



MONTEREY BAY SLR VULNERABILITY STUDY

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Central Coast Wetlands Group
March 2017

Thank you to the League of Women Voters

TALK OUTLINE

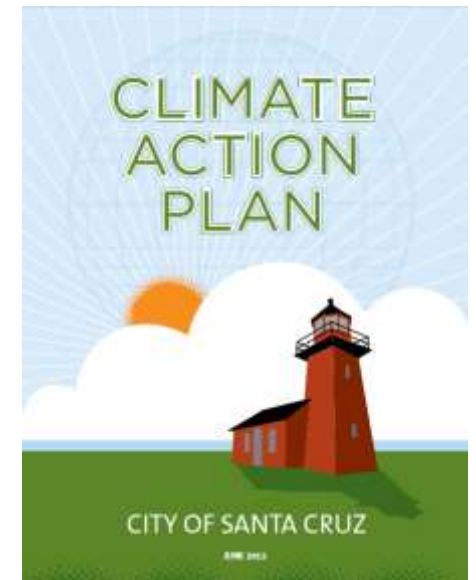
“Warming of the climate system is unequivocal...” *

Projected coastal climate hazards are significant

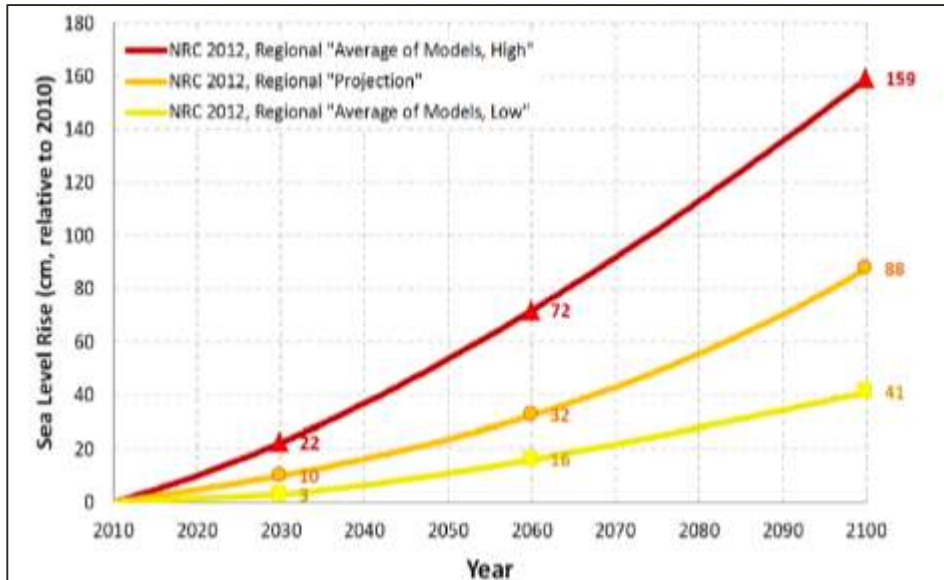
Discuss coastal processes and review adaptation options

Encourage the public to be part of the conversation

*International Panel on Climate Change, 4th Assessment Report



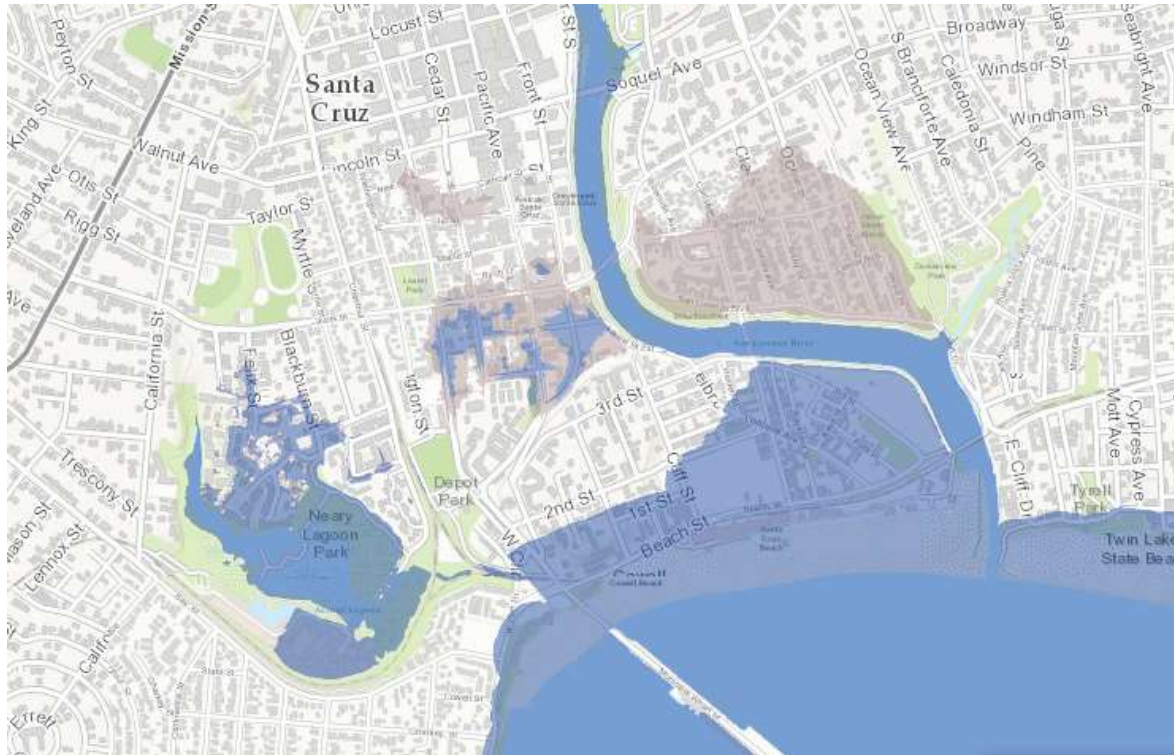
SLR SCENARIOS AND HAZARDS



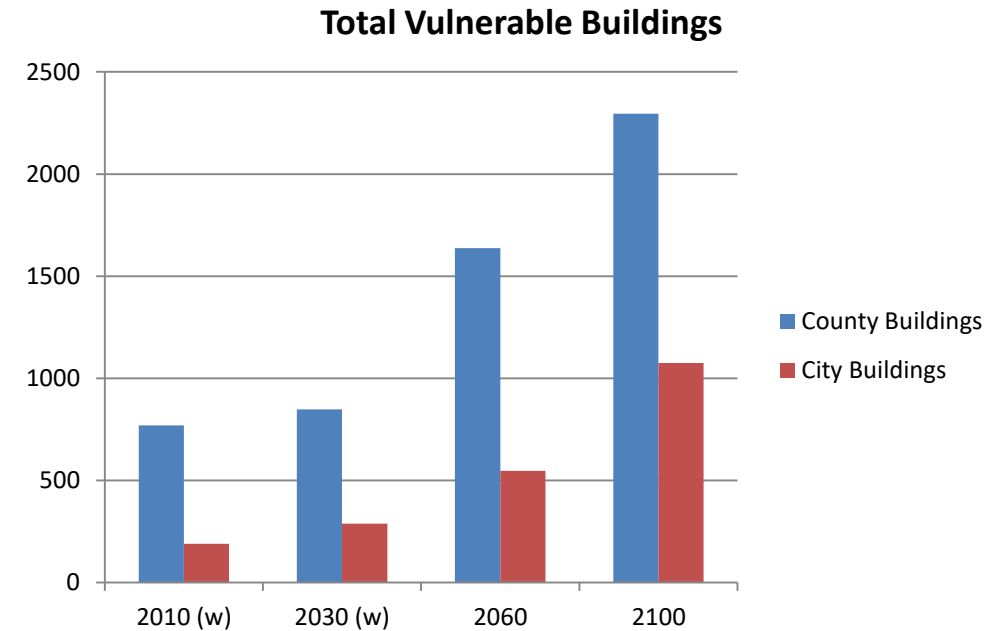
So-called “global warming” is just a secret ploy by wacko tree-huggers to make America energy independent, clean our air and water, improve the fuel efficiency of our vehicles, kick-start 21st century industries, and make our cities safer and more livable. Don’t let them get away with it!
 –Chip Giller, founder of Grist.org

Scenario	Erosion (dune & cliff)	Coastal Flooding	Rising Tides	Fluvial
2030 mid with protection	x	x	x	no
2060 high	x	x	x	no
2100 high	x	x	x	no

SANTA CRUZ SLR HAZARDS (MAPS OF DOOM)



<http://coastalresilience.org/project/monterey-bay/>



Disclaimer: These data represent outputs of regional climate models and are estimates of potential risks. These data have not yet been fully reviewed by the program's Technical Committee and are likely to change. Final reports expected out soon. centralcoastwetlands.org

INFRASTRUCTURE AT RISK (TABLES OF DESTRUCTION)



City of Santa Cruz

ASSETS	UNITS	TOTAL	2010 WITH ARMOR	2030 WITH ARMOR	2060 NO ARMOR	2100 NO ARMOR
Land Use and Buildings						
Total Buildings	Count	8,203	190	288	547	1,075
Residential	Count	7,439	143	210	372	753
Commercial	Count	358	33	62	141	228
Public	Count	79	2	2	5	34
Visitor Serving	Count	206	6	8	21	45
Other	Count	121	6	6	8	15
Schools	Count	2	0	0	0	0
Libraries	Count	1	0	0	0	0
Post Offices	Count	0	0	0	0	0
Emergency Services	Count	3	0	0	1	2
Farmland	Acres	57	0	0	0	0
Cleanup Sites	Count	3	0	0	1	1
Transportation						
Roads	Feet	304,200	10,376	14,304	43,890	68,689
Rail	Feet	10,528	1,556	1,556	5,887	5,887
Bridges	Count	8	6	6	6	7
Highway 1	Feet	2,587	0	0	0	7

DIFFERENT COASTAL HAZARDS AFFECT INFRASTRUCTURE DIFFERENTLY

Cliff erosion



Dune erosion



Rising tides



Storm flood impacts



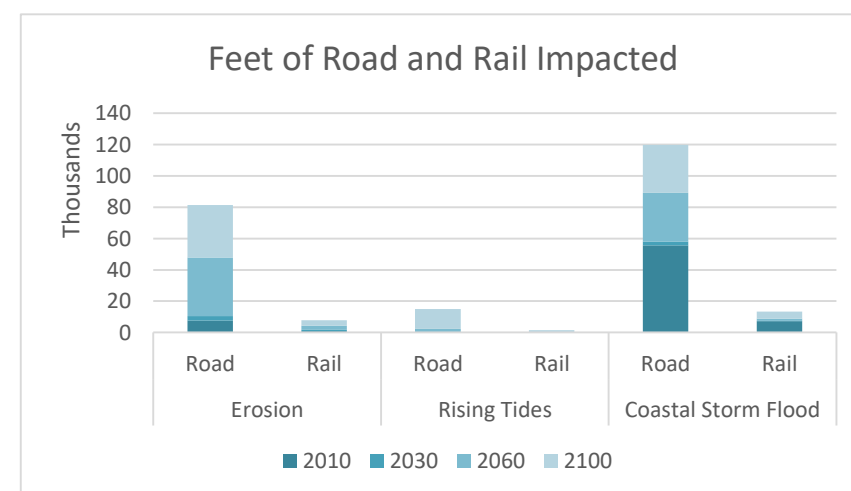
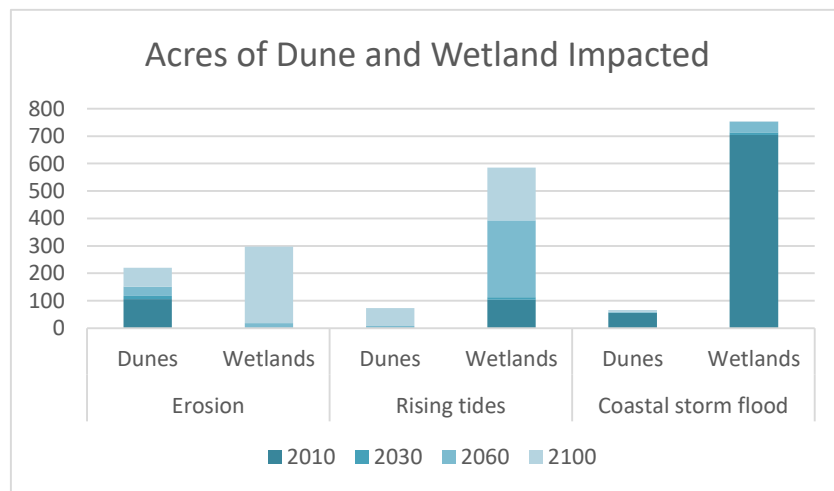
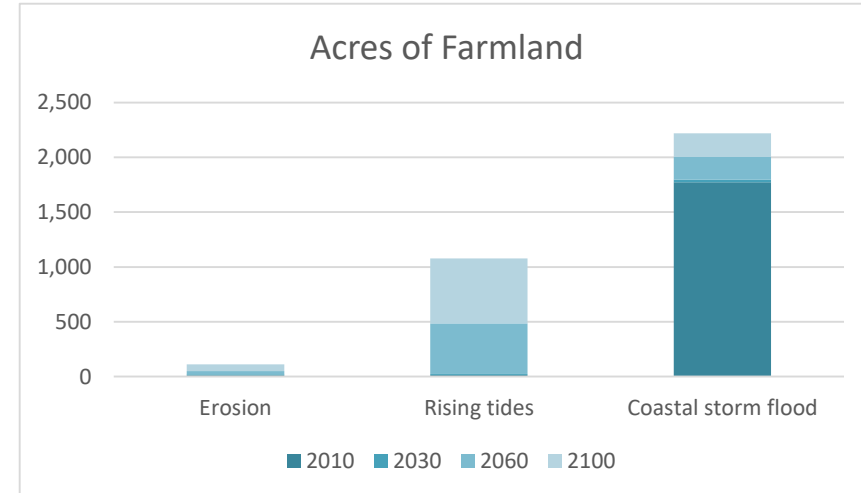
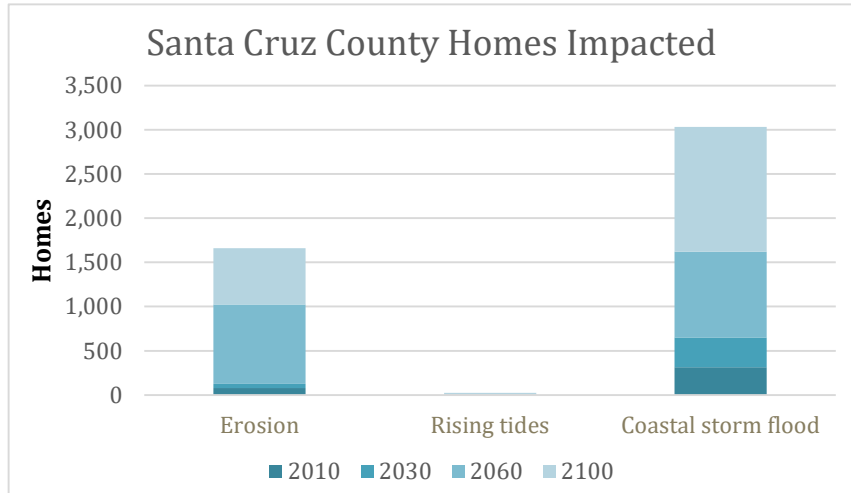
Temporary Impacts

- Fluvial Flooding
- Coastal Storm Flooding

Permanent Impacts

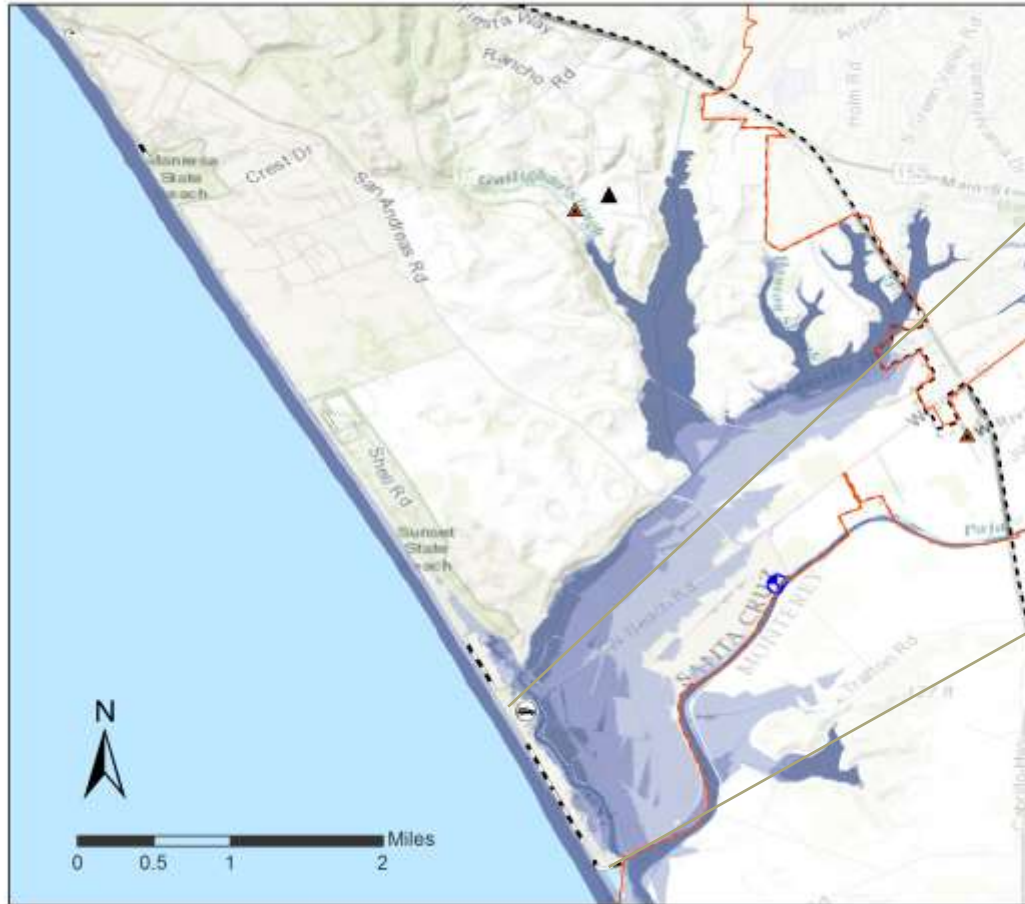
- Tidal Inundation
- Cliff and Dune Erosion

RISKS FROM INDIVIDUAL COASTAL HAZARDS

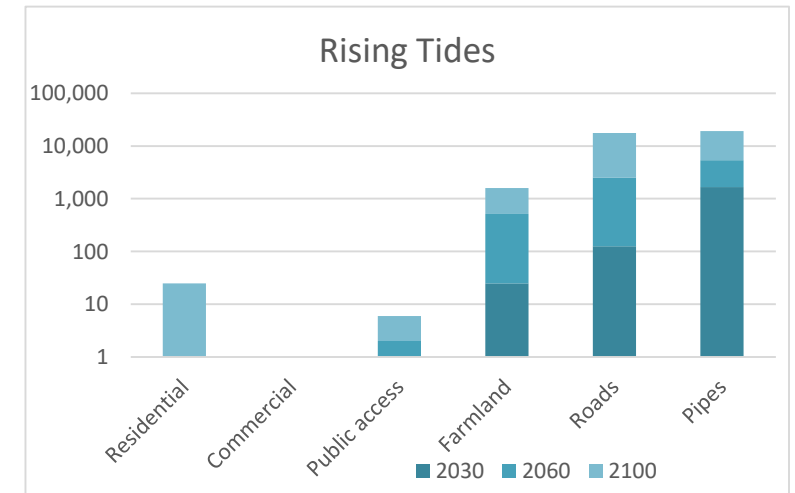


RISKS FROM RISING TIDES

SANTA CRUZ COUNTY COASTAL HAZARD ANALYSIS SECTION 4: RISING TIDES IMPACTS

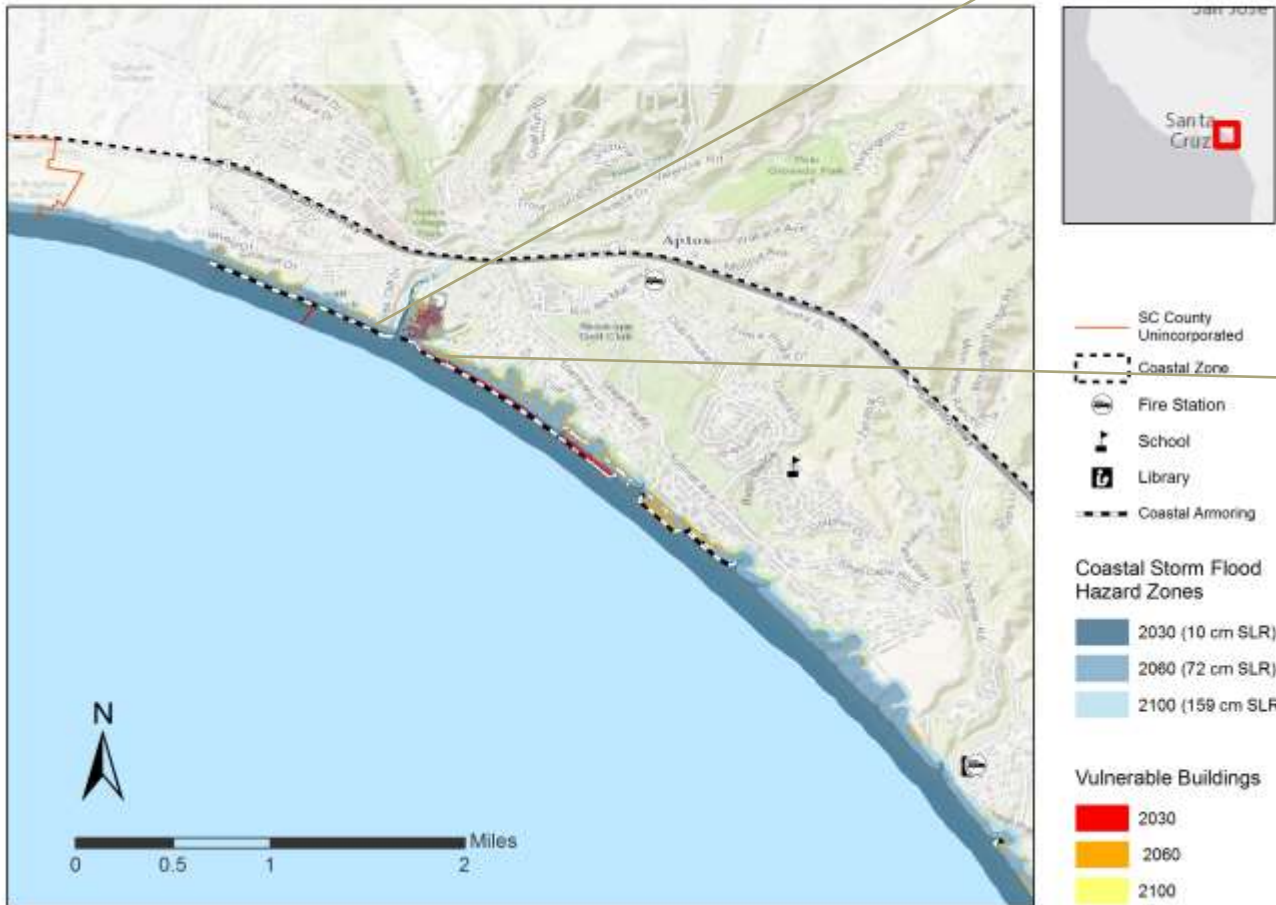


Pajaro Valley Agriculture

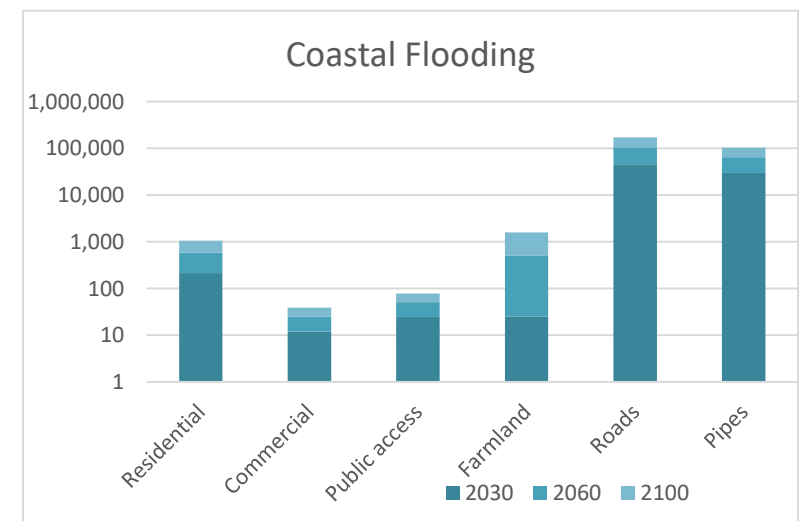


RISKS FROM STORM FLOODING

SANTA CRUZ COUNTY COASTAL HAZARD ANALYSIS
SECTION 3: COASTAL STORM FLOODING IMPACTS

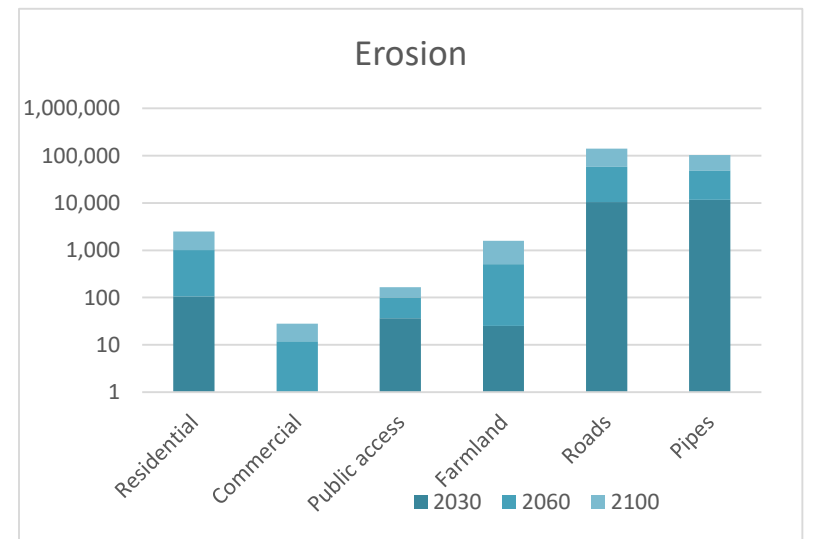
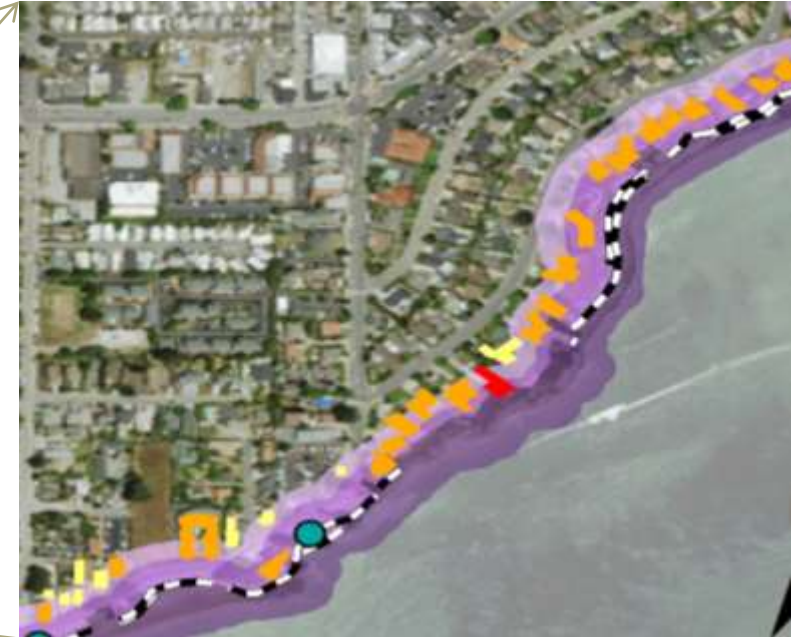
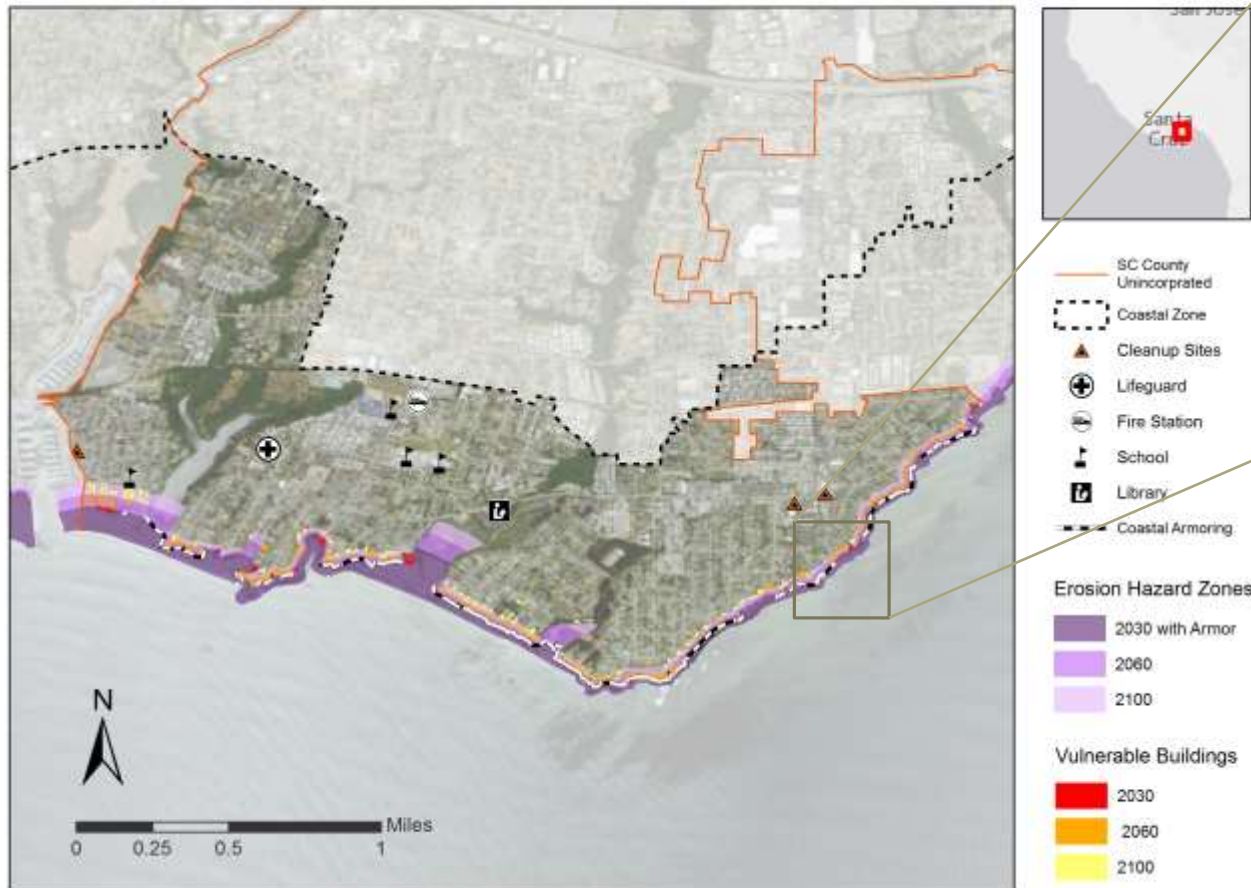


RIO DEL MAR
BUILDINGS VULNERABLE TO COASTAL STORM FLOODING



RISKS FROM COASTAL EROSION

SANTA CRUZ COUNTY COASTAL HAZARD ANALYSIS
SECTION 2: EROSION IMPACTS



FUTURE RISKS TO CRITICAL INFRASTRUCTURE

(CAPITOLA)



Capitola Avenue flooded from Noble Gulch Creek on Saturday March 26, 2011 (source: Santa Cruz Sentinel)

FACILITY	TYPE	COASTAL HAZARD IMPACT	IMPACT THRESHOLD
Fire Station	Emergency	Coastal storm flooding River flooding	2060 2030
Police Station	Emergency	River flooding	2030
City Hall/ Emergency Operations	Public	River flooding	2030
Post office	Government	River flooding	2100
Capitola Historical Museum	Public/Visitor Serving and Historic District	River flooding	2030
Capitola Venetian (and Historical District)	Visitor Serving	Coastal storm flooding Erosion Rising Tides River flooding	2030 2060 2100 2030
Capitola Wharf*	Public/Visitor Serving	Coastal storm flooding Erosion	2030 2060
Soquel Creek Park	Park	Coastal storm flooding River flooding Rising tides	2030 2030 2100
Esplanade Park	Park	Erosion Coastal storm flooding	2030 2030

FINANCIAL IMPLICATIONS (DRAFT COUNTY VALUES)

Asset	Value per unit	2010 With Armor	2030 With Armor	2060 No Armor*	2100 No Armor
Residential	\$ 958,043	\$452,196,530	\$509,679,140	\$1,187,015,892	\$1,757,051,772
Commercial	\$ 930,000	\$78,120,000	\$81,840,000	\$105,090,000	\$111,600,000
Public	\$ 500,000	\$10,500,000	\$11,500,000	\$19,500,000	\$27,500,000
Emergency Services	\$ 2,000,000	\$4,000,000	\$4,000,000	\$4,000,000	\$4,000,000
Property losses		\$544,816,530	\$607,019,140	\$1,315,605,892	\$1,900,151,772
Transportation					
Roads	\$ 280	\$22,222,480	\$24,223,920	\$33,924,520	\$41,928,040
Highway	\$ 4,000	\$75,212,000	\$77,868,000	\$80,872,000	\$90,884,000
Rail	\$ 280	\$4,069,800	\$4,501,000	\$4,980,920	\$5,294,800
Transportation losses		\$101,504,280	\$106,592,920	\$119,777,440	\$138,106,840
Water and Utility Infrastructure					
Storm Drain conduit	\$ 1,080	\$68,281,250	\$71,361,193	\$98,226,761	\$118,338,693
Waste Water conduit	\$ 1,080	\$57,183,523	\$60,245,114	\$95,901,420	\$118,506,023
Drinking Water conduit	\$ 189	\$467,614	\$743,750	\$1,776,705	\$2,550,379
Utility Losses		\$125,932,386	\$132,350,057	\$195,904,886	\$239,395,095
Total Combine losses		\$772,253,197	\$845,962,117	\$1,631,288,218	\$2,277,653,707

*To protect these structures from erosion, almost 8 miles of armoring will need to be upgraded or replaced before 2060 (at an estimated cost of \$410 million to construct).

HAZARD ANALYSIS FINDINGS

Coastal access, parking and commercial and residential buildings are vulnerable to wave damage and coastal flooding by 2030 within the low lying sections of Santa Cruz County.

An additional 1000 buildings are at risk of impact by 2060 from a predicted 2.4 ft. rise in sea levels as coastal protective structures begin to fail.

If all current coastal armoring is replaced and additional structures are constructed to protect the additional buildings and roadway, more than 12 miles of the Santa Cruz County coastline would be armored by 2060.

By 2100, more than 1,800 residential properties within the unincorporated county are vulnerable to coastal climate change hazards.

The total value of residential properties at risk increases to \$1.75 billion by 2100.

Almost 3.5 miles of coastal armoring will be necessary to protect the current north county highway alignment through 2100.

ADAPTATION STRATEGIES

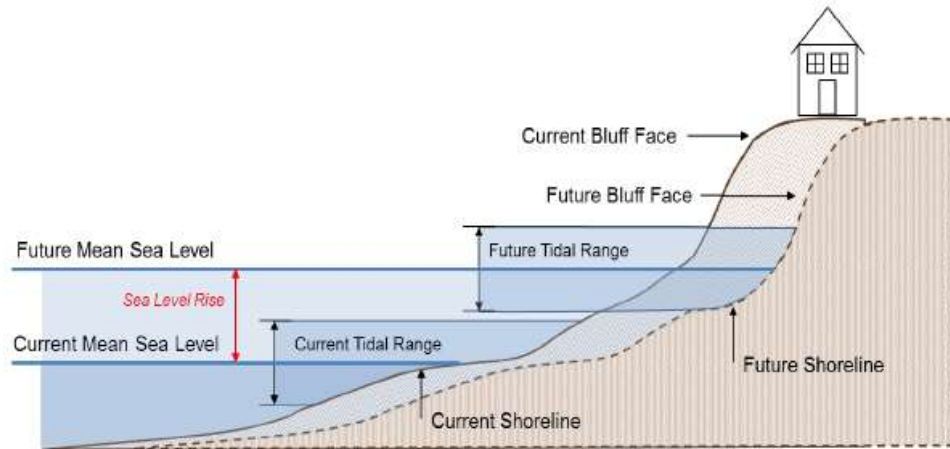


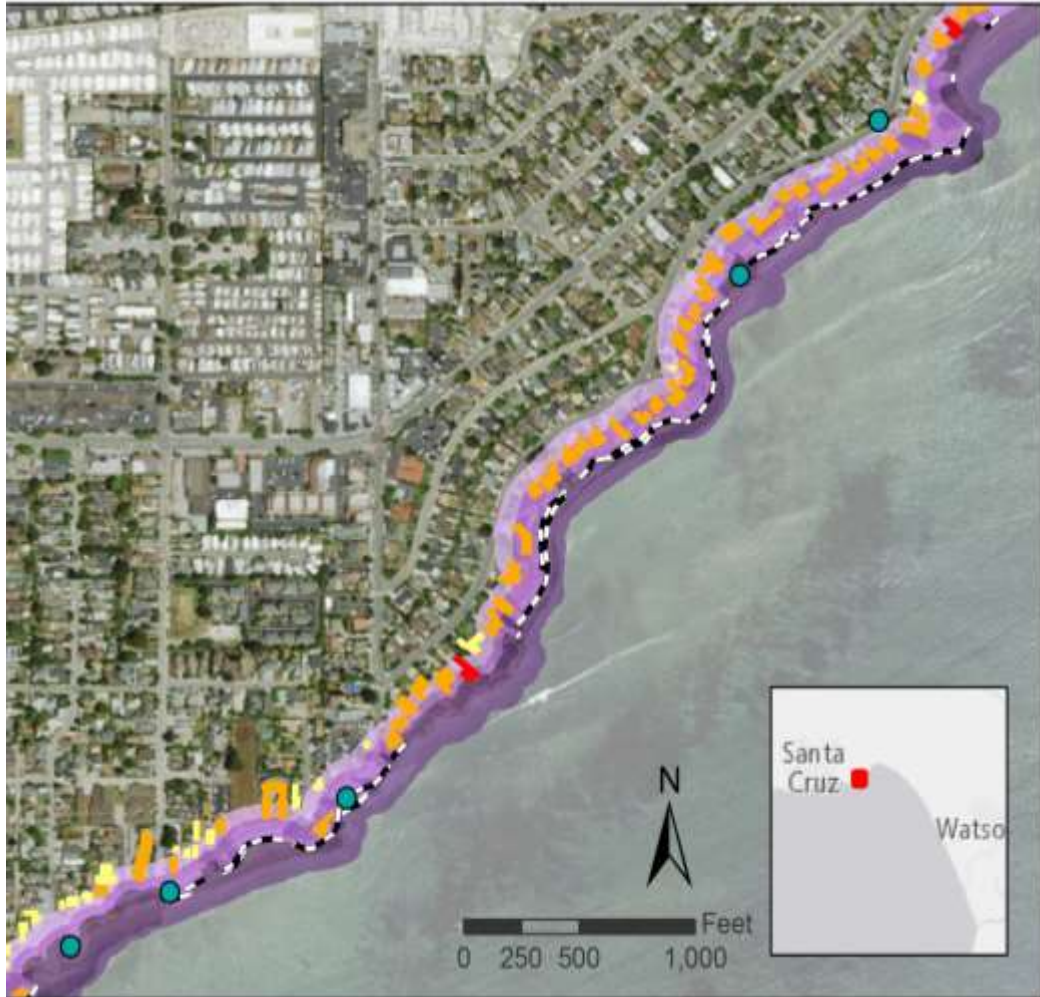
Figure B-6. Bluff erosion with changes in sea level. (Source: L. Ewing, 2013).



Capitola coastal protection (photo by R. Clark)

TYPE	LENGTH OF PROTECTION	RIVER FLOODING	COASTAL STORM FLOODING	EROSION	RISING TIDES
Hard					
Levee	medium	x	x		x
Seawall or Revetment	medium		x	x	
Tidal Gate	medium	x	x		x
Flood wall	short	x	x		x
Groin	medium			x	
Soft					
Wetland shoreline	medium	x	x		
Dune restoration	short	x	x		x
Beach Nourishment	short			x	
Offshore structure	medium	x	x		
Accommodate	long	x	x		
Elevate	medium	x	x		x
Other Building design	short-long	x			
Managed Retreat	medium		x	x	
Retreat	long	x	x	x	x
Rolling easement	long	x	x	x	x
Strict land use re-zone	long	x	x	x	x
Regulatory Tools					
Stricter Zoning	long	x	x	x	x
Floodplain Regulations	long	x			
Setbacks/Buffers	long	x	x	x	x
Rebuilding Restrictions	long	x	x	x	x
Planning Tools					
Comprehensive Plan	long	x	x	x	x

CLIFF EROSION—MANAGED, REGULATED & OTHERWISE



Armoring Considerations

10 Miles of replacement or new armoring

\$20-\$52 million a mile plus maintenance

Use of public beach to protect public and private infrastructure

COASTAL ARMORING SECONDARY CONSEQUENCES

LOCATIONS OF BEACH LOSS DUE TO RISING TIDES AT EACH TIME HORIZON



SECONDARY CONSEQUENCES

LOCATIONS OF BEACH LOSS DUE TO RISING TIDES AT EACH TIME HORIZON

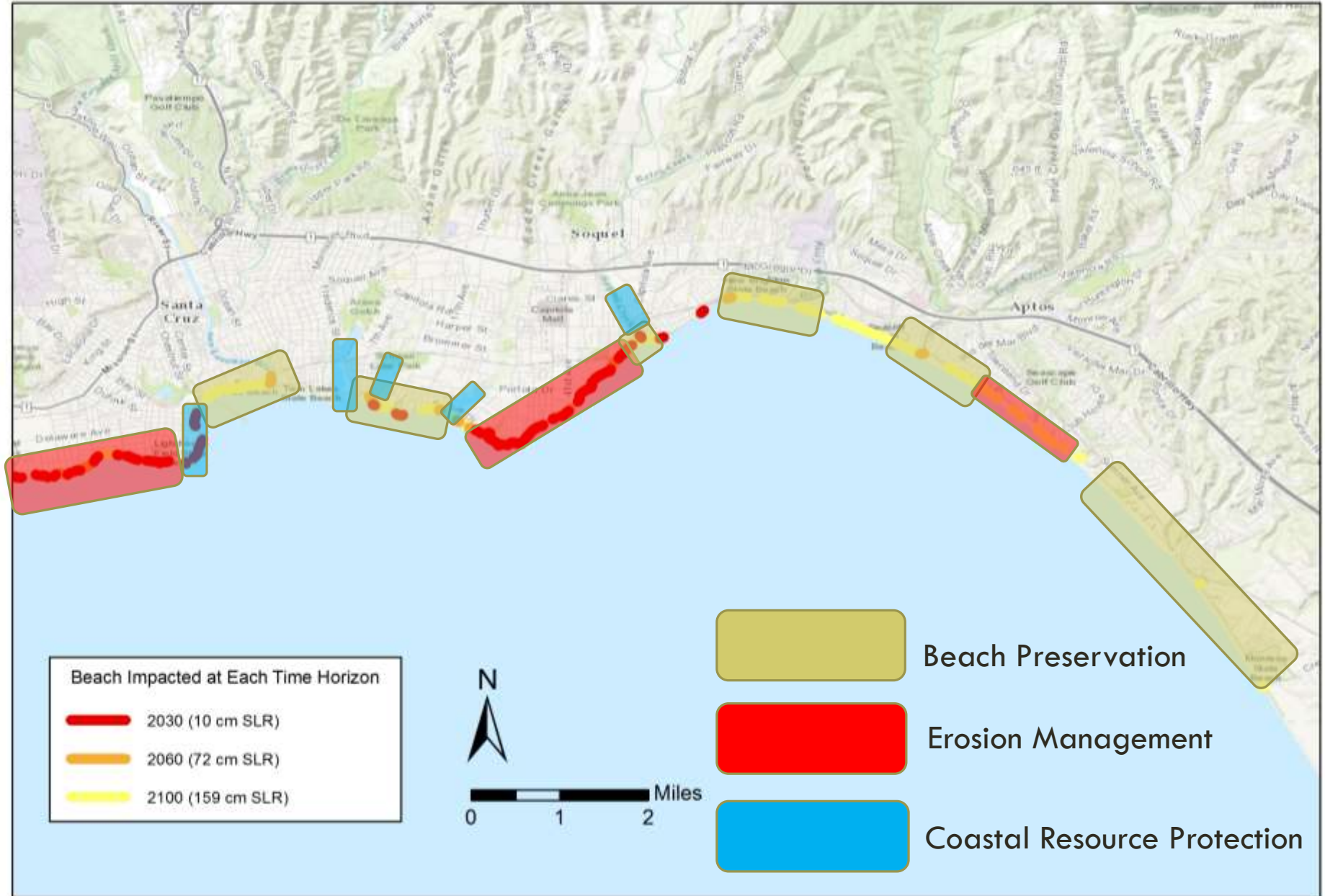


CLIFF EROSION—MANAGED, REGULATED & OTHERWISE



THE FUTURE OF COASTAL PLANNING FOR EROSION & SLR

LOCATIONS OF BEACH LOSS DUE TO RISING TIDES AT EACH TIME HORIZON



ADAPTATION WITHIN RIVER VALLEY AGRICULTURE



ADAPTATION TO RISING TIDES



ADAPTATION TO RISING TIDES



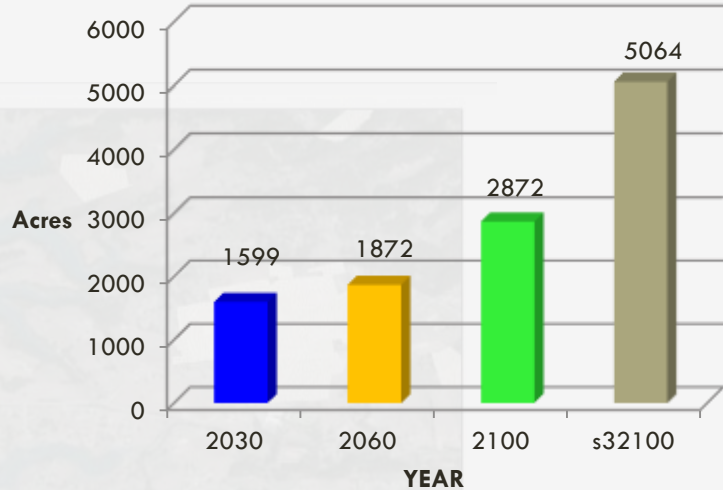
ADAPTATION TO RISING TIDES



ADAPTATION TO RISING TIDES



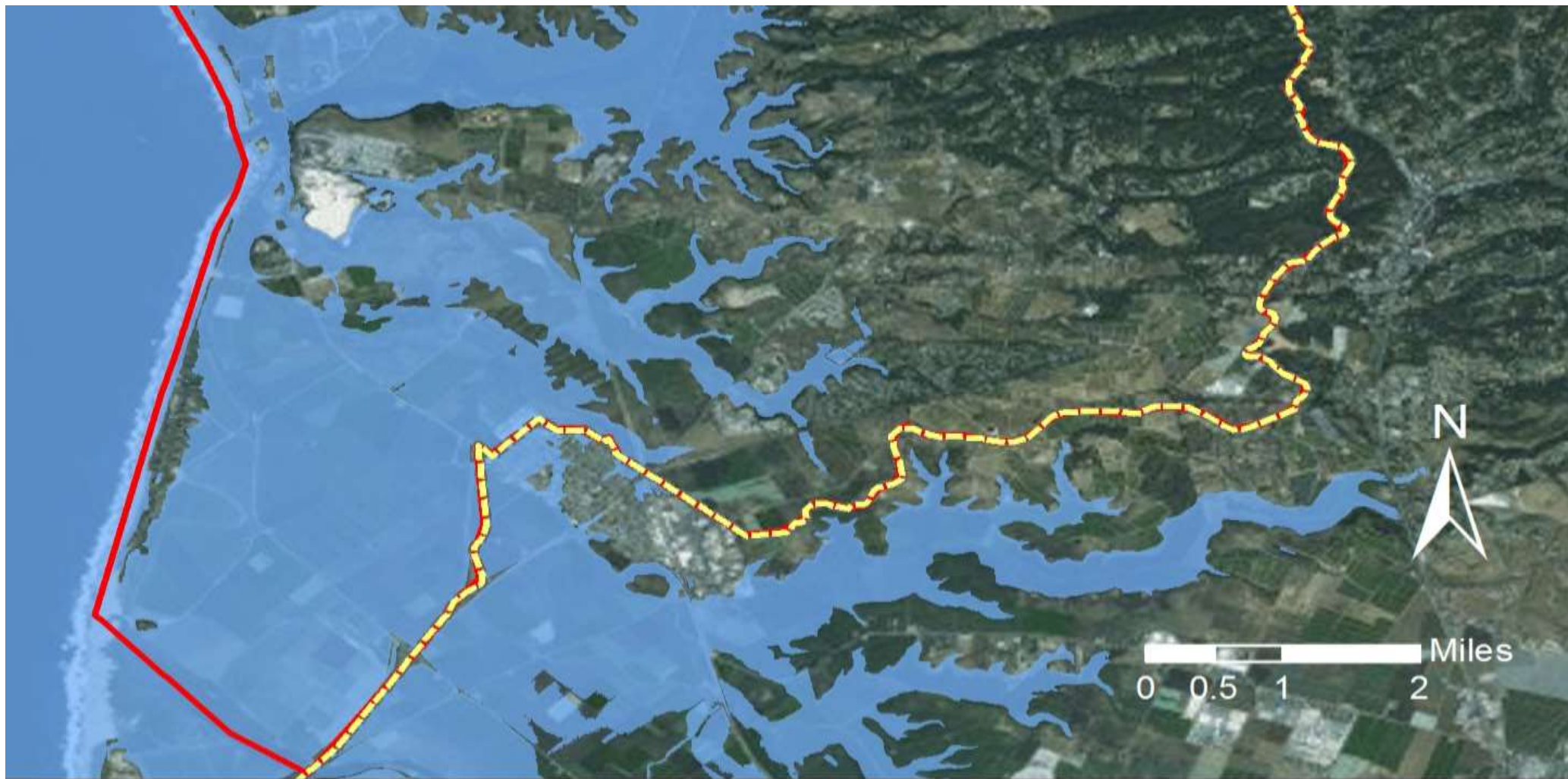
**Coastal Ag Land Threatened:
Rising Tides in Central Monterey Bay**



MANAGED RETREAT WITHIN AGRICULTURE



2060 COASTAL FLOODING WITHOUT DUNES



FROM ANALYSIS TO IMPLEMENTATION



Potrero Tide Gates

One important adaptation strategy is to ensure that the coastal dunes remain functional as barriers to wave surge that could flood the valley.

Monterey Bay Natural Capital Project

Langridge et. al, 2013

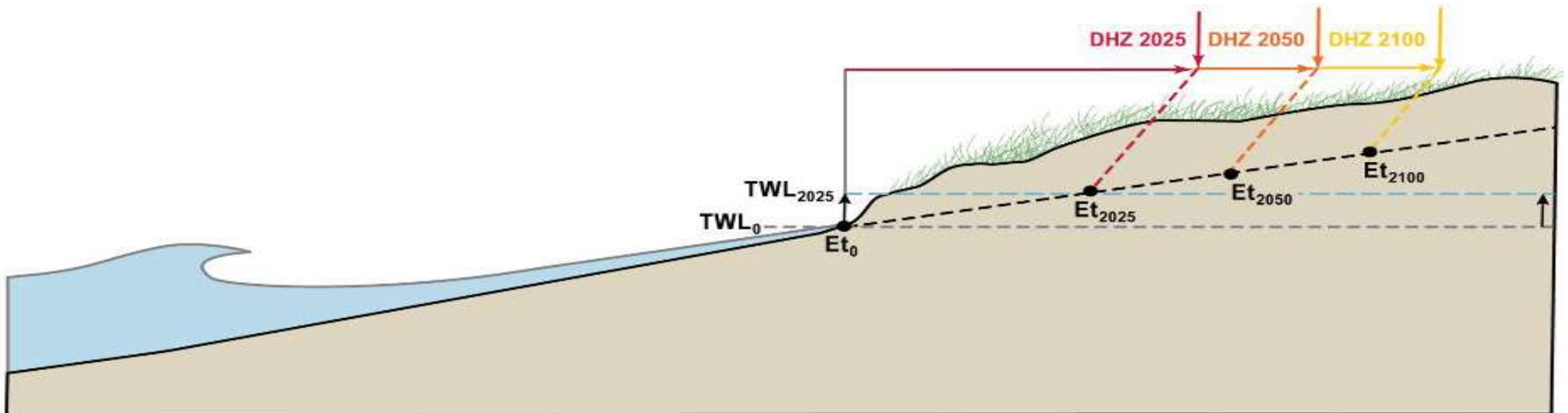
Salinas River Levee

DUNES PROTECT INLAND RESOURCES



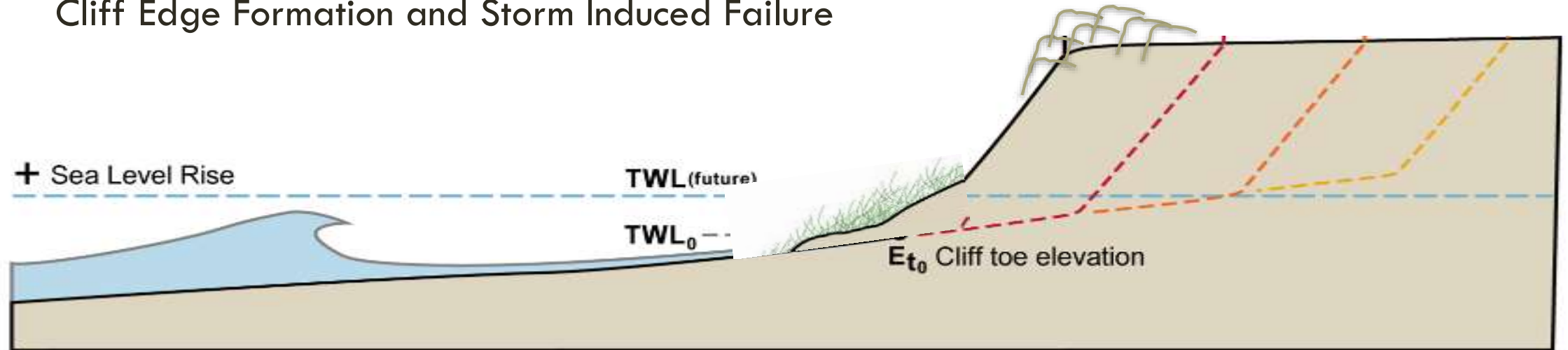
NATURAL DUNE LOSS AND REGENERATION

Storm Induced Dune Loss- Leads to Regeneration



ICE PLANT DOMINATED DUNE LOSS

Cliff Edge Formation and Storm Induced Failure



COMBINE THREATS OF ICE PLANT AND UNMANAGED PATHWAYS



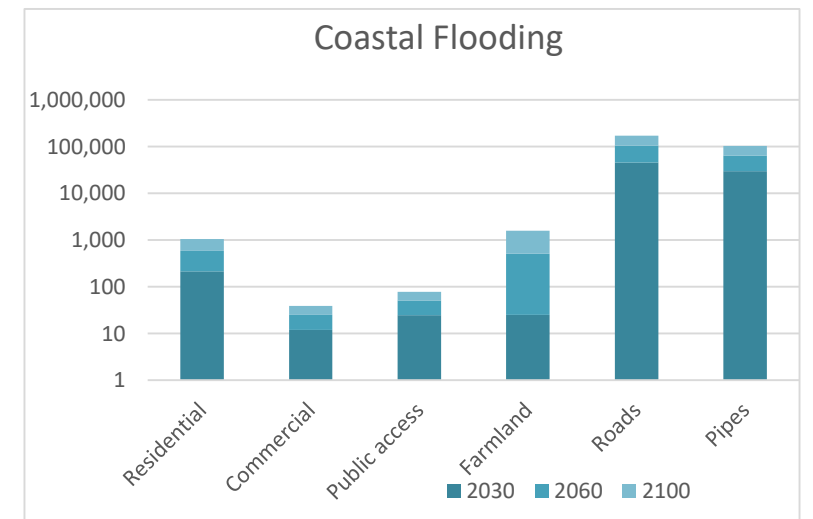
ICE PLANT REMOVAL & NATIVE PLANTING



Funding by California Coastal Conservancy

2017-2030 ADAPTATION OPTIONS FOR SANTA CRUZ

- ***Adopt policies to limit municipal capital improvements that would be at risk***
- ***Upgrade building standards in storm flood hazard zones***
- ***Improve resiliency to flooding along the River and Coast***
- ***Upgrade storm drains***
- ***Prioritize coastal protection upgrade and replacement***
- ***Investigate beach nourishment***



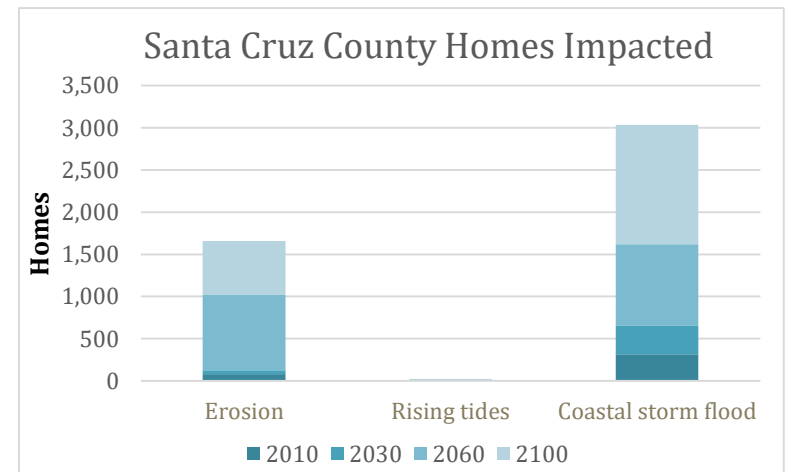
LONG TERM ADAPTATION OPTIONS

2030-2060

- **Identify priority areas for future protection accounting for costs, structural feasibility and secondary implications.**
- **Identify priority areas for managed retreat to retain sufficient beach area for recreational use**

2060-2100

- **Implement managed retreat strategies**
- **Realign roads and utility infrastructure**



POSSIBLE FIRST STEPS:

Support Climate Action

Adopt municipal review guidelines for sea level rise hazard areas

Discuss impacts and implications of predicted coastal hazards

Understand costs of adaptation

Consider secondary impacts of adaptation strategies

Insist on the equitability of preferred strategy

Decide what we want our coast to look like in 2060

Thank You

www.centralcoastwetlands.org

