.

Fiscal Impacts

<u>Damages:</u> Removal cost for the remaining 5,381 feet of coastal armoring ranges from approximately $915,000 to $1,075,000 (assuming a unit cost of $170 to $200 linear foot to remove).

<u>Fiscal Impact to the City:</u> The City may be liable for its portion of the remnant structures (approximately $243,440 - $286,400). Other facility owners would be liable for their portion (e.g. 421 road sea wall equates to a range of approximately $329,290 -$387,400; Sandpiper equates to a range of approximately $342,040 - $402,400).

<u>Adaptation costs:</u> Previous work completed during the March through April 2014 beach hazards removal activity was approximately $225,000 based upon estimates provided by the CSLC and contractor.

<u>Public vs private:</u> Existing seawalls along Ellwood Mesa are considered public property and the CSLC or the City will likely finance removal. The existing seawall protecting the Sandpiper Golf Course property is considered private property. Removal of any structure once it is below mean sea level would increase the cost.

Adaptation Strategies

<u>Range of Strategies:</u> The structures could either be removed or left to continue to deteriorate on their own over time.

<u>Secondary Impacts:</u> The long term impact of seawalls or revetments will equate to a narrowing of the beach width and ultimately impact beach recreation, lateral access, and sandy beach habitats (designated ESHA).

Continued removal of the existing armoring could maintain beaches for recreation, sandy beach habitat, and public access. Given the General Plan policy of no new structures for new development, the oil and gas piers removal of existing coastal armoring structures should be a high priority and the CSLC 2002 Beach Hazard Removal Program completed.

Because there is a cost to the City to pay for removal of the nuisance structures, financial incentives and fee structures could be put in place to pay for maintenance and removal of the structures as they continue to become derelict. For existing structures that protrude beyond the Mean High Water (MHW) shoreline limiting recreation, public access, and ESHA, a public trust resources lease could be leveraged to support other coastal recreation and ESHA improvements.

Additional Information

Recommendations

- Improve regulation, mitigation, and adaptive management of existing armoring projects.
- Allocate funds for the removal of derelict structures.
- Develop a sand/recreational loss fee policy in the General Plan/LCP Safety Element.
- Develop a public lands lease policy, which would require structures that extend beyond MHW to pay fees in the form of rent. These fees would pay for the removal of derelict structures and improve coastal public access or mitigate ESHA impacts.
- Support adaptation measures, including insurance programs and regulations that require and/or incentivize private property owners to assume the risks of developing in hazardous areas.
- Prohibit placement of backfill to shore up any remnant structures.

Existing Condition

Elwood Mesa Beach
Photo: D. Revell

Figure C. Coastal Armoring and Coastal Hazards

Coastal Zone Boundary   City Boundary

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Coastal Hazard Zones

	Surface Connected	Potentially Connected
Existing		
2030 (10.2")		
2060 (27.2")		
2100 (60.2")		
Existing FEMA 100-Year Flood		

Hazard Modeling by ESA 2015

Armoring Structure Type

- Revetment
- Timber Seawall
- Remnant H-Beams
- Revetment and Timber Seawall

Oil and Gas

Overview

Oil and gas development in the City of Goleta began in the 1920s with development of the Ellwood Marine terminal (located just east of the City's Coastal Resource Sub-Area). Production peaked between the 1930s and the 1950s. Production since the 1950s has largely shifted to offshore platforms permitted by the federal government. Unknown amounts of legacy wells and remnants for which little is known remain along the Goleta coastline.
According to the California Division of Oil, Gas, and Geothermal Resources, there are 3 active wells and approximately 47 inactive and capped wells within the City boundaries, and 26 wells immediately offshore. Active oil and gas operations in the City include the legally non-conforming 4.5-acre Ellwood Oil and Gas Processing Facility (EOF), and two oil piers associated with the 421 Lease. Oil spills in 1969 and 2015 have coated City beaches in oil.

Measures of Impact

To quantify the impact of coastal hazards and climate change on oil and gas infrastructure, the following measures of impacts have been identified:

- Active sites
- Inactive sites
- Cost of removal
- Oil spill cleanup costs.

Photo: A. Wells

Existing Conditions

Historical

Goleta Coast circa 1938 Photo: State Lands Archives

Present

<u>Coastal Erosion</u>

- 3 active sites (421 Lease and associated piers)
- 27 inactive sites

<u>Coastal Flooding</u>

- 2 active sites (421 Lease and associated piers)
- 36 inactive sites

<u>FEMA Creek flooding</u>

- 2 inactive sites

There also remain unknown amounts of below ground infrastructure. In nearby Summerland, unmarked legacy wells were discovered leaking oil and have yet to be resolved. A similar situation could occur within the City of Goleta.
For details on the locations of the wells, refer to Figure D.

Vulnerabilities

2030

<u>Coastal Erosion</u>

- 35 inactive sites

<u>Coastal Flooding</u>

- 2 inactive sites

Potential exists for oil spills of active wells. Inactive and unknown legacy wells may erode, leak, or become exposed and result in beach hazards. Soils previously affected by petroleum releases may become exposed by erosion or mobilized by coastal flooding.

2060

<u>Coastal Erosion</u>

- 35 inactive sites

<u>Coastal Flooding</u>

- 2 inactive sites

Potential exists for oil spills of active wells. Inactive and unknown legacy wells may erode, leak, or become exposed and result in beach hazards. Soils previously affected by petroleum releases may become exposed by erosion or mobilized by coastal flooding.

2100

<u>Coastal Erosion</u>

- 35 inactive sites

<u>Coastal Flooding</u>

- 2 inactive sites

Potential exists for oil spills of active wells. Inactive and unknown legacy wells may erode, leak, or become exposed and result in beach hazards. Soils previously affected by petroleum releases may become exposed by erosion or mobilized by coastal flooding. The EOF displays potential impacts from coastal flood hazards.

Fiscal Impacts

<u>Damages:</u> The cost of recapping a well (active or not) ranges from approximately $100,000 to $800,000 per well depending whether it is on or offshore. For 79 sites, the total cost ranges from approximately $7.9 million to $63.2 million. The cost of no action cleanup is considerable, and estimated to be similar to the recent Refugio Oil Spill that cost approximately $257 million.

<u>Fiscal Impact to the City:</u> The City does not have liability, but nevertheless may be responsible for some of the cleanup costs. Oil spilled on beaches would also have recreational, tourism, economic, and ESHA impacts not assessed in the fiscal impact.

<u>Adaptation costs:</u> $7.9 million for capping wells, with approximately $100,000 to investigate petroleum releases. Potentially several times that amount to remediate the release at a legacy well.

<u>Clean up:</u> $257 million.

<u>Public vs. private:</u> City may bear some liability if oil and gas companies or governmental agencies do not properly mitigate.

Adaptation Strategies

<u>Range of Strategies:</u> Oil and gas infrastructure could be relocated, elevated, or protected in place. Adaptation to any of these oil and gas issues will be contentious. There may be a need to have a non-polarized regional forum focused on oil and gas response, remediation, and restoration. Such a partnership would require coordination with the California State Lands Commission and Santa Barbara County, as well as entities charged with oil spill response and clean up

Retreat – Requires a phased removal to cap, abandon, decommission, investigate/remediate petroleum releases, and restore. Well casings and onshore support infrastructure may be re-exposed as erosion continues.

Accommodate – For the Lease 421 piers, it is possible to extend the wells onto constructed platforms with access via boat.

Protect – Armor cliffs to prevent coastal erosion in addition to nourishment of beaches to ensure sand coverage of wells.

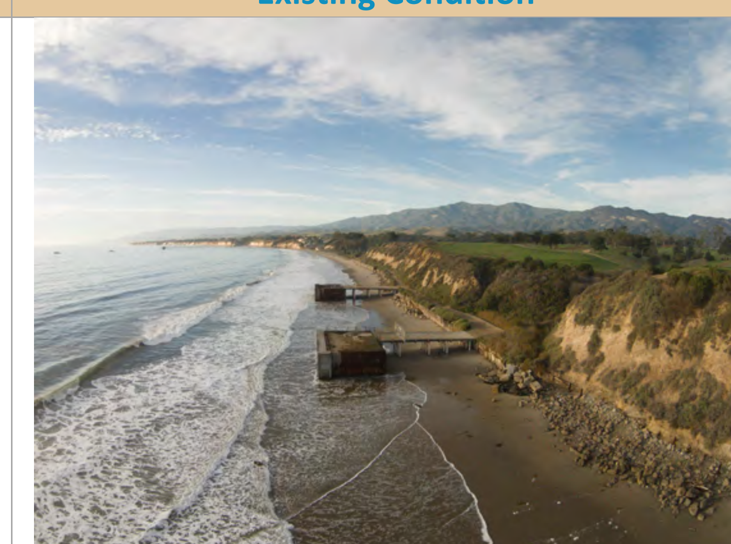
<u>Secondary Impacts:</u> Delays in any response could result in oil spills and nuisance hazards. Environmental and permitting require substantial time and high costs in that there are long lead times. Elevating would increase the exposure to wave impacts and have escalating maintenance costs. All options would have short-term habitat impacts to ESHAs.

Additional Information

Recommendations

- Formalize and participate in a regional Joint Powers Authority (JPA) with OSPER, CLSC, Coast Guard, County Energy Division, and the City. This JPA would form a round table for oil and gas responses and lessons learned.
- Generate funds for rapid response to remove eroded wells.
- Upon decommissioning of active sites, the removal of all shore protection, access roads, pipes, and other infrastructure should be required.
- Develop a regional environmental and permit streamlining process for rapid remediation of legacy wells.
- Note: The current data gap for this area is pipeline alignments and remaining oil volumes stored inside.

Existing Condition



Goleta Coast 2015 Photo: City of Goleta

Figure D. Oil/Gas Wells and Coastal Hazards

Coastal Zone Boundary
City Boundary

Coastal Hazard Zones

	Surface Connected	Potentially Connected
Existing		
2030 (10.2")		
2060 (27.2")		
2100 (60.2")		
Existing FEMA 100-Year Flood		

Hazard Modeling by ESA 2015

Impacted Oil and Gas Wells

- Existing Wells
- 2030 Wells
- 2060 Wells
- 2100 Wells
- Unflooded Wells
- ☆ Indicates Active Well

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Hazardous Materials

Overview

There are two types of hazardous materials evaluated in this report: businesses that store hazardous materials and leaking underground fuel tanks (LUFTs). The type of chemical and the state (solid, liquid, or gas) determines the relative risk of dispersal to the City. Facilities located near the City have the potential of causing damages within the City and are included.

Businesses using hazardous materials are required to file a Hazardous Material Business Plan (HMBP) with the Santa Barbara County Fire Protection Services Department. Hazardous chemicals are associated with dentist offices, medical supplies, laundromats, auto repair shops, etc. In 2015, there were 649 HMBPs filed within the City.

LUFTs are often associated with gas stations, and contaminants can leak into the surrounding groundwater table and disperse or flow based on groundwater elevations. As of 2015, there are 24 LUFTs in various stages of remediation.

Measures of Impact

To quantify the impact of coastal hazards and climate change on hazardous materials, the following measures of impacts have been identified:

- Number of leaking underground fuel tanks
- Number of (HMBP)s
- Cost of remediation for a LUFT
- Cost of remediation for a flooded LUFT

For details on the locations of the businesses storing hazardous materials and LUFTs, refer to Figure E.

Existing Conditions

Historical

The City has a history of land uses that rely on hazardous chemicals including industrial, commercial, and agricultural sites. The City also has a history of contamination from LUFTs primarily associated with automotive-related industries.

Present

Coastal Flooding

- No leaking underground fuel tanks
- 7 hazardous material business plans

FEMA Creek flooding

- 6 leaking underground fuel tanks
- 249 hazardous material business plans

There is no evidence of coastal erosion exposure to either LUFTs or HMBPs.

Vulnerabilities

2030

Coastal Flooding

- 0 LUFTs
- 8 HMBPs

Dominant flood hazards result from barrier beach closure. The joint probability of creek flooding and high lagoon water levels was not assessed.

2060

Coastal Flooding

- 1 LUFT
- 12 HMBPs

Dominant flood hazards result from barrier beach closure. The joint probability of creek flooding and high lagoon water levels was not assessed.

The business with the LUFT is Steelhead Recyclers.

2100

Coastal Flooding

- 5 LUFTs
- 84 HMBPs

Flood hazards result from barrier beach closure. The joint probability of creek flooding and high lagoon water levels was not assessed.

Businesses with LUFTs include Applied Magnetics, Bardex Corporation, Raytheon Systems, McLean Property, and Automated Business Forms.

Fiscal Impacts

Damages: The average cost to clean up a LUFT tank is $125,000, assuming that the hazardous materials have not leaked into the groundwater table. The cost is considerably higher (approximately $1.5 million per LUFT) if the hazardous materials have already leaked into the groundwater table.

Fiscal Impact to the City: If these tanks are owned by private businesses, the current owners are liable. However, the City could become liable if private owners are unable to pay the costs. Since mitigation is far more economical before groundwater contamination becomes an issue, the City should focus on investigation and remediation of unidentified LUFT sites. For existing cases, expediting clean up would properly mitigate tanks before they are exposed to inundation that is associated with barrier beach flooding and sea level rise.

Impacts by planning horizon: LUFTs should be mitigated by 2030.

Adaptation costs: Total clean up/remediation costs range from $750,000 (no groundwater leakage) to $10.5 million or more (groundwater leakage).

Clean up: Owners of properties with existing storage tanks should mitigate against leakage in a timely manner.

Public vs. private: The costs are primarily private. While contained within a single parcel, the City should incentivize clean up so that LUFTs are remediated before contaminants extend beyond the parcel boundary, becoming a City liability.

Adaptation Strategies

The majority of the hazardous material impacts identified in the vulnerability assessment are largely avoidable.

Range of Strategies: Hazardous storage plan strategies would range from a "do nothing" approach, to protection of businesses with HMBPs, to policy options that would accommodate levels of flooding without exposing the hazardous materials, to requiring all businesses with a HMBP to effectively retreat from the coastline.

Secondary Impacts: The "do nothing" approach could have substantial clean up impacts, but there are relatively low cost options to store materials in a more flood-proof manner.

Range of Strategies: Leaking underground tanks have limited adaptation options other than to remediate or adjust the timing and exposure of the contaminants to prolonged barrier beach flooding. Adaptation strategies that reduce the exposure of the contaminants would include inlet management, containment, and remediation.

Secondary Impacts: Inlet management has several secondary impacts ranging from sediment accretion on wetlands to increased exposure for sensitive and endangered species in the neighboring Goleta Slough.

Additional Information

Recommendations

- Establish more stringent policies for timing associated with cleanup. The timing would be based upon projected exposure to flooding.
- Cleanup LUFTs (some of these include sites associated with the Steelhead Recyclers, Applied Magnetics, Bardex Corporation, Raytheon Systems, McLean Property, and Automated Business Forms).
- Strengthen policies regarding storage for hazardous materials that would require additional elevation and containment.
- Clean up LUFTS prior to long-term flooding associated with barrier beach closure and elevated groundwater.

Threshold

For LUFTs, establish a threshold between 2 and 5 feet based on the escalated cost and spread of contaminants into and surrounding the City boundaries.

Disclaimer: LUFTs and HMBPs outside but near the City were not included in this analysis. Coastal confluence flooding in the future is unavailable and should be considered in a future update. The type and quantity of hazardous materials, state of matter, dispersal mechanism, and solubility in water was beyond the scope of this analysis.

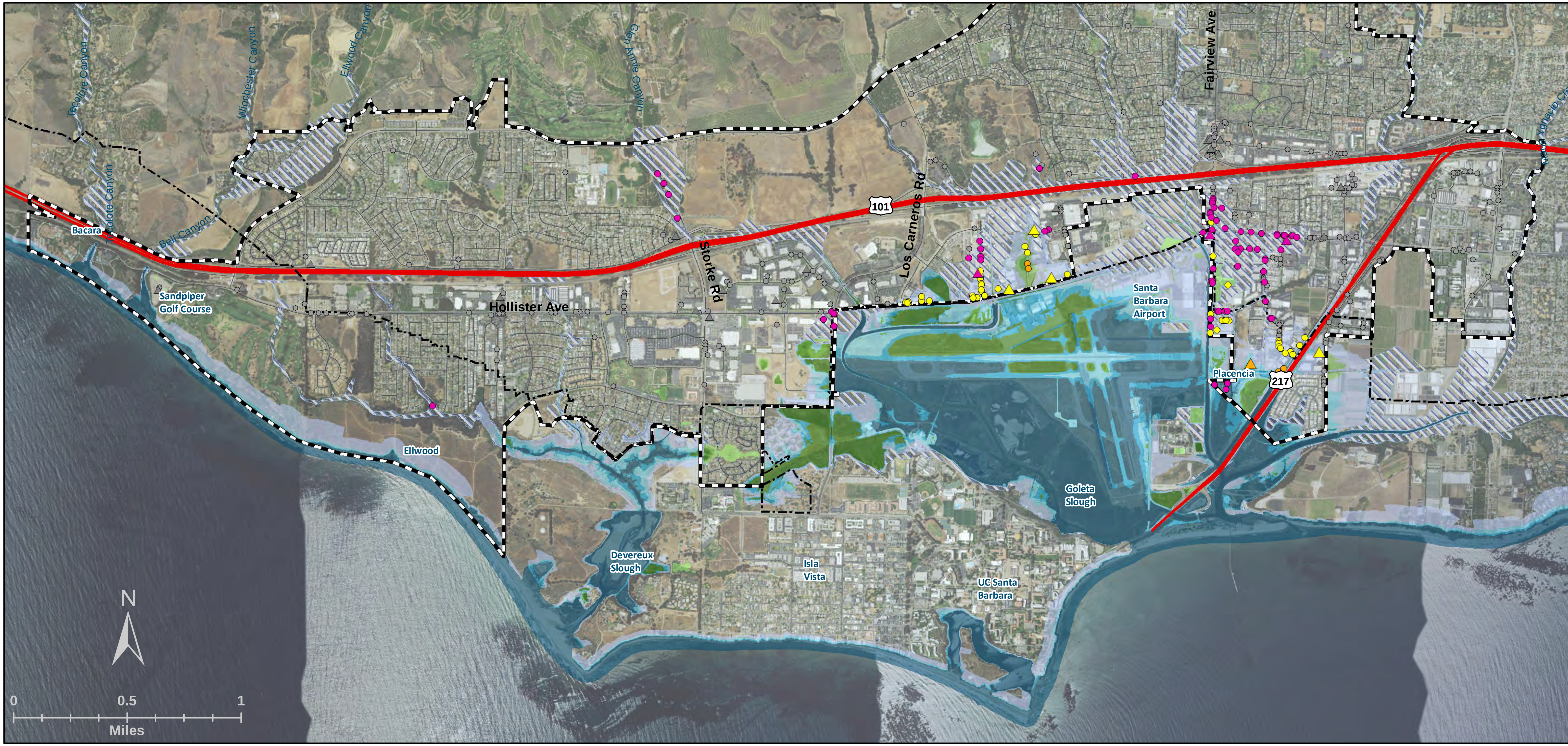

Figure E. Hazardous Materials, LUFT Sites and Coastal Hazards

Coastal Zone Boundary

City Boundary

Coastal Hazard Zones

	Surface Connected	Potentially Connected
Existing		
2030 (10.2")		
2060 (27.2")		
2100 (60.2")		

Existing FEMA 100-Year Flood

Hazard Modeling by ESA 2015

HazMat Sites

- Existing HazMat Storage
- 2030 HazMat Storage
- 2060 HazMat Storage
- 2100 HazMat Storage
- Unflooded HazMat Storage

Leaking Underground Fuel Tanks (LUFT)

- Existing LUFT Sites
- 2030 LUFT Sites
- 2060 LUFT Sites
- 2100 LUFT Sites
- Unflooded LUFT Sites

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Natural Resources

Overview

Habitat resources occur in each of the subareas including the western Coastal Resources Sub-Area, Storke Ranch wetlands, Phelps Road vernal pools, Rancho Goleta Lake, the southern portion of the Southwest Residential Sub-Area, and along streams. Two creeks, Bell Canyon and Tecolote Creek, drain to the ocean via coastal estuaries; the other creeks drain into either Devereux or Goleta Sloughs, just south of the City boundary.

ESHAs require protection to sustain the habitat values. The map of ESHAs is adopted in the City's General Plan (Figure 4-1) and contains the following habitats: creek and riparian areas, wetlands, coastal dunes, lagoons, coastal bluff scrub, beaches, marine habitats, coastal sage scrub, chaparral, native woodlands, native grasslands, monarch butterfly sites, and nesting roosting sites for raptors.

Measures of Impact

To quantify the impact of coastal hazards and climate change on ESHAs, the following acreages have been identified by ESHA types:

- Acres of Beach and Shoreline Habitats
- Acres of Monarch Butterfly/ Raptor Roosting
- Acres of Native Grassland
- Acres of Open Water
- Acres of Riparian, Marsh or Wetland
- Acres of Scrub
- Acres of Unvegetated Open Creek Channel

For details on the locations of the impacted natural resources, refer to Figure F.

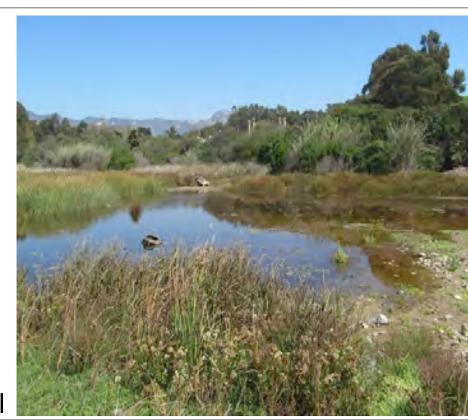
Existing and Future Vulnerabilities

	Environmentally Sensitive Habitat Area	Existing Conditions	2030	2060	2100
Coastal Erosion	Beach and Shoreline	16.96	16.96	16.96	16.96
	Monarch Butterfly and/or Raptor Roosting Habitat	0.13	0.33	0.95	1.6
	Native Grassland	0.04	0.09	0.33	3.79
	Riparian/Marsh/Vernal	1.79	0.21	0.27	1.2
	Scrub	28.81	26.21	28.37	32.47
Coastal Flooding	Beach and Shoreline	19.94	19.94	19.94	19.94
	Monarch Butterfly and/or Raptor Roosting Habitat	1.92	2.35	3.33	7.46
	Native Grassland	0.04	0.09	0.33	3.79
	Open Water	1.37	1.37	1.37	1.86
	Riparian/Marsh/Vernal	22.47	27.1	34.74	46.66
	Scrub	31.44	32.95	35.41	40.64
	Unvegetated Open Creek Channel	1.67	1.97	2.61	4.75

* Impacts to ESHAs are reported in acres

Note: The identified habitat acres in the table are currently in the modeled coastal hazard zones and are exposed to the identified coastal processes creating the coastal hazards.

Disclaimer: The acreages are not based on any habitat evolution modeling which would indicate where the habitat might shift or evolve in response to changes in the physical processes. Habitats typically evolve by transgressing inland, shifting ranges, migrating up in elevation, or by accreting sediment.



Tecolote Creek
Photo: D. Revell

Fiscal Impacts

No fiscal impact analysis was conducted on this sector.

Adaptation Strategies

<u>**Range of Strategies:**</u> ESHAs could either be relocated or protected using soft protection schemes like sediment management or regulatory changes to enhance the ability of the habitats to migrate landward.

Retreat – Policy options to increase landscape connectivity and support habitat migration include purchase of upland properties such as areas above Hollister Avenue, development of rolling easements, and transfer of development rights programs.

Accommodate – Sediment management.

Protect – Build horizontal levees and transition slopes, establish conservation easements or other development restrictions to protect habitat, and create ecological buffer zones that increase the size of existing buffers.

<u>**Secondary Impacts:**</u> Sediment management impacts depend on the types of volumes, grain size, and mechanism to move the sediment and range from small temporary impacts to long-term habitat alterations.

Additional Information

Recommendations

- Increase buffers for ESHAs.
- Improve policy language to maintain riparian corridors and landscape connectivity.
- Develop anticipatory policy language to support sensitive species in changing climate conditions.
- Develop sediment management program regulations, which would support wetland accretion.
- Collaborate regionally to support the use of horizontal levees, transition slopes, and inlet management.
- Identify habitat and species triggers to implement adaptation strategies.
- Support regional monitoring efforts.

Future Monitoring

- Support monitoring of specific climate variables that affect habitat location.
- Stay current on climate science related to precipitation, wildfire, and temperature changes.
- Understand relationship between habitats/elevation and duration of inundation.
- Support monitoring of adaptation impacts on the overall health of ecosystems, including hydrology, sensitive species habitats, and biodiversity.
- Support comprehensive monitoring programs as well as site-specific analyses to refine understanding and gauge effectiveness.
- Establish permanent plots to detect long-term vegetation changes at the community level.
- Create monitoring protocols specific to each species, habitat type, and management action.

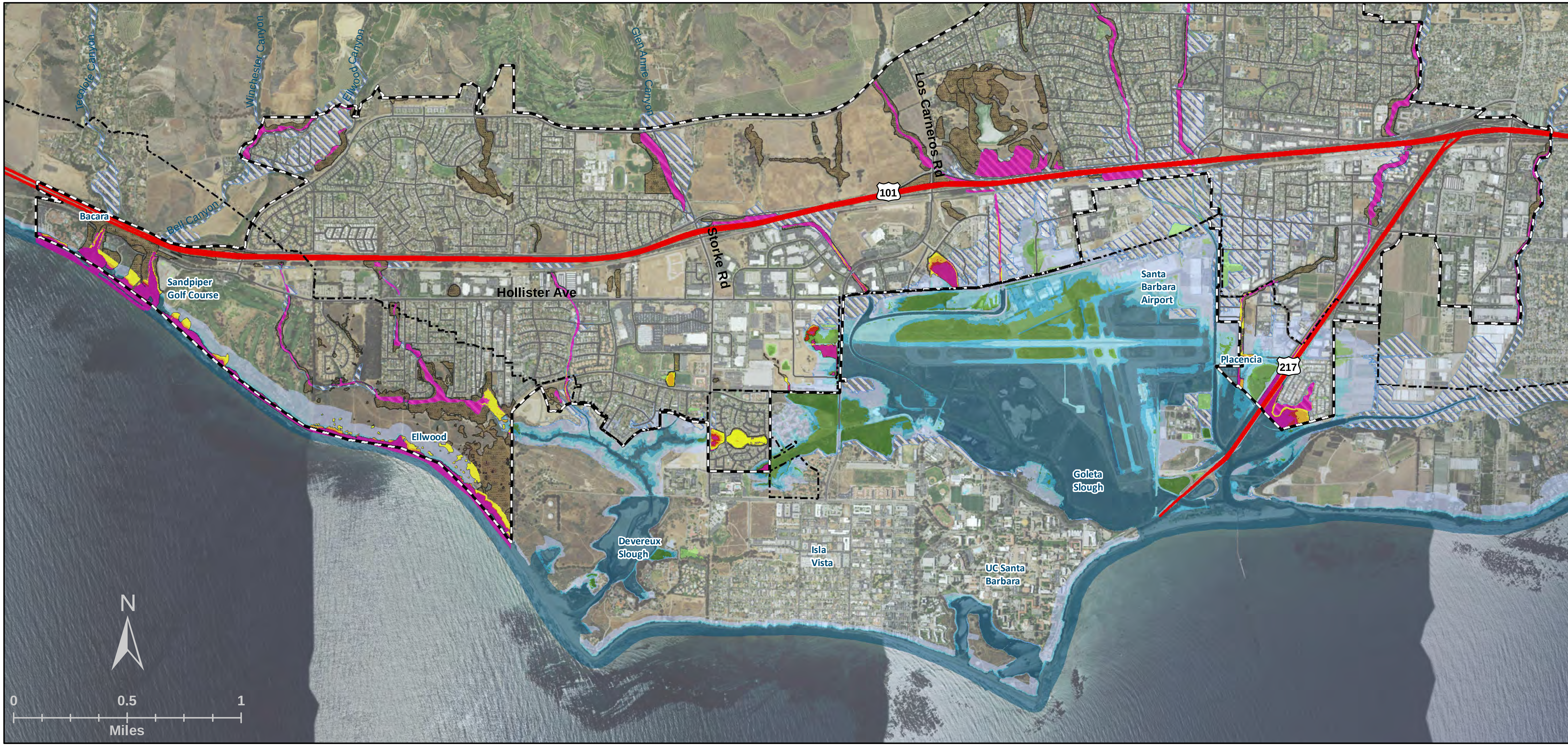


Figure F. Natural Resources and Coastal Hazards

Coastal Zone Boundary   City Boundary

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Coastal Hazard Zones

	Surface Connected	Potentially Connected
Existing		
2030 (10.2")		
2060 (27.2")		
2100 (60.2")		
Existing FEMA 100-Year Flood		

Hazard Modeling by ESA 2015

Impacted Environmentally Sensitive Habitat

- Existing ESHA Flooding
- 2030 ESHA Flooding
- 2060 ESHA Flooding
- 2100 ESHA Flooding
- Unflooded ESHA

Public Access

Overview

Examples of passive coastal recreation in the City of Goleta include hiking, birdwatching, and beach combing primarily along the Ellwood Mesa Open Space/Sperling Preserve and Haskell's Beach in the Coastal Resource Sub-Area. The trail network includes a portion of the California Coastal Trail and the Juan Bautista de Anza Trail. Additionally, there are a number of unimproved access points (Access Points E and F) that provide coastal views and vertical access to the beach. The Haskell's Beach public access is maintained by and is designated as a condition of approval for the Bacara Resort and Spa. This access includes a visitor-serving Beach House.

Measures of Impact

To quantify the impact of coastal hazards and climate change on recreation and trails, the following measures of impacts have been identified:

- Length of trails
- Number of interruptions in the trail network
- Number of formal access

For details on the locations of impacts to public access, refer to Figure G.

Existing Conditions

Historical

Historically, much of the open space in the Coastal Resource Area was owned by oil and gas development interests. As the oil and gas extraction dwindled, some remediation and cleanup was completed prior to the land being sold for development. Through the 1990s, public interest groups contested several development proposals until a transfer of development right agreement was reached and the proposed development was pulled away from the open space and moved inland to what is now known as the Bluffs at Sandpiper. Historic armoring (see coastal armoring) impacts lateral beach access during high tides.

Present

The formal access and Bacara Beach House are currently exposed to **all** coastal hazards.

Coastal Erosion

- 2,129 feet of trails
- 12 interruptions in the trails

Coastal Flooding

- 2,444 feet of trails
- 14 interruptions in the trails

FEMA Creek flooding

- 7,272 feet of trails
- 16 interruptions in the trails

Vulnerabilities

2030

Coastal Erosion

- 3,684 feet of trails
- 23 interruptions in the trails

Coastal Flooding

- 431 feet of trails
- 4 interruptions in the trails

Coastal erosion permanently interrupts the trail continuity. Coastal flooding temporarily interrupts the trail for a short time period that depends on elevation and duration of flood events.

2060

Coastal Erosion

- 6,914 feet of trails
- 12 interruptions in the trails

Coastal Flooding

- 878 feet of trails
- 6 interruptions in the trails

Coastal erosion permanently interrupts the trail, while coastal flooding only has a temporary impact. A decrease in trail interruptions represents a merging of small breaks into larger interruptions.

Lateral beach access impaired during high tides due to historic armoring.

2100

Coastal Erosion

- 11,443 feet of trails
- 13 interruptions in the trails

Coastal Flooding

- 2,191 feet of trails
- 8 interruptions in the trails

Coastal erosion permanently interrupts the trail, while coastal flooding only has a temporary impact. The increasing number of trail interruptions by 2100 show that new locations along the trail network are being impacted.

Lateral beach access impaired during high tides due to historic armoring.

Fiscal Impacts

Damages: 2,129 feet of coastal trails are impacted by erosion and will need to be moved and replaced to City standards, including Coastal Trail and De Anza Trail standards. Coastal flooding will lead to some temporary loss of recreation impacts, including 2,444 feet of trails.

Fiscal Impact to the City: The City is responsible for maintaining these coastal trails. It is assumed that impacted trails will require active relocation to minimize impacts to natural resources, as opposed to opportunistic relocation by trail users. Based on recent plans to improve the Ellwood Mesa Coastal Trails, the cost of relocating was estimated at approximately $170 per linear foot. For information on the Ellwood Mesa Coastal Trails and Habitat Restoration Project, refer to page 4-9.

Impacts by planning horizon:

- ***Existing conditions***: Replacement cost of 2,129 ft. of trails at $170 per linear ft. equates to $361,930.
- ***2030:*** Replacement cost of 3,684 ft. of trails at $170 per linear ft. equates to $626,280.
- ***2060:*** Replacement cost of 6,914 ft. of trails at $170 per linear ft. equates to $1,175,380.
- ***2100:*** Replacement cost of 11,443 ft. of trails at $170 per linear ft. equates to $1,945,310.

Clean up: There may be nominal clean-up costs associated with flooding.

Public vs private: Most of costs will be borne by the City of Goleta with some costs by Bacara as per their permit conditions.

Adaptation costs for the bathhouse:

- ***Retreat and rebuild*** - estimated $421,000 to rebuild in a new location.
- ***Elevate*** - $140 to $240/sq. ft. multiplied by 2,000 sq. ft. equates to $280,000 to $480,000.
- ***Protect*** - $5182 to $6100/linear foot multiplied by 60 ft. equates to $310,920 to $366,000.

Adaptation Strategies

Range of Strategies: The trails and designated public access at Haskell's Beach could either be relocated or protected.

Secondary Impacts: Relocation of trails would potentially affect some small portions of ESHA (scrub, grassland). A protection strategy (coastal armoring) would impact the beach and shoreline ESHA. As erosion continues, the 2 vertical access trails will become less passable without improvements and maintenance. Improvements to maintain vertical access from Ellwood to the beach include grading or natural steps built into the existing bluff trail. According to the Ellwood Mesa Coastal Trails and Habitat Restoration Project MND, the City would manage the relocation of the Coastal Trail if unsafe conditions exist along the bluffs. Removing coastal armoring will improve the lateral beach access, which is currently limited during high tides. The one formal public access at Haskell's Beach is currently vulnerable to **all** coastal and fluvial related hazards. The access itself can likely be either protected or retreated with some regrading or stairs.

Range of Strategies: The Bacara Beach House adjacent to the Haskell's Beach access serves both public and resort visitors. One strategy would be to relocate the facility farther inland beyond the identified hazard zones; an accommodation strategy would elevate the facility so that the coastal processes could pass underneath, while a protection strategy would require construction of coastal armoring.

Secondary Impacts: Secondary impacts associated with retreat and accommodation strategies are minimal. A protection strategy would impact ESHA (beach and dune and riparian wetlands) and lateral access along the beach. Costs would be expected to include substantial construction and maintenance over time, and ultimately result in the complete loss of the beach for which the bathhouse was built to provide amenities to beach goers and resort visitors.

Additional Information

Recommendations

- Remove coastal armoring to improve lateral beach access.
- Develop policies, which generate revenue to maintain, create, and improve beach access at Haskell's Beach.
- Coordinate with the Bacara Resort and Spa to identify a suitable site for Beach House relocation.
- Restrict the type and intensity of development associated with the formal public access.

Existing Condition

High Tide 10/29/2015
Photo C. Slaven

Figure G. Public Access and Coastal Hazards

Coastal Zone Boundary

City Boundary

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Coastal Hazard Zones

	Surface Connected	Potentially Connected
Existing		
2030 (10.2")		
2060 (27.2")		
2100 (60.2")		
Existing FEMA 100-Year Flood		

Hazard Modeling by ESA 2015

Designated Public Access

Flooded Recreational Trails

- Existing Trails
- 2030 Trails
- 2060 Trails
- 2100 Trails
- Unflooded Trails

Transportation

Overview

Goleta is served by an existing network of roadways. US Highway 101 traverses the central spine of the entire east-west length of the City, providing regional access to Goleta. Santa Barbara Metropolitan Transit District (MTD) operates bus routes within Santa Barbara County. Specific bus routes have been developed to serve the UCSB campus. Mobility depends on a safe and efficient transportation system that facilitates the flow of traffic, while enhancing pedestrian safety, and providing for alternative modes of transportation. Hollister Avenue is a primary thoroughfare for both the City and the region, and bisects the Old Town area of the City.

Measures of Impact

To quantify the impact of coastal hazards and climate change on roads and public transportation, the following measures of impacts have been identified:

- Length of roads (including Hollister thoroughfare)
- Number of interruptions
- Number of bus stops

The City's street pavement network consists of 86 centerline miles equaling a total pavement area of approximately 16.2 million square feet.

Existing Conditions

Historical

Creek flooding events have occurred episodically in the past with the worst flooding caused by the combination of high stream flow during high tides/ slough water levels. These impacts have caused substantial flood damages, particularly in the area around Old Town.

Changes to the Goleta Slough inlet management has increased flooding and duration of inundation at the low lying area around the City's Placencia neighborhood and Robin Hill Road area. San Jose Creek was improved to convey a 100-year event. The culvert under Highway 101 on San Jose Creek is also being improved to pass a 25-year flow event. Both projects reduce Old Town creek flooding.

Present

Coastal Flooding

- 959 feet of roads (including Hollister thoroughfare)
- 5 interruptions
- 48 bus stops

FEMA Creek flooding

- 72,316 feet of roads (13.7 miles)
- 71 interruptions
- 123 bus stops

Most flooding occurs in the Placencia neighborhood, Hollister Ave north of the Santa Barbara Airport, and in the Robin Hill Road area (also north of the airport and Hollister Avenue).

Vulnerabilities

2030

Coastal Flooding

- 1,746 feet of roads
- 9 interruptions
- 97 bus stops

A few roadways including Los Carneros, Hollister, and Fairview serve as emergency evacuation routes. Beach closure of Goleta Slough mouth and severe storm events could flood these routes. Residents traveling by bike or bus have limited alternatives during flood events. During high tide storm events, emergency vehicles may be delayed in reaching some locations.

2060

Coastal Flooding

- 5,420 feet of roads
- 12 interruptions
- 111 bus stops

As Hollister Avenue is the major thoroughfare for the City, the only alternative route is Highway 101. There are no other viable alternative routes through the City in times of emergency. While temporary shut downs during high tides and storms could be tolerated, chronic flooding could render road segments along Fairview and Hollister Avenues frequently impassable.

2100

Coastal Flooding

- 23,149 feet of roads (4.4 miles)
- 24 interruptions
- 246 bus stops

There are no other viable alternative routes through the City in times of emergency. While temporary shut downs during high tides and storms may be tolerable, routine tidal flooding could render portions of Hollister and Fairview Avenues impassable daily.

Fiscal Impacts

Damages: No roads/bus stops are threatened by coastal erosion. However, some traffic will be interrupted by flooding. Some bus stops also will be underwater. These will require clean up following flood events.

Fiscal Impact to the City: The City would likely bear the cost of clean-up and repair and some of the costs of adaptation. Flood damages across the City depend on the magnitude and extent of flooding (~$500,000 for a minor flood (e.g., 2005) to $4.5 million for a major flood (e.g., 1997-98 El Niño). Road damages and clean-up costs alone could range from $30,000 to $100,000 per mile depending on the type of road and amount of debris associated with the flooding.

Adaptation Costs: Under an accommodation strategy, the City could add a thicker (~2 to 4 inches) layer of asphalt every ten years as part of routine resurfacing which would reduce road flooding. The costs are as follows:

2030: ~$500,000, **2060**: ~$2.2 million, **2100**: ~$12.5 million.

Clean up: See Fiscal Impact to the City.

Public vs. Private: Costs for repair for City infrastructure will be borne by the City and managed by the Public Works Department. Public transit costs and related repair will be borne by the MTD, which is operated under the County of Santa Barbara.

Adaptation Strategies

Range of Strategies:

Retreat – relocate or remove roads from the hazardous areas. This would require creation of a new cross town thoroughfare to replace Hollister Avenue.

Accommodate – It is possible to elevate roads to accommodate higher flood water levels. This could be accomplished by elevating long segments of road on causeways. Another option would be to incrementally elevate the road surface during routine repaving by adding an additional 1-2 inch lift of asphalt. Inlet management may help reduce the duration of flood impacts.

Protect – (Green) Contour additional elevations into a horizontal levee for areas in and around open spaces.

(Gray) Construct levees and install pumps to flood proof the most road segments.

Secondary Impacts:

Retreat strategies may negatively impact traffic, ESHA, and other resources of the City, depending on the realignment. Accommodation strategies may create additional stormwater drainage issues. Protection strategies (green) could provide some room for habitat transgression for roads adjacent to wetlands. Gray protection strategies could negatively impact ESHA and wetland habitat transgression as well as escalating maintenance costs.

Additional Information

Recommendations

- Elevate critical roads along Hollister Avenue, Fairview Avenue, and Los Carneros Road.
- Amend Capital Improvement Plan to add additional inches to the lift in street resurfacing to gain elevation at the pace of sea level rise or greater.
- Develop alternative bus routes.
- Efforts to proactively reengineer existing routes will require collaboration amongst several land owners, private and public. Emergency services should be considered to ensure roadways are wide enough as responders depend on accessibility to any affected areas.
- Note: Coastal confluence modeling would likely show an expansion of the extent and duration of future flooding.

Existing Condition

February 1998 flooding Photo: City of Goleta

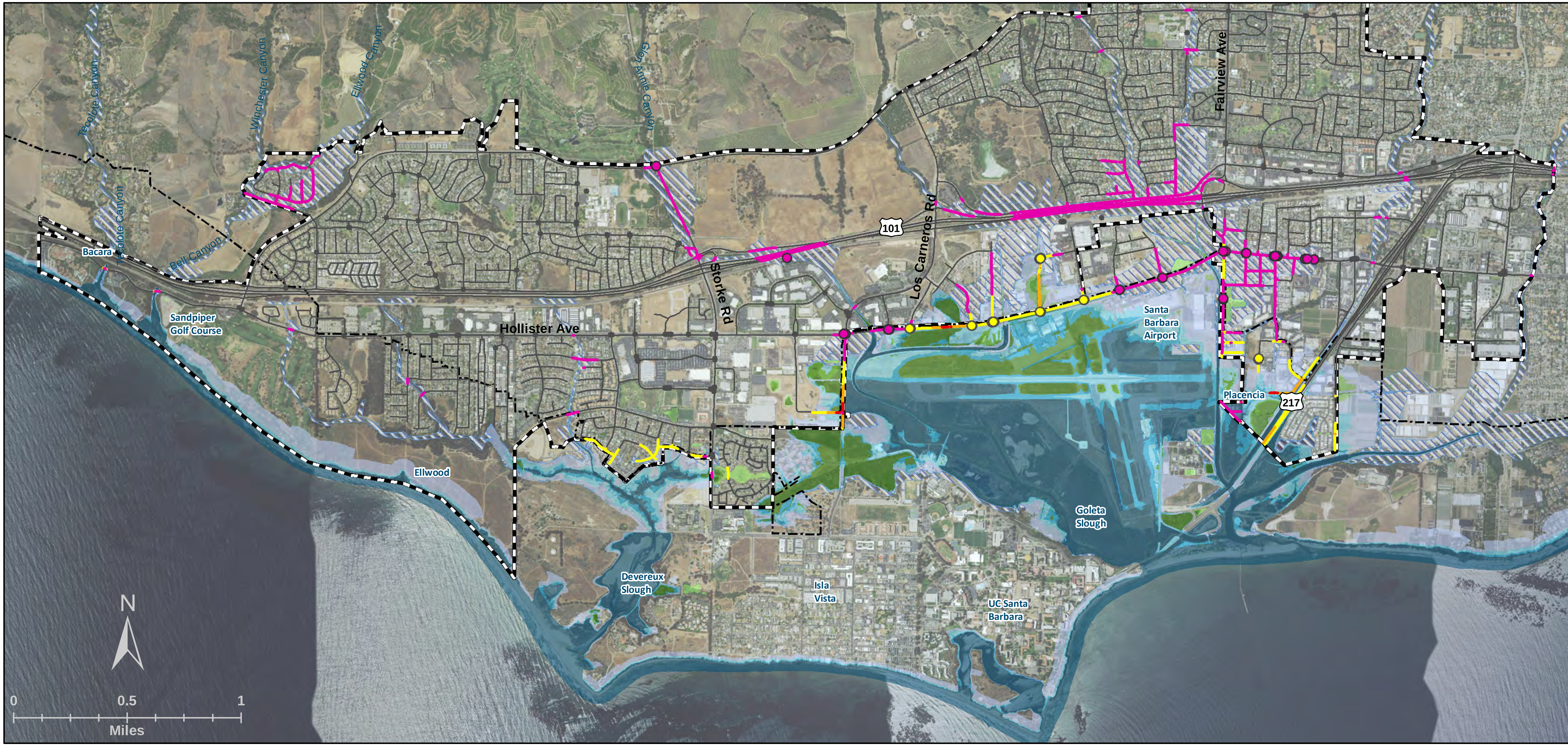

Figure H. Transportation and Coastal Hazards

Coastal Zone Boundary
City Boundary

Coastal Hazard Zones

	Surface Connected	Potentially Connected
Existing		
2030 (10.2")		
2060 (27.2")		
2100 (60.2")		
Existing FEMA 100-Year Flood		

Hazard Modeling by ESA 2015

Flooded Roads and Bus Stops

- Existing Roads / Bus Stops
- 2030 Roads / Bus Stops
- 2060 Roads / Bus Stops
- 2100 Roads / Bus Stops
- Unflooded Roads / Bus Stops

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Wastewater

Overview

Two separate special districts, Goleta Sanitary District (GSD) and Goleta West Sanitary District (GWSD), provide wastewater collection, treatment, and disposal services to the City of Goleta and the larger Goleta Valley. GWSD serves the western portion of the City with a collection system only. The eastern portion of the City is served by GSD, which collects, treats, and disposes of all wastewater, including wastewater received from GWSD. The GSD wastewater treatment plant, located adjacent to the City and Santa Barbara Airport on William Moffett Place, has a capacity of 9.72 million gallons per day (MGD). For impacted locations, refer to Figure I.

Measures of Impact

Operate and maintain the wastewater collection system including approximately 62 miles of sewer lines and 2 pump stations. To quantify the impact of coastal hazards and climate change on wastewater infrastructure, the following measures of impacts have been identified:

- Number of pump stations
- Length of pipe (feet)
- Number of manholes

Failure in the system could be passed onto City rate payers.

Existing Conditions

Historical

The wastewater treatment plant is built on what was once Mescalitan Island. The island was cut to fill the Goleta Slough and create the Santa Barbara Airport. The wastewater system has had no reported sewage spills or damages, even during the 1995, 1998, and 2005 flood events. During the 1995 tide gate experiment, there was no tidal inundation to the infrastructure although tides inundated Mesa Road and crossed under Los Carneros into the Storke Ranch development. A recent Mesa Road Realignment Project relocated about 1,700 feet and 6 manholes from the Storke Ranch wetlands to Mesa Road, improving maintenance access, conveyance capacity, and habitat at a project cost of $9 million. Until 2014, Goleta Slough was managed for open tidal conditions utilizing mechanical breaching. This inlet management practice was stopped due to concerns for endangered species, and future management is in question.

Present

There is **no** infrastructure within the City at risk from erosion.

Coastal Flooding

- 1,535 feet of pipe
- 6 manholes

FEMA Creek flooding

- 63,416 feet of pipe
- 204 manholes

The most vulnerable area is in the Old Town Sub-Area due to barrier beach flooding. During flood conditions, access to the GSD treatment plant could be completely isolated. Two pump stations and a clean out vault are in various hazard zones, outside of the Goleta boundaries.

System failures from any hazards cause sewage spills.

Vulnerabilities

2030

Coastal Flooding

- 2,885 feet of pipe exposed
- 14 manholes exposed
- GWSD stormwater drains to a conveyance system of 11.16 ft.

Vulnerabilities primarily occur in the Old Town Sub-Area. Portions of the system near the former Ocean Meadows Golf Course become increasingly vulnerable. Underground pipes exposed to flooding should not pose a risk although maintenance costs may rise.

2060

Coastal Flooding

- 7,128 feet of pipe exposed
- 29 manholes exposed
- GWSD door to pump station 12.25 ft.

Vulnerabilities primarily occur in the Old Town Sub-Area, specifically in the Placencia neighborhood adjacent to Highway 217. Portions of the Central Planning Sub-Area, north of the Santa Barbara Airport, become increasingly vulnerable. Underground pipes exposed to flooding should not pose a risk although maintenance costs may rise.

2100

Coastal Flooding

- 22,945 feet of pipe exposed
- 82 manholes exposed

Vulnerabilities primarily occur in the Old Town Sub-Area adjacent to Highway 217 and Fairview Avenue. Portions of the Central Planning Sub-Area, north of the Santa Barbara Airport, and the Southwest Residential Sub-Area, notably portions of Ellwood Shores, and Storke Ranch become increasingly vulnerable.

Fiscal Impacts

Damages: The cost to retrofit each of the two lift stations would be $150,000. Sealing manhole covers costs approximately $150 each. Damages to the ocean outfall cleanout access vault at Goleta Beach could be caused by erosion, with the cost to relocate at $75,000.

Fiscal Impact to the City: The Sanitary Districts will finance these improvements and pass costs on to ratepayers.

Impacts by planning horizon:

- 2030: 14 manhole covers
- 2060: 29 manhole covers
- 2100: 82 manhole covers

Adaptation costs:

- 2030: 14 manhole covers at $150 per manhole will cost $2,100.
- 2060: 29 manhole covers at $150 per manhole will cost $4,350.
- 2100: 82 manhole covers at $150 per manhole will cost $12,300.

Clean up: None, if retrofits are performed in a timely manner, otherwise cost could vary from $20,000 to several hundred thousand dollars.

Public vs. private: All the costs will be borne by the Sanitary Districts, which would eventually be passed on to rate payers.

Adaptation Strategies

Range of Strategies: A range of strategies includes retreat, inlet management to reduce the flood levels, elevating key vulnerable infrastructure to accommodate additional flood levels, and flood proofing retrofits to protect existing components.

Retreat: Phased relocation of the ocean outfall cleanout access vault in the short-term and pump stations in the long-term. One substantial section of the wastewater conveyance network servicing the Southwest Residential Sub-Area runs through the UCSB North Campus Open Space (formerly Ocean Meadows Golf Course). As the restoration design is currently ongoing, the opportunity to relocate the wastewater infrastructure seems prudent since there would be cost savings associated with co-joining the two projects.

Accommodate: Recognizing that the primary flood risk for this sector is from "closed" barrier beach flooding, inlet management and increasing the elevation of some of the key access roads to the GSD plant would provide better emergency access to valves and the treatment plant itself.

Protect: Flood-proof retrofits to the two pump stations would provide a relatively low-cost option to accommodate several feet of sea level rise. Seal the manholes to minimize additional infiltration of brackish floodwaters and stormwater into the wastewater system.

Secondary Impacts: Phased relocation may increase rates to cover initial costs but may reduce long-term maintenance costs. Inlet management has several secondary impacts from sediment accretion on wetlands to increased exposure for sensitive and endangered species in the Goleta Slough. Protect strategies may limit the ability for the habitats to advance landward.

Additional Information

Recommendations

- Add policy language to require relocation or avoidance of wastewater hazards to the extent possible.
- Conduct advanced maintenance to keep lines clear.
- Recommend flood proofing the pump stations through retrofits and installation of collars for the storm drain entrances at the pump stations.
- Recommend relocation of the sewer line away from the Upper Devereux Slough/North Campus Open Space restoration area.
- Recommend relocation of the pump vault at Goleta Beach.
- Note: Coastal confluence modeling would likely show an expansion of the extents and duration of future flooding.

Existing Condition

Lift stations retrofit: $300,000

- GWSD facility
- GSD Firestone Pump Station
- Ocean Meadows/Upper Devereux Restoration, opportunity to relocate facility out of wetland during restoration project and avoid retrofit costs (estimated ~$9 million based on Mesa Road relocation).

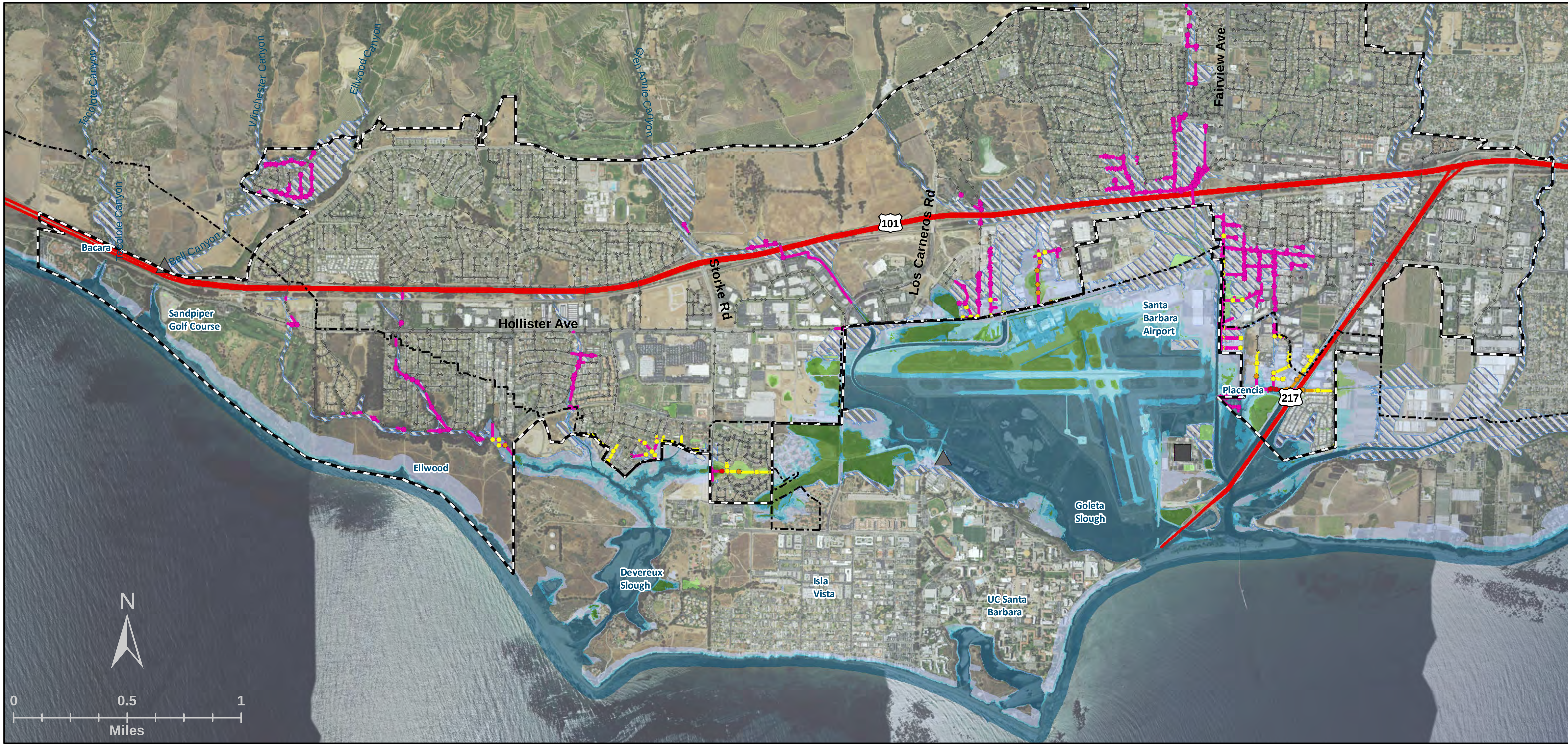

Figure I. Wastewater and Coastal Hazards

Coastal Zone Boundary
City Boundary

Coastal Hazard Zones

	Surface Connected	Potentially Connected
Existing		
2030 (10.2")		
2060 (27.2")		
2100 (60.2")		
Existing FEMA 100-Year Flood		

Hazard Modeling by ESA 2015

Wastewater Infrastructure

- Existing Pipes/Manholes
- 2030 Pipes/Manholes
- 2060 Pipes/Manholes
- 2100 Pipes/Manholes
- Unflooded Pipes/Manholes
- Pump Station
- Treatment Plant

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Water Supply

Overview

The Goleta Water District (GWD) provides water supply to the Cities of Goleta and Santa Barbara and unincorporated Santa Barbara County. The GWD service territory spans from the City of Santa Barbara to El Capitan State Park, which includes approximately 87,000 residents using 270 miles of pipe. The current water use in GWD is 13,143 acre-feet per year (AFY) based on average sales data from the years 2006 to 2010. Sources of potable drinking water include: Lake Cachuma, the California Water Project, and seven (7) wells that provide water from the Goleta Groundwater Basin and enable groundwater injection during wet years. Recycled water from the GWD has been available since 1995 and is used primarily for irrigation and restroom facilities.

Measures of Impact

Measures of Impact:

- Miles of pipe
- Number of hydrants
- Number of wells
- Number of control valves

Note: Due to alignment confidentiality concerns by GWD, specific locations have not been mapped.

Pipes are generally not overly susceptible to flood damages; however, the valves are critical to isolating leaks and managing the water supply. Access to maintain and repair valves when they are flooded increases maintenance costs.

Existing Conditions

Historical

GWD was formed in 1944 to take advantage of the water supply to be developed by the Federal Cachuma Project on the Santa Ynez River. GWD initially relied on local groundwater until the Cachuma Project began making deliveries in 1955.

Present

Coastal Flooding from Sandbar Closure

- 1,044 feet of pipe
- 3 valves

Creek Flooding (FEMA)

- 10.16 miles of pipe
- 68 hydrants
- 2 wells
- 312 control valves

Saltwater intrusion was **not** included in this vulnerability analysis.

Vulnerabilities

2030

Coastal Flooding

- 2,154 feet of pipe
- 3 hydrants
- 8 valves

No water supply–related infrastructure within the City is at risk from erosion. Coastal flooding hazards come primarily from long-term sand bar closure. Coastal confluence flooding has not been conducted or included in the vulnerability assessment.

2060

Coastal Flooding

- 4,995 feet of pipe
- 3 hydrants
- 21 control valves

No water supply–related infrastructure within the City is at risk from erosion. Coastal flooding hazards come primarily from long-term sand bar closure. Coastal confluence flooding has not been conducted or included in the vulnerability assessment.

2100

Coastal Flooding

- 18,801 feet (3.56 miles) of pipe
- 3 hydrants
- 21 control valves

No water supply–related infrastructure within the City is at risk from erosion. Coastal flooding hazards come primarily from long-term sand bar closure. Coastal confluence flooding has not been conducted or included in the vulnerability assessment.

Fiscal Impacts

No fiscal impact analysis was conducted on this Sector.

Adaptation Strategies

Range of Strategies:

Retreat – Relocate distribution pipelines from flooding hazard areas; relocate or eliminate "at risk" outfalls; reduce or find alternatives for septic systems in hazardous areas.
Accommodate – Coordinate with GWD on the following: determine need for treatment capacity of Lake Cachuma water for injection wells; develop a water banking system south of the Sacramento Delta; increase water use efficiency and use of recycled water with the Model Water Efficient Landscape Ordinance; reduce annual SAFE allocations; increase capacity of stormwater infrastructure to reduce impacts from higher water levels, especially from upstream actions.
Protect – Prevent coastal flooding from long-term sand bar enclosure.

Secondary Impacts:

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 use of recycled water.

Encroachment would require relocation of distribution pipes as well as additional monitoring wells to be installed to ensure that downward percolation of saline water does not occur. Higher temperatures could increase evapotranspiration causing an increase in outside water use and crop irrigation. Increased wildfire frequency and severity may increase water demand for firefighting.

Additional Information

Recommendations

- Continue to improve policies to promote water conservation and reclaimed water use.
- Continue integrating climate projections on precipitation and temperature into water supply allocations.
- Participate in regional water supply discussion, notably, GWD's updated Water Supply Management Plan, Infrastructure Improvement Plan, and Sustainability Plan.
- Restrict development of new wells in sensitive habitat or vulnerable areas.
- Monitor demand and supply for potential additional groundwater pumping – limiting extraction from shallow aquifers, to reduce saltwater intrusion potential.
- Ensure that adequate long-term water supplies are available to serve additional new development.
- Update policies to encourage use of gray water by discouraging septic systems and reducing volumes discharged through ocean outfalls.
- Improve policies to reduce saltwater intrusion by limiting groundwater pumping and diversifying water supplies.

Existing Condition

Bradbury Dam forming "Lake" Cachuma Reservoir.
Photo source: T. Robinson

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Utilities

Overview

Southern California Edison Company (SCE) provides electrical service to Goleta and to all of southern Santa Barbara County. Two SCE substations occur in the City: the Hollister Avenue substation and the Glen Annie substation. Sixteen kilovolt (kv) electrical distribution lines and a 64 kv main line also exist in the City.

A “Peaking Station” occurs in western Goleta on Las Armas Road south of Highway 101 For a term of 30 years, the City of Goleta is allowing SCE the use of city streets and property to use and construct poles, wires, conduits, and other facilities necessary for the transmission and distribution of electricity within the City.

Measures of Impact

To quantify the impact of coastal hazards and climate change on electric utilities, the following measures of impacts have been identified:

- Length above ground
- Length below ground

Damages: Below ground lines are sealed and should be protected against coastal flooding. Above ground lines are not vulnerable to coastal flooding, but are vulnerable to high winds associated with coastal storms. Future projections of wind intensity were not considered in this assessment. Disruptions could cause a temporary loss of electrical power that would impact City services, local businesses, and residents.

Existing Conditions

Historical

There are a number of locational considerations associated with these facilities. Since these utility services are generally provided through service lines within City right of ways, management of City right of ways will need to anticipate the maintenance and development of utility lines. The potential development and expansion of the nearby natural gas resources at the storage facility near Goleta Beach will involve potential hazard considerations near the site and along the transmission lines serving the resource.

Note: Due to alignment confidentiality concerns by SCE, specific locations have not been mapped.

Present

Coastal Erosion

- 300 feet above ground
- 510 feet below ground

Coastal Flooding

- 5,383 feet above ground
- 4,463 feet below ground

FEMA Creek flooding

- 31,556 feet above ground (6.0 miles)
- 35,069 feet below ground (6.6 miles)

Vulnerabilities

2030

Coastal Erosion

- 322 feet above ground
- 531 feet below ground

Coastal Flooding

- 8,143 feet above ground (1.5 miles)
- 5740 feet below ground (1.1 miles)

Vulnerabilities to above ground lines will continue to exist from wind with temporary loss of power impacting City services, residents, and businesses. Once flooded, below ground lines will be more difficult to maintain.

2060

Coastal Erosion

- 360 feet above ground
- 671 feet below ground

Coastal Flooding

- 12,659 feet above ground (2.4 miles)
- 8,176 feet below ground (1.5 miles)

Vulnerabilities to above ground lines will continue to exist from wind with temporary loss of power impacting City services, residents, and businesses. Once flooded, below ground lines will be more difficult to maintain.

2100

Coastal Erosion

- 637 feet above ground
- 1,636 feet below ground

Coastal Flooding

- 28,784 feet above ground (5.5 miles)
- 21,928 feet below ground (4.2 miles)

Vulnerabilities to above ground lines will continue to exist from wind with temporary loss of power impacting City services, residents, and businesses. Once flooded, below ground lines will be more difficult to maintain.

Fiscal Impacts

Damages: Below ground lines are sealed and should be protected against coastal flooding. Above ground lines are not vulnerable to coastal flooding, but are vulnerable to high winds associated with coastal storms.

Fiscal Impact to the City: SCE will bear the costs of repair. These costs will likely be passed on to ratepayers as evidenced with other similar events such as the recent PG&E natural gas explosions in the Bay Area. A temporary loss in electrical power would impact City services, local businesses, and residents.

Adaptation Costs: These are the estimate costs of replacement.

2030: 322 ft. above ground power lines at $10 per linear ft. will equate to $3,220.
531 ft. below ground at $30 per linear ft. will equate to $15,930.

2060: 360 ft. above ground power lines at $10 per linear ft. will equate to $3,600.
671 ft. below ground at $30 per linear ft. will equate to $20,130.

2100: 637 ft. above ground power lines at $10 per linear ft. will equate to $6,370.
1636 ft. below ground at $30 per linear ft. will equate to $49,080.

Clean up: There may be some cleanup costs from downed power lines. This cost will be borne by SCE.

Public vs. private: Replacement/cleanup costs will be borne by SCE. The costs of electrical outages will be borne by residents, businesses, school districts, and the City.

Adaptation Strategies

Range of strategies: Potential to relocate, remove, or place lines underground.

Retreat: Requires relocation or realigning power lines to less hazardous areas.

Accommodate: Either underground lines to avoid wind hazards in non-flooded areas or elevate to accommodate flooding.

Protect: Pole footings could be fortified so that the poles are more resilient to wind and flood hazards.

Secondary impacts of Adaptation Strategies: Retreat and accommodate strategies would have short term habitat impacts along transmission corridors. Elevation of lines would have aesthetic impacts.

Additional Information

Recommendations

- Strengthen policies to underground lines in non-flood prone areas.
- Incentivize realignment of underground lines in flood prone areas.
- Phase realignment based on projections of future flood risks.

Existing Condition

Hollister Avenue

Photo: City of Goleta

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