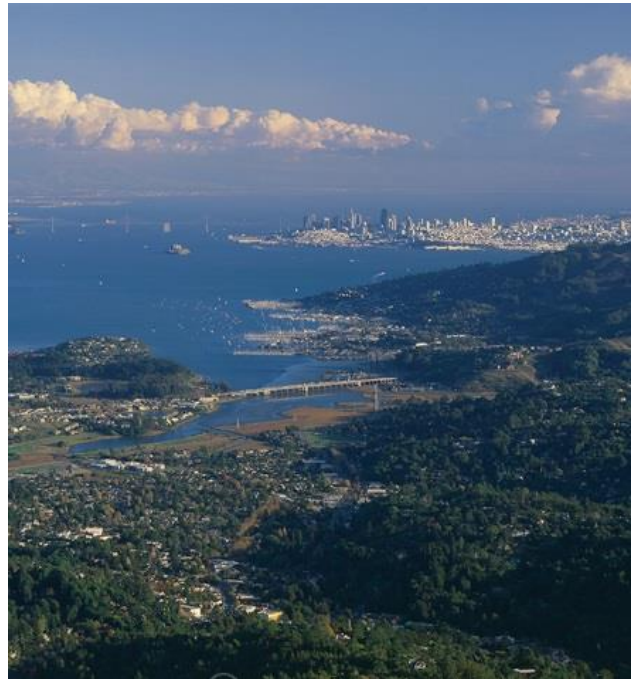


CONCLUSION

Conclusion

The Bay Waterfront Adaptation and Vulnerability Evaluation (BayWAVE) sea level rise vulnerability assessment examined the exposure, sensitivity, and adaptive capacity of built and natural assets in Marin County. Many of Marin's essential and beloved shoreline assets are vulnerable to sea level rise and a 100-year storm surge. Key takeaways from this assessment are:

- Everything is connected— impacts to one asset or one community could have regional impacts. Even people who live high and dry could be vulnerable to disruptions along Marin's shoreline, especially travel to and from work, school, and health services. Thus, asset managers, property owners, elected and appointed officials, government and consultant professionals will all need to work together to strategize for and implement the best possible outcomes.
- Without safeguards, kinks in the utility and transportation networks could impact hundreds of thousands of residents, employees, and visitors as early as the near-term. Disruptions or damages to these networks could be crippling to modern daily life. Few alternative route options are politically or physically viable.
- Areas seasonally impacted now or during king tides could flood almost daily in the near-term.
- Shifts to higher high tides impact public and private ownership under the public trust doctrine requiring hundreds of households to pay fees to the State they do not currently pay.
- Areas on fill and bay mud will face increasing rates of subsidence.
- The majority of low-lying areas, even those protected by levees, could experience tidal impacts after three feet of sea level rise.
- Some of the most vulnerable places are occupied by those with the least amount of resources and abilities.
- San Rafael and small shoreline unincorporated communities in Southern Marin could be the first to experience significant tidal flooding in the near-term.



Mill Valley from Mount Tamalpais. Credit: Ed Callert

15-year Expectations

Storm surge flooding could impact 2,500 parcels and 3,800 buildings. These figures amount to six percent of parcels and buildings in the study area. Storm surge flooding, especially combined with stormwater flooding, could impact North Novato at Gness Field, Sea level rise flooding could reduce useable living space, and adversely affect tourism, transportation, recreation and natural resources within 15 years. The first threats are to buildings, roads, and original utility systems along the shoreline. Tidal closures and/or damage to roads, and breakdowns utility networks could have regional ripple effects beyond the flooded areas for extended period of time.

In this near-term timeframe, tidal flooding at 10 inches of sea level rise (MHHW) could reach 5,000 acres with 1,300 parcels and 700 buildings, potentially impacting tens of thousands residents, employees, and visitors. These figures amount to two percent of parcels and one percent of buildings in the study area. Monthly tidal flooding could adversely impact San Rafael east of U.S. Highway 101, bayfront Belvedere and Tiburon, Greenbrae, Waldo Point, and Paradise Cay within this time period.

CONCLUSION

With an additional 100-year storm surge added to sea level rise, the previously impacted acres, parcels, and buildings could face tidal and storm surge flooding. And an additional 3,000 acres, with Black Point on the Petaluma River, lower Santa Venetia, Belvedere around the lagoon, bayfront Corte Madera, bayfront Mill Valley, Marinship in Sausalito, Tamalpais, and Almonte.

Eight miles of road could expect tidal flooding. Many of the flooded intersections already experience storm and king tide flooding. These are:

- The Manzanita area, U.S. Highway 101 at Shoreline Highway,
- Miller Avenue in Mill Valley,
- The Marinship area in Sausalito,
- U.S. Highway 101 in Corte Madera and Larkspur, and
- State Route 37 in Novato.

This is expected to worsen in severity and could be experienced daily by near-term scenario 1. Tidal flooding could soon start to regularly reach the Canal area of San Rafael all the way to Interstate 580. Several roads that are now dry may begin to experience seasonal, king tide, and storm surge flooding. These would be roads in Santa Venetia, Tamalpais, Belvedere, Mill Valley, Marin Lagoon of San Rafael, and bayfront Corte Madera and Larkspur.

Water travel infrastructure could be compromised at ferry facilities in Larkspur, Tiburon, and Sausalito preventing commuters from traveling to work. Even if the facilities are able to handle near-term high tides, providing safe parking and access to ferry users could prove challenging. Smaller marinas and boat launches along the bay in Sausalito, Mill Valley, Strawberry, Tiburon, Belvedere, Bel Marin Keys, and Black Point could be flooded out and unusable several months out of the year during high tides. Storm surges can be powerful enough to damage and sink boats. This is especially a concern for residential boats.

Southern Marin Fire Protection and Sausalito Police Department boats are included in the boats harbored in marinas vulnerable to sea level rise. The Castro Fire Station in San Rafael is vulnerable to tidal flooding in the near-term and the California Highway Patrol could expect storm surge flooding in this time period. Most concerning, however, is the potential inability of emergency vehicles to access

people and places in danger due to the roads flooded in the near-term.

In addition, the marshlands that buffer the shoreline communities from high tides and storm surges could begin to experience transitions in habitat, especially those in Southern Marin where they are typically bordered by urban development. Consequently, the waters here would get deeper and flood out the existing habitat. This might shift marsh habitat from high marsh to low marsh, low marsh to mud flat, and mud flats to open water. Without adequate light in deeper waters, eelgrass beds would shrink. Collectively, these habitat shifts could have significant impacts on vulnerable species, such as the salt marsh harvest mouse, Ridgway's Rail, or the long-fin smelt.

IMPACTS AT-A-GLANCE: SCENARIO 2

5,000 acres flooded @ MHHW	200,000+ residents plus commuting employees
8,000 acres flooded @ MHHW +100-year storm surge	2,000 agricultural acres (mostly ranch)
4,500 homes, businesses, & institutions	Property Owners County of Marin Municipalities Caltrans Sanitary Districts Water Districts Fire Districts Sausalito Police Department CHP SMART GGBD MTA PG&E AT&T DFW CA Wildlife Conservation Board
80 miles of wet road, 3 ferry landings, 5 marinas, 4 boat launches	
Beaches Tidal Marshes Eelgrass beds Wetlands	

CONCLUSION

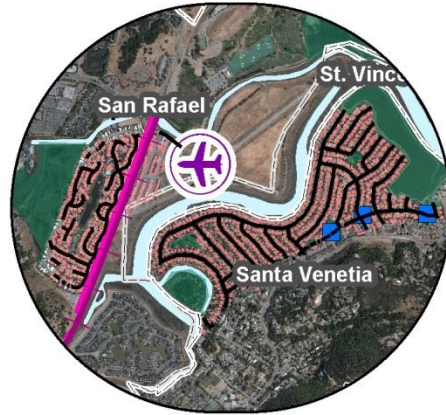
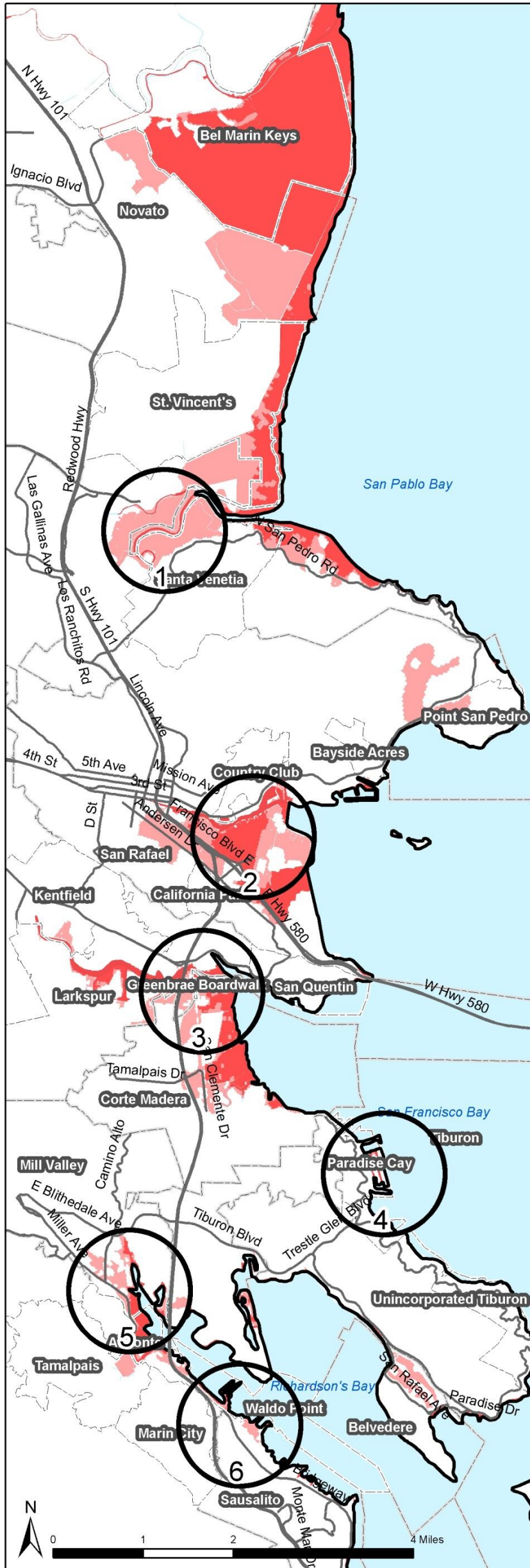
Map 131. Fifteen-year Expectation: Near-term Vulnerable Assets

NEAR TERM

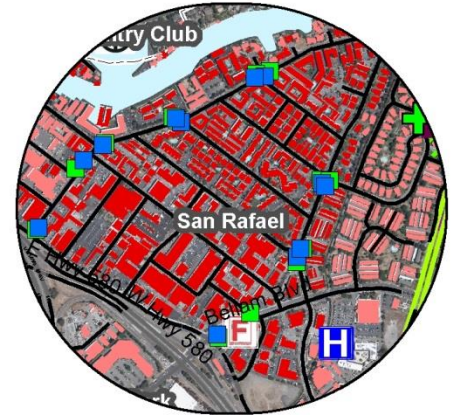
Scenario 1:
10 in. Sea Level Rise

Scenario 2:
10 in. Sea Level Rise
+ 100-year storm surge

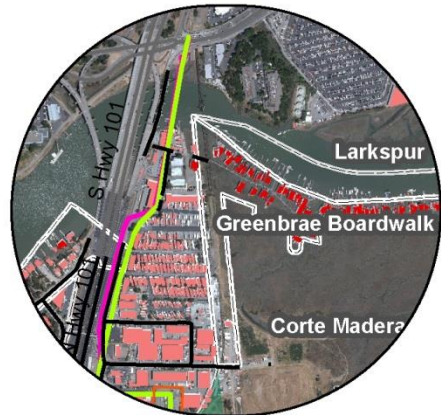
In 15 years, high tides could threaten Marin's shoreline buildings, roads, and original utility systems. Damage and breakdowns in road and utility networks would impact the entire County, especially Southern Marin. Tidal flooding (red) could reach 5,000 acres, 1,300 parcels, 700 buildings, and 8 miles of road in San Rafael east of State Route 101, bayfront Belvedere and Tiburon, Greenbrae Boardwalk, Waldo Point, and Paradise Cay. A 100-year storm surge (pink) would flood these areas with storm surge flooding, and flood an additional 3,000 acres, 2,500 parcels, 3,800 buildings, and 20 miles of road in North Novato, Black Point on the Petaluma River, lower Santa Venetia, Belvedere Lagoon, bayfront Corte Madera and Mill Valley, Marinship in Sausalito, Marin Lagoon in San Rafael, Tamalpais, and Almonte. Flooded ferry facilities would prevent commuters and visitors from traveling across the Bay. Boating facilities in Sausalito, Mill Valley, Strawberry, Tiburon, Belvedere, San Rafael, Bel Marin Keys, and Black Point may be inaccessible. This is especially a concern for marinas with residential boats and Southern Marin Fire and Sausalito Police boats. The Castro St. Fire Station in San Rafael is vulnerable to tidal flooding, though all emergency professionals would be denied vehicular access to people in vulnerable areas. Southern Marin marshlands would shift high marsh to low marsh to mud flat, and eelgrass beds could shrink under deeper darker waters. These habitat shifts would have significant repercussions for plant, insect, fish, and animal species.



1: Santa Venetia



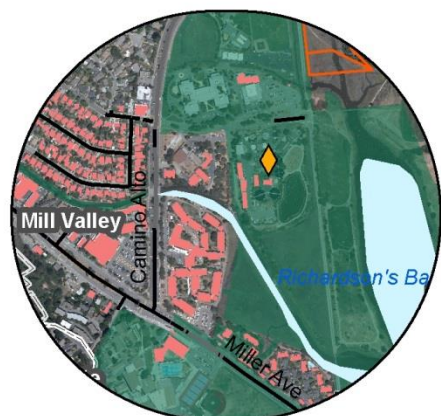
2: Canal Area



3: Greenbrae Boardwalk/
Larkspur



4: Paradise Cay



5: Mill Valley



6: Waldo Point Harbor

Vulnerable Assets

Vulnerable Buildings

- Scen. 1: 10" Sea Level Rise (SLR)
- Scen. 2: 10" SLR+Storm Surge
- Park
- Vulnerable Road
- Marin Transit Stop
- Golden Gate Transit Stop
- ▲ Park & Ride
- + SMART Track
- ✈ Airport
- Marina

- ✈ School
- H Medical Facility
- + Emergency Shelter
- + Fire Station
- ◆ District Office
- + Gas Pipe
- ▲ Electrical Transmission Tower
- PG&E Property
- Transmission Lines

Sea Level Rise Scenarios

- Scen 1: 10" SLR
- Scen 2: 10"SLR+Storm Surge

Location Indicators

- Unincorporated
- Municipality
- Road
- Bay

Disclaimer: Vulnerability Assessment maps, tables, etc. can be used as a resource to help identify potential hazardous areas and vulnerable assets. Marin County, and data providers here in, make no warranties of the accuracy or completeness of maps and data. Maps are representational and subject to future revision. Local site conditions must be examined. Commercial use is prohibited.

EV3 CONSULTING
Date: 3/29/2017

OCOF
CoSMoS

CONCLUSION

IMPACTS AT-A-GLANCE: SCENARIO 4

6,700 acres flooded @ MHHW	200,000+ residents plus commuting employees
13,500 acres flooded @ MHHW +100-year storm surge	2,000 agricultural acres (mostly ranch)
5,600 homes, businesses, & institutions	Property Owners County of Marin Municipalities Caltrans
62 miles of wet road, 3 ferry landings, 5 marinas, 4 boat launches	Sanitary Districts Water Districts Fire Districts Sausalito Police Department CHP SMART GGBD MTA PG&E AT&T DFW CA Wildlife Conservation Board
Beaches Tidal Marshes Creeks Eelgrass beds Ponds Wetlands	



Shoreline Park, San Rafael. Credit: Abey Arnold Associates

Mid Century Expectations

In this medium-term timeframe, tidal flooding at 20 inches of sea level rise (MHHW) could reach nearly 7,000 acres, 3,000 parcels, and 2,000 buildings, and impact even more residents, employees, and visitors than in the near-term. These figures amount to two percent of parcels and three percent of buildings in the study area. Monthly tidal flooding could adversely impact the same locations flooded in the near-term, though more severely.

With an additional 100-year storm surge, the previously impacted acres, parcels, and buildings could face tidal and storm surge flooding, and an additional 7,000 acres, with 2,200 parcels and 3,600 buildings could anticipate storm surge flooding. These figures amount to eight percent of parcels and seven percent of buildings in the study area. This is a significant jump in impacted area, likely because many inadequate levees and other shoreline armoring structures could be overtopped at this water level. Storm surge flooding could impact the same locations as in near-term storm surge scenario 2, and extends further inland beyond the marshes of Mill Valley, Strawberry, San Rafael, St. Vincent's, and North Novato.

Eighteen miles of roadway, ten more miles than in the next fifteen years, could expect tidal flooding. Many of the impacted roads are the same as those impacted in the near-term, though much greater lengths could anticipate tidal flooding at MHHW and depths of flooding would increase on segments exposed to flooding in the near-term. Storm surge flooding could reach a total of 62 miles of roadway. Water travel could experience similar outcomes as in the near-term, though the highest high tides and storms surges would cause even more damage than weathered twenty years earlier.

With respect to utilities, pipelines under vulnerable roads, and lateral pipes to vulnerable properties, would become squeezed between rising groundwater and the confining roadway. This could cause pipes to bend and break, and could even damage roadways. In the medium-term, impacts to the North Marin Water District assets would impact water service in Bel Marin Keys and unincorporated Novato. Vulnerable electrical substations, transmission towers and lines, and underground natural gas pipelines along the shoreline would be compromised by flooding and subsidence, and would subsequently affect transportation, sewer,

CONCLUSION

stormwater, food storage, and communications assets, and general public safety.

This twenty inch increase in sea level would continue to shrink trapped habitats in Southern Marin. Storm surges would only exacerbate erosion as well.

CONCLUSION

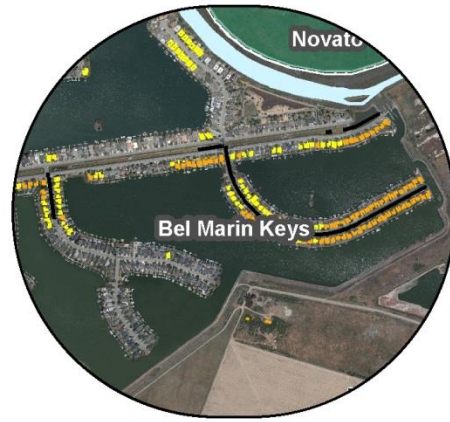
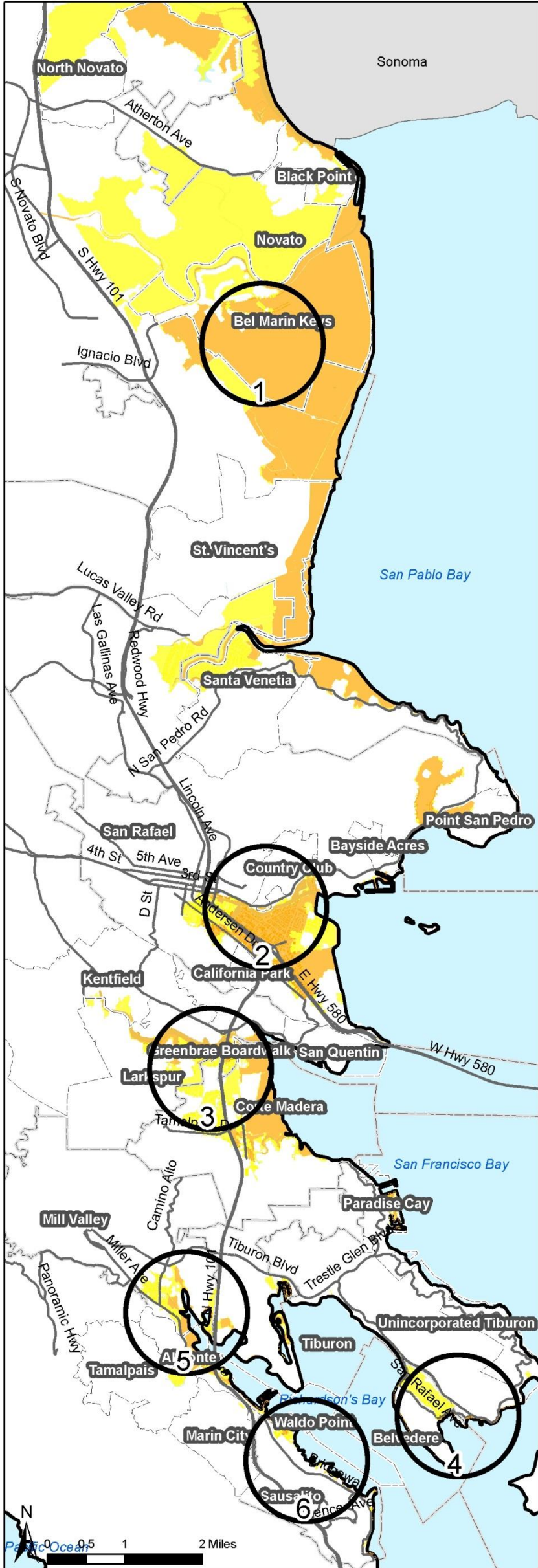
Map 132. Mid-century Expectation: Medium-term Vulnerable Assets

MEDIUM TERM

Scenario 3:
20 in. Sea Level Rise

Scenario 4:
20 in. Sea Level Rise
+ 100-year storm surge

Tidal flooding could reach 7,000 acres, 3,000 parcels, 2,000 buildings, and 18 miles of roadway in the same locations impacted in the near-term, though more severely. With a 100-year storm surge, the area vulnerable to tidal flooding would also experience storm surge flooding. An additional 7,000 acres, 2,200 parcels (8%), 3,600 buildings (7%), and 40 miles of roadway could anticipate storm surge flooding. Most levees south of Novato are not designed to withstand this level of flooding and would be overtopped. Storm surge flooding would extend further inland beyond the marshy areas of Mill Valley, Strawberry, San Rafael, St. Vincent's, and North Novato. Water travel could experience similar outcomes as in the near-term, though the highest high tides and storms surges would cause even more damage than weathered twenty years earlier. Pipelines beneath flooded roads could become squeezed between rising groundwater and the roadway, cause pipes to bend and break, and even damage roadways, this is true for sanitary, stormwater, and potable water pipes. PG&E substations, electrical transmission towers and lines, and natural gas pipelines could be bent or broken by flooding, subsidence, and erosion, with far reaching impacts on utilities, buildings, and transportation. This ten inch increase in sea level would continue to shrink trapped beach and marsh habitats in Southern Marin. Shoreline parks and pathways would flood often.



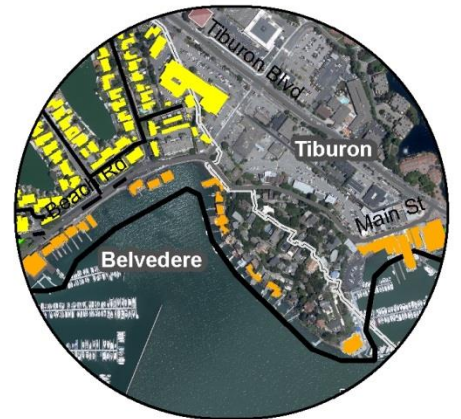
1: Southern Bel Marin Keys



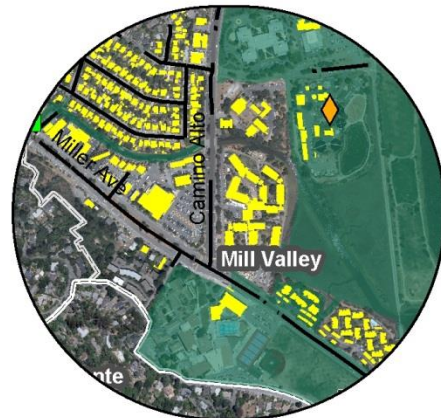
2: U.S. Hwy. 101 @ Interstate 580



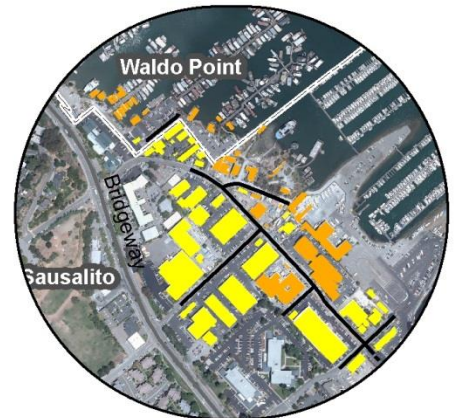
3: Riviera Circle



4: Tiburon/Belvedere



5: Mill Valley



6: Marinship

Vulnerable Assets

- Scen. 3: 20" Sea Level Rise
- Buildings Vulnerable to Storm Surge
- @20"+Storm Surge
- Park
- SMART Track
- Marin Transit Stop
- Golden Gate Transit Stop
- Park & Ride
- Ferry
- Airport
- Boat Launch
- Marina
- School
- Medical Facility
- Law Enforcement
- Emergency Shelter
- Fire Station
- District Office
- Gas Pipe
- Electrical Transmission Tower
- Substation
- Transmission Lines

Sea Level Rise (SLR) Scenarios

- Scen 3: 20" SLR
- Scen 4: 20"SLR+Storm Surge

Location Indicators

- Unincorporated
- Municipality
- Road
- Bay

Disclaimer: Vulnerability Assessment maps, tables, etc. can be used as a resource to help identify potential hazardous areas and vulnerable assets. Marin County, and data providers here in, make no warranties of the accuracy or completeness of maps and data. Maps are representational and subject to future revision. Local site conditions must be examined. Commercial use is prohibited.



Date: 4/1/2017



CONCLUSION

IMPACTS AT-A-GLANCE: SCENARIO 6

16,300 acres flooded @ MHHW	200,000+ residents plus commuting employees
18,000 acres flooded @ MHHW +100-year storm surge	4,150 agricultural acres (mostly ranch)
12,100 homes, businesses, & institutions	Property Owners County of Marin Municipalities Caltrans Sanitary Districts Water Districts Fire Districts Sausalito & Central Marin Police Departments CHP SMART GGBD MTA PG&E AT&T DFW CA Wildlife Conservation Board
\$15.6 billion in assessed property value ²²⁰	
200 miles of wet road, 3 ferry landings, 5 marinas, 4 boat launches	
Beaches Tidal Marshes Creeks Eelgrass beds Ponds Wetlands	



Kappas Marina. April 2016. Credit: Richardson's Bay Floating Homes Association.

End of Century Expectations

In this long-term timeframe, tidal flooding at 60 inches of sea level rise (MHHW) could reach nearly 7,000 acres, 8,000 parcels, and 9,000 buildings, potentially impacting hundreds of thousands of residents, employees, and visitors. These figures amount to 13 percent of parcels and 12 percent of buildings in the study area. Regular tidal flooding could adversely impact the same locations impacted in the near- and medium-terms and significant portions of what would have previously only flooded during a 100-year storm surge. The areas that could now also be tidally flood at this higher high tide are:

- Tamalpais Valley,
- Mill Valley from the Richardson's Bay shoreline up to and beyond Camino Alto between Miller and East Blithedale Avenues,
- Mill Valley and Strawberry fronting US Highway 101 between Seminary Drive and Tiburon Boulevard,
- Santa Venetia north of N. San Pedro Boulevard,
- Cove Neighborhood, Tiburon,
- Belvedere Lagoon neighborhood,
- Paradise Cay,
- Mariner Cove, Marina Village, Madera Gardens, and major retail centers lining US Highway 101,
- Riviera Circle, Creekside, and Heatherwood neighborhoods, Larkspur,
- Interstate 580 and westward towards Andersen Drive in San Rafael and the community of California Park,
- Marin Lagoon and Peacock Gap neighborhoods, San Rafael,
- Bel Marin Keys northern and southern lagoon areas,
- Hamilton, Vintage Oaks, and pockets of development east of US Highway 101 at Rowland Boulevard and State Route 37 in Novato, and,
- North Novato at US Highway 101 and Binford Road.

In long-term scenario 6, storm surge flooding could occur on nearly 13,500 acres hosting 12,600 parcels with 12,000 buildings. These figures amount to nearly one-fifth of parcels and more than 15 percent of the buildings in the study area. Areas that could anticipate storm surge flooding under scenario 6 conditions are:

- Sausalito west of Bridgeway,
- Marin City neighborhood,

²²⁰ 2016 dollars

CONCLUSION

- Mill Valley east of East Blithedale Ave at Alto Shopping Center,
- Las Gallinas and N. San Pedro Blvd, east of US Highway 101, San Rafael,
- Bayside Acres,
- Country Club, and
- Kentfield.

Tidal and storm surge flooding could cause significant economic losses. Minor storm impacts alone could account for \$61 million²²¹ in property damages. The market value of vulnerable single-family homes could exceed \$20 billion in 2016 dollars. The assessed value, typically less than market value, for all the vulnerable parcels in the study area is \$15.5 billion.²²² By the end of the century, these figures would likely be even higher.

One-hundred miles of public and private roadways, or five percent of all road miles in the study area, could be vulnerable to tidal flooding. Roads could simply degrade more quickly, or if flood waters are deep enough, become impassable when tides rise. Lane miles could be more than double this figure. An additional 30 miles of roadway could be vulnerable at 60 inches of sea level rise and a 100-year storm surge.

In addition, several park and rides, several hundred bus stops, and bus transit and SMART rail routes could flood. The San Rafael Transit Center, where the SMART train and nearly all buses stop, is vulnerable in the long-term to sea level rise. high tides. Breakdowns in the transportation network would have major impacts on the economy and daily life functions. In addition, significant safety hazards could cause injury or loss of life.

Flooding at the SASM and Novato Sanitary Wastewater Treatment Plants is a significant vulnerability that could arise, potentially disrupting hundreds of thousands of people. By this time, much of the low-lying shoreline sanitary sewer and stormwater infrastructure could be overrun with tidal waters.

By the end of the century, sea level rise could have direct impacts to Tiburon Fire Station No. 1, Corte Madera Station No. 13, and Novato Atherton Avenue Fire Station. A few emergency shelters in Southern Marin communities could be vulnerable to

tidal flooding, and several more could expect 100-year storm surge flooding and may not be available when needed most. By this time, the Central Marin Police Department could have to stave off flood water surrounding the site to reach Larkspur and Corte Madera residents in need.

Southern Marin marshes may no longer exist by the end of the century, destroying the habitat of several shoreline birds and mammals. Northern Marin marshes would become increasingly tidally influenced, with tide water reaching US Highway 101 in Bel Marin Keys and North Novato up the Petaluma River. Typically freshwater marshes west of US Highway 101, for example, Sutton Marsh, could also be subject to damaging salinity impacts. Tidal marsh lands may increase in Northern Marin if they not prevented from migrating inland.

Finally, all of these assets contain or contribute to the well-being of the region's cultural, archeological, and historic resources that constitute each community's sense of place. This is especially a concern for Sausalito, Tiburon, and Novato.



China Camp Historic pier. December 2016 King Tide. Credit: Ron Rothbart

²²¹ 2016 dollars

²²² 2016 dollars

CONCLUSION

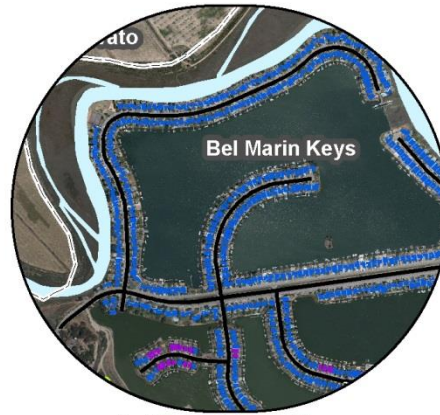
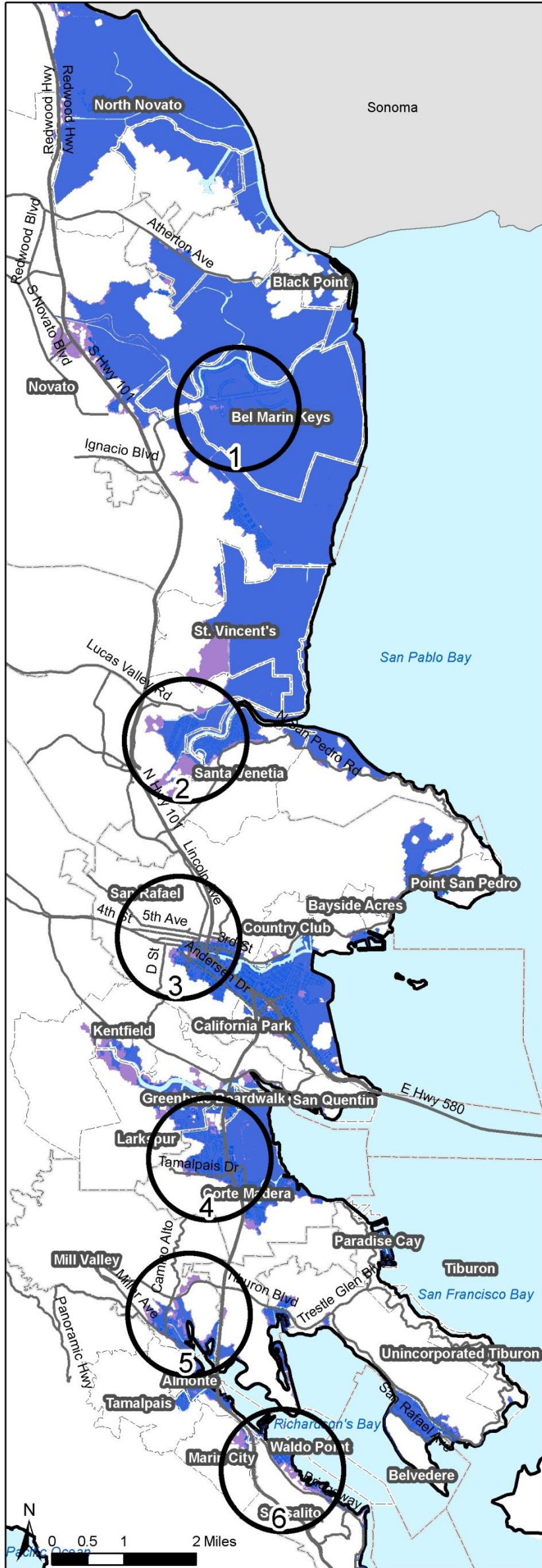
Map 133. End of Century Expectations: Long-term Vulnerable Assets

LONG TERM

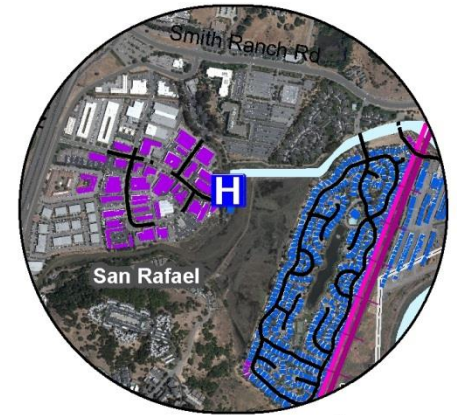
Scenario 5:
60 in. Sea Level Rise

Scenario 6:
60 in. Sea Level Rise
+ 100-year storm surge

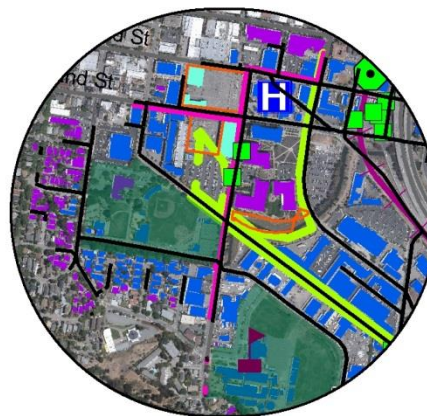
By 2100, tidal flooding could reach nearly 7,000 acres, 8,000 parcels (13%), 9,000 buildings (12%), and 100 miles of road. Higher high tides could adversely impact the locations flooded in medium-terms, and significant portions of the areas that previously suffered storm surge flooding. Tidal flooding would reach beyond the State Routes 101 and 580 in low-lying areas, into Southern Marin's narrow valleys and creek sides, and over every levee in Marin County. A 100-year storm surge could flood these areas, and an additional 6,500 acres, 4,600 parcels (20% total), 3,000 buildings (15% total), and 30 miles of road, extending to Sausalito west of Bridgeway, Marin City housing, Mill Valley's Alto Shopping Center, Las Gallinas and N. San Pedro Blvd. in San Rafael, Bayside Acres, Country Club, and Kentfield. Minor building damage could amount to \$61 million (2016 dollars). Vulnerable single family homes exceed \$20 billion in market value (2016 dollars). Several park and rides, hundreds of bus stops, and bus routes, and SMART rail track, including the San Rafael Transit Center, could experience flooding. Disruptive flooding at the SASM and NSD wastewater treatment plants and pump stations would affect tens of thousands of people. Storm surges could flood Tiburon Fire Station No. 1, Corte Madera Fire Station No. 13, and Novato Atherton Ave. Fire Station. A few emergency shelters in Southern Marin flood at high tide, and many more could be closed during a storm. The Central Marin Police Department may have to navigate deep water to reach Larkspur and Corte Madera shoreline residents. In Southern Marin, mud flats and water would dominate existing marshes. In the north, tidal marshes could expand.



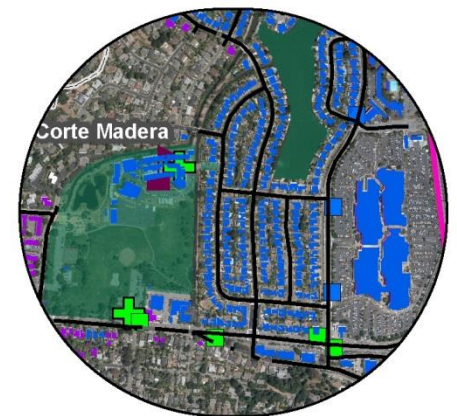
1: Bel Marin Keys



2: Marin Lagoon/Las Gallinas



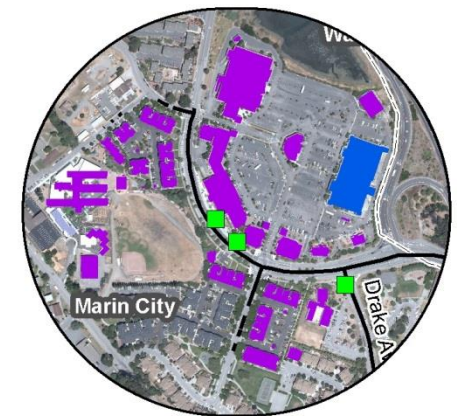
3: Central San Rafael



4: Corte Madera west of U.S. Hwy. 101



5: Strawberry



6: Marin City

Vulnerable Assets

- Vulnerable Buildings
 - @60" Sea Level Rise
 - @ 100-Year Storm Surge
 - Park
 - Park & Ride
 - Marin Transit Stop
 - Golden Gate Transit Stop
 - Public Boat Launch

- SMART Station
- SMART Track
- School
- Medical Facility
- Emergency Shelter
- Gas Pipe
- Transmission Lines

- Sea Level Rise (SLR) Scenarios
 - Scen 5: 60" SLR
 - Scen 6: 60"SLR+Storm Surge
- Location Indicators
 - Unincorporated
 - Municipality
 - Road
 - Bay

Disclaimer: Vulnerability Assessment maps, tables, etc. can be used as a resource to help identify potential hazardous areas and vulnerable assets. Marin County, and data providers here in, make no warranties of the accuracy or completeness of maps and data. Maps are representational and subject to future revision. Local site conditions must be examined. Commercial use is prohibited.

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Table 132. East Marin Assets Vulnerable to Sea Level Rise and a 100-year Storm Surge

	Near-term Scenarios 1 & 2	Medium-term Scenarios 3 & 4	Long-term Scenario 5	Long-term w/ surge Scenario 6
Sausalito	<ul style="list-style-type: none"> • Marinship neighborhood • GGBHTD Sausalito Ferry • Shops & restaurants east of Bridgeway • Swedes Beach • Tiffany Beach • Dunphy Park • Emergency rescue boats 	<ul style="list-style-type: none"> • Cass Gidley Marina • Clipper Yacht Harbor • Fire Station • Gate 5 Road • Marina Plaza Harbor • Pelican Yacht Harbor • Schoonmaker Beach & Marina 	<ul style="list-style-type: none"> • Bay Trail • Bridgeway • Turney Street Boat Ramp • Yee Tock Chee Park 	<ul style="list-style-type: none"> • Sausalito Marin City Sanitary District treatment plant
Mill Valley	<ul style="list-style-type: none"> • Residential and commercial at Shelter Bay and Hamilton Dr. to 101 	<ul style="list-style-type: none"> • Bay Trail • Bayfront Park • Mill Valley Middle School • Miller Avenue • Sycamore neighborhood • Redwood Retirement • SASM treatment plant • Shelter Bay • Shelter Bay neighborhood • Mill Valley/ Sausalito Pathway 	<ul style="list-style-type: none"> • Camino Alto • E. Blithedale Avenue • Freeman Park • Hauke Park • Redwood Highway Frontage Road • Sycamore Avenue • Sycamore Park 	<ul style="list-style-type: none"> • Mill Valley Recreation Center • Sutton Manor shopping center • Tamalpais High School
Belvedere	<ul style="list-style-type: none"> • West Shore Road homes • San Francisco Yacht Club 	<ul style="list-style-type: none"> • Belvedere Corp Yard • Belvedere Lagoon homes • San Rafael Avenue 	<ul style="list-style-type: none"> • Beach Road • Belvedere Community Center Mini Park • West Shore Road 	<ul style="list-style-type: none"> • City Hall, Police Department, community center
Tiburon	<ul style="list-style-type: none"> • Richardson Bay Lineal Park • Downtown commercial • Blackie's Pasture • Mc Kegney Green • Corinthian Yacht Club • Ferry facilities • Cypress Garden Park • Pt. Tiburon Shoreline Park 	<ul style="list-style-type: none"> • Cove Shopping Center • Library • Post Office • Tiburon Blvd. Shopping • Town Hall • Tiburon Fire Station 	<ul style="list-style-type: none"> • Bay Trail • Bel Aire Park • Main Street • Pt. Tiburon Marsh • Tiburon Blvd. • Zelinsky Park 	
Corte Madera	<ul style="list-style-type: none"> • Marina Village • Mariner Cove Neighborhood • Paradise Dr. auto dealerships and commercial • Corte Madera Creek Path • CA Highway Patrol Marin office • Triangle Marsh 	<ul style="list-style-type: none"> • Bay Trail • Corte Madera Town Center Commercial • Cove Elementary School • Hal Brown Park • Marin Montessori • Higgins Dock • Madera Gardens Lagoons Neighborhood off Madera Dr. • Neil Cummins Elem. School (emergency shelter) • Paradise Drive • Tamalpais Drive • The Village at Corte Madera • San Clemente Park 	<ul style="list-style-type: none"> • N. Hwy 101 • Redwood Highway • Ring Mountain • S. Hwy 101 • San Clemente Drive • Shorebird Marsh • Skunk Hollow Park • Town Park 	<ul style="list-style-type: none"> • Aegis Senior Living • Fire Station 13 • Bike Trail • Holy Innocents Episcopal (emergency shelter) • Marin Country Day School (emergency shelter) • Marin Lutheran Church (emergency shelter) • MMWD Headquarters

CONCLUSION

	Near-term Scenarios 1 & 2	Medium-term Scenarios 3 & 4	Long-term Scenario 5	Long-term w/ surge Scenario 6
Larkspur	<ul style="list-style-type: none"> • Bay Trail • Remillard Park • Cal Park wetlands • Bon Air Landing Park • Larkspur Landing Beach 	<ul style="list-style-type: none"> • Doherty Drive • Golden Gate Mobile Homes Park • Hamilton Park • Larkspur Landing Ferry facility and emergency fuel reserve tanks • Redwood High School • Riviera Circle homes • San Andreas High School • Tamiscal High School 	<ul style="list-style-type: none"> • Heatherwood Park • Hwy 101 N & 101 S • Redwood Highway • Sir Francis Drake Blvd. • Riviera Circle 	<ul style="list-style-type: none"> • Niven Park • PG&E Substation behind Cost Plus World Market • Henry Hall Middle School
San Rafael	<ul style="list-style-type: none"> • Bay Trail • Francisco Blvd E • Canal Street • Hwy 580 E & 580 W • Kerner Blvd • Marin County Health Innovation Campus • Marin Yacht Club • Canal/Shoreline open space • AT&T Headquarters and Yard • Fire Station No. 54 • Bahia Way • Pickleweed Park • Jean & John Starkweather Shoreline Park • Hi-Tide Boat sales & services • San Rafael Yacht Harbor • Tiscornia Marsh 	<ul style="list-style-type: none"> • 3rd Street • Andersen Drive • Beach Park • Canal District • Davidson Middle School • Peacock Gap Golf Course • Downtown • Francisco Blvd W • GGBD offices and depot • Grand Avenue • Loch Lomond Marina • Lowrie Yacht Harbor • Marin Lagoon • Montecito Plaza • Hwy 101 N. 101 S. • Peacock Drive • Peacock Gap Lagoon and golf course homes • Peacock Gap Neighborhood Park • PG&E office and yard • Pickleweed Park facilities • Pt. San Pedro Road • SMART tracks • San Rafael High School • San Rafael Transit Center • San Rafael Yacht Club 	<ul style="list-style-type: none"> • 2nd Street • 4th Street • Albert Park • Candy's Park • Hetherton Street • Lincoln Avenue • Schoen Park • Smith Ranch Airport • SMART tracks, eastern San Rafael 	<ul style="list-style-type: none"> • US Post Office-Bellam Blvd. • Department of Public Works • Glenwood Elementary School

CONCLUSION

	Near-term Scenarios 1 & 2	Medium-term Scenarios 3 & 4	Long-term Scenario 5	Long-term w/ surge Scenario 6
Novato	<ul style="list-style-type: none"> • Scottsdale Marsh • Bahia Marsh 	<ul style="list-style-type: none"> • Bay Trail 	<ul style="list-style-type: none"> • Deer Island Preserve • E Hwy 37 • Fire Station 62 • Future Hamilton recreation area • Hamilton Airport Park • Hamilton Amphitheater Park • Hamilton Community Center • Hamilton Parkway • N. Hwy 101 • North Marin Water District intertie valve with Marin Municipal Water District • NMWD Pipes, Bel Marin Keys • Novato Sanitary District Treatment Plant • Vintage Oaks shopping center 	<ul style="list-style-type: none"> • Fire Protection Administrative Services • Las Robles Mobile Home Park • North Marin Water District headquarters (w/ stormwater) • Novato Corp Yard • Novato Fire Association Office • Rowland Blvd. • Rush Creek • S. Hwy 101 • Slade Park • SMART rail • South Hamilton Park • W Hwy 37

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	Near-term Scenarios 1 & 2	Medium-term Scenarios 3 & 4	Long-term Scenario 5	Long-term w/ surge Scenario 6
Unincorporated Marin	<ul style="list-style-type: none"> • Greenbrae • Waldo Point Marina, Homes, and Businesses • Bel Marin Keys Blvd. • Caltrans Corporate Yard, Almonte • Tam Junction Commercial • Paradise Cay homes and marina • Black Point Boat Launch Mc Nears Beach Park • Richardson Bay Marina, Waldo Point • Bahama Reef Boat Launch, Bel Marin Keys • Cavalia Cay Park, Bel Marin Keys • Dolphin Isle Boat Launch, Bel Marin Keys • Del Oro Park, Bel Marin Keys • Santa Margarita Island, Santa Venetia • Santa Venetia Marsh • Seaplane Adventures, Almonte • Strawberry Community Park boat launch • Paradise Beach Park • Marin County Sheriff Water rescue boat 	<ul style="list-style-type: none"> • Charles F. McGlashan Pathway, Almonte • Shoreline Highway, Almonte • Almonte Blvd. • Almonte Sanitary District • Beach Drive, Bayside Acres • Bel Marin Keys CSD Office • Bel Marin Keys Yacht Club • Calypso Bay Public Dock, Bel Marin Keys • Caribe Isle Park, Bel Marin Keys • Homes east of Bel Marin Keys Blvd. • Homes west of Bel Marin Keys Blvd. • Montego Park • Marin RV Park, Greenbrae • Apartments on offices off Sir Francis Drake Blvd., Kentfield • Homes along Barren's Slough, Kentfield • Homes along McCallister Slough, Kentfield • Buildings, San Quentin • N. San Pedro Road • Santa Venetia homes • Brickyard Cove • Commercial along Seminary Marsh • Greenwood Cove homes • Homes along Seminary Dr. • Strawberry Circle • Strawberry Point Park • Strawberry Point Tidal Area • Birdland Neighborhood • Westminster Presbyterian Church & preschool 	<ul style="list-style-type: none"> • Bel Marin Keys Public Dock • Atherton Avenue • Pt. San Pedro Road • N. Hwy 101, Greenbrae • Redwood Highway, Greenbrae • S. Hwy 101, Greenbrae • Stadium Way • N. Hwy 101, Marin City • Redwood Blvd., Marin City • S. Hwy 101, Marin City • Gness Field Airport • N. Hwy 101, North Novato • Redwood Highway, North Novato • S. Hwy 101, North Novato • SMART rail, North Novato • Adrian Rosal Park • Buck's Landing • Castro Park • Santa Venetia neighborhood streets • Pueblo Park • SMART tracks, St. Vincent's • De Silva Island Drive • N. Hwy 101 • Redwood Highway Frontage Road • S. Hwy 101 • Seminary Drive • Cathodic protection well 	<ul style="list-style-type: none"> • Adaline E Kent Middle School • Anthony G Bacich Elementary School • College of Marin • Kent Middle School • Martin Luther King Jr Academy • St. Andrews Presbyterian Church • N. Hwy 101, Marin City • Marin County Expo Center and Amphitheater • Strawberry Point Elem School • Strawberry Point Elementary School • Strawberry Recreation Center • Strawberry Village shopping center • Tiburon Blvd. • Paradise Cove treatment plant

Source: MarinMap, CoSMoS

CONCLUSION



Boardwalk One and Larkspur Plaza Drive affordable multi-family housing on Corte Madera Creek. Larkspur. Credit: Marin County DPW.

Table 132Table lists the Marin shoreline communities' vulnerable assets by onset for each community and unincorporated Marin. These assets are vulnerable under the six scenario selected for the BayWAVE process, 10 inches, 20 inches, and 50 inches of sea level rise, and each with a 100-year storm. A significant degree of uncertainty exists as to how soon these increases in sea level could occur because future carbon emissions, a major variable in modeling, are an unknown. However, even if global citizens stabilize carbon emissions, sea level rise would likely continue. Moreover, even if the growing global population reduces carbon emissions to levels where atmospheric concentrations decline, the decline will be slow and sea levels would still likely continue to rise for decades, and hundreds of years could pass before the sea level stabilizes or drops.^{223,224} If emissions continue to increase, the rate of sea level rise is also likely to increase and these assets could be vulnerable sooner than this assessment presents. Because of this uncertainty, this assessment is the first step in an iterative

²²³ IPCC Fourth Assessment Report: Climate Change 2007. Climate Change 2007: Working Group I: The Physical Science Basis. 10.7.2 Climate Change Commitment to Year 3000 and Beyond to Equilibrium. https://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch10s10-7-2.html

²²⁴ IPCC Fourth Assessment Report: Climate Change 2007. Climate Change 2007: Working Group I: The Physical Science Basis. 10.7.4 Commitment to Sea Level Rise. https://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch10s10-7-4.html

process that will need to be updated as additional science becomes available and adaptation efforts are implemented. The sea level rise preparation process will require consistent monitoring and evaluation to improve modeling assumptions and ensure preparation efforts are effective and efficient.

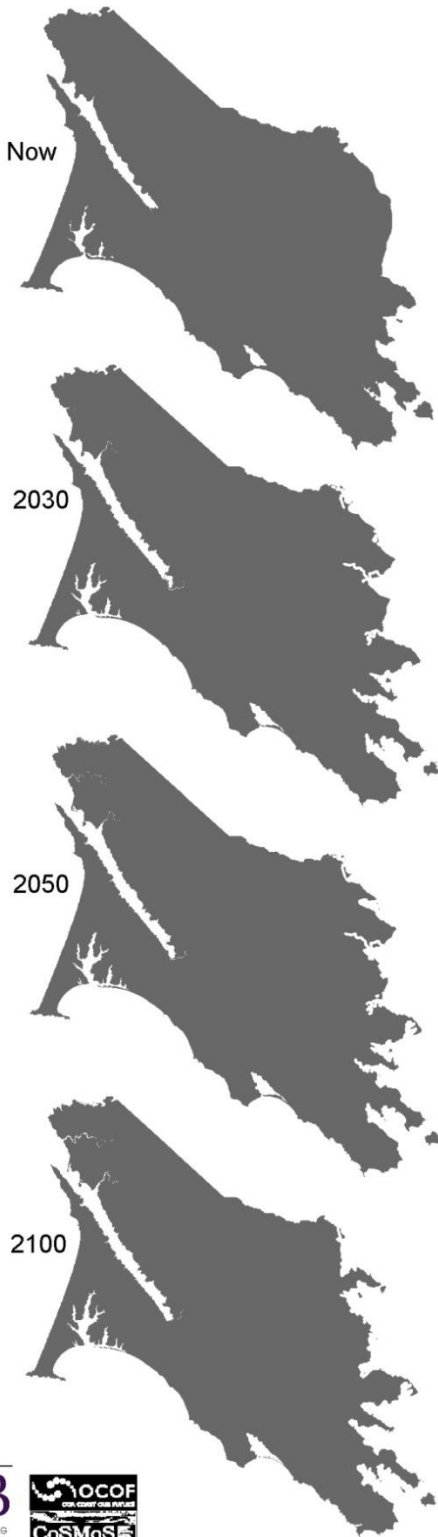
Built and natural features in Table 132Table are many assets to be addressed in adaptation planning. Some communities are already adapting to sea level rise. Efforts in Waldo Point, Strawberry, Las Gallinas, the Redwood Landfill, and others are already working to decrease vulnerability to higher tides and subsidence. Implementing additional adaptation measures may require new institutional, legal, and financing arrangements, engineering measures, and other incremental actions property owners and government entities can take. These measures and sea levels on the coast must be monitored and evaluated to inform need and effectiveness of these types of strategies. This vulnerability assessment lays the informational foundation for adaptation planning and implementing the necessary measures to protect, accommodate, retreat, or preserve existing geographies.

Combined with potential losses in West Marin due to potential sea level rise, the impacts to Marin County will be significant across all asset categories. The image to the left combines estimates for land area that would be lost at MHHW across the near-term, 2030, the medium-term, 2050, and the long-term, 2100 scenarios applied to Western and Eastern Marin.

With the Vulnerability Assessment complete, Marin County, municipal, and special district governments, and other essential service providers, non-profits, and property owners have a glimpse of a potential future with higher tides. By the end of the century, sea level rise could significantly alter daily life in Marin County. The Vulnerability Assessment summarizes the worst case scenario with business as usual. Fortunately; business as usual is already changing with significant restoration, conservation, and redevelopment efforts along the Marin shoreline that show promise for the coming decades.

CONCLUSION

Figure 6. Estimated Decreases in Marin County Land Area due to Sea Level Rise



Sea level rise is a moving target, and likewise, adaptation efforts will need to keep pace and be able to adjust more quickly than the seas rise. Moving forward, government officials, residents, and professionals will have to weigh the options to protect, reinvent, or relocate existing assets where feasible, or at worst, what assets cannot be saved. These decisions will trigger several other challenging questions, especially in an area where developable land is not readily available, demand for housing is high, and new development can be politically challenging. Getting through these questions, entering the study and planning phases, getting approvals, securing funding, and implementing improvements can be a multi-year to multi-decade process. Because of this, it is imperative that sea level rise preparation planning and implementation is strongly supported and undertaken promptly and continuously in the coming decades to ensure the County and its residents are prepared for and safe from sea level rise. The future phases of BayWAVE will explore these options further and provide the basis for continued discussion, planning, and action.



Miller Avenue at Bothin Marsh, Mill Valley. King tide, Nov. 25, 2015. Credit Marin County DPW



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APPENDIX A

Appendix A: Vulnerability Assessment Interview Tool

BAYWAVE PROGRAM

BAY WATERFRONT ADAPTATION AND VULNERABILITY EVALUATION

ASSET VULNERABILITY ASSESSMENT TOOL AND SCRIPT

MANAGING AGENCY: _____ DATE: _____
ASSET MANAGER NAME(S): _____ PHONE: _____
ASSET: _____

This assessment tool will be used to gather information on how sea level rise can impact public assets on Marin's bayside shoreline. Thank you for taking the time to respond to this series of questions. At most, it could take 1 hour to answer 30 questions. The tool asks several yes or no and short answer questions, followed by ranking degrees of sensitivity, adaptive capacity, and risk factors associated with sea level rise and storm surges. Lastly, the tool asks for preliminary ideas for adaptation. Let's begin.

The first set of questions may be useful in the planning process and will help get us thinking about sea level rise and storm surge preparation.

1. Are there efforts underway to address SLR/SS (emergency or climate change efforts) at your agency or organization?
 No Yes, _____
2. What is your level awareness of sea level rise?
 None Low, heard/read of SLR Moderate, involved in training/project High, expert
3. What is your general workplace's awareness of sea level rise?
 None Low, heard/read of SLR Moderate, involved in training/project High, expert
4. Please describe the current physical condition of the asset. Are there existing stresses, are they likely to improve/worsen?
5. Has the asset been disrupted in the past due to an unplanned stress e.g., weather-related closure, emergency repair, strike?
 No Yes. How long did disruption last? _____
- 5a. Was the asset able to continue functioning? No Partially Yes
6. When was the last repair or update? _____
7. Is any major maintenance or repair planned? No Yes, when _____
8. Were/are any permits from state and regional agencies, such as the Bay Conservation and Development Commission (BCDC), required to do conduct needed work in questions 5, 6, 7 or other flood prevention measures? If yes, please describe your experience with the permit process.

For the second set of questions, please respond about how the following sea level rise and storm surge could impact the asset. Impacts the asset could be exposed to include:

- Permanent flooding
- Temporary flooding
- Rising water table
- Saltwater intrusion/corrosion
- High wind impacts
- Beach/cliff erosion
- Habitat shifts (natural resource assets only)

The following questions address sensitivity, adaptive capacity, adaptation ideas, and risk for each. For the sensitivity assessment, sensitivity is defined as the *degree an asset could be damaged or the service it provides disrupted*. Please indicate if the asset will be sensitive for each exposure according to these levels:

BayWAVE Vulnerability Assessment Tool | 1

BIBLIOGRAPHY

No Sensitivity: Not impaired, damaged, or disrupted

Low Sensitivity: Minimally impaired, damaged, or disrupted. The asset may require minor repairs or suffer minimal disruption.

Medium Sensitivity: Somewhat impaired, damaged, or disrupted. The asset may require repairs and able to maintain most functions.

High Sensitivity: Greatly impaired, damaged, or disrupted with complete loss or shut-down. The asset will require significant repairs and disruption could impact public health and safety.

Maximum Sensitivity: Permanent loss or disruption.

Using the definitions of sensitivity above, how sensitive is *the asset* to:

	No	Low	Med	High	Max
9. Temporary flooding?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. Permanent flooding?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11. Cliff/beach erosion?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. Water table rising?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13. Saltwater intrusion/corrosion?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14. High winds?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15. Habitat shifts?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

16. If the asset is sensitive to any of these exposures, how could exposure impact the asset. For example, % reduction in service, hours of system shutdown; what is the NATURE of the sensitivity?

Please rate the level of adaptive capacity of the asset for each exposure you rated medium, high or maximum. Adaptive capacity is defined as *the ability of an asset to recover from the damage or disruption from the elements the asset is exposed to WITHOUT human intervention*. Please indicate the level of adaptive capacity for the asset according to these categories:

Maximum Adaptive Capacity: Asset is able to tolerate [impact], no need for intervention.

High Adaptive Capacity: Asset is able to tolerate [impact] and cope with the consequences without the no need for significant intervention or modification (e.g. alternate infrastructure routes, elevated structure). Could be easily replaced, repaired.

Medium Adaptive Capacity: Asset is somewhat able to tolerate [impact], and cope with the consequences with significant intervention or modification (repair, replacement are possible)

Low Adaptive Capacity: Asset has limited ability to tolerate [impact], and cope with the consequences (no alternative routes, no restoration possible. Would require replacement or very costly repairs.

No Adaptive Capacity: Asset is not able to tolerate [impact]. Not repairable or replaceable in current location.

Using the definitions above please indicate the asset's level of adaptive capacity for each of the moderate, high, and maximum sensitivity exposures. *[insert appropriate exposures into the blanks below]*

	No	Low	Med	High	Max
17. _____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18. _____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19. _____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

If you rated the asset as having High or Maximum adaptive capacity you are finished with the questionnaire. If you rated the asset as having No, Low, or Medium adaptive capacity, please continue as adaptation may be necessary to ensure the asset avoids destruction and unsafe conditions. The following questions are about potential adaptation considerations and options.

20. What, if any, adaptation or preparation actions have been incorporated into managing the asset for flooding and/or storms?

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21. What ideas do you or your agency have for new adaptation or preparation actions?

Physical:

Social:

Financial:

Political:

If no action is taken, sea level rise and storms could have potentially damaging consequences for the asset and those the asset serves. Responses to these question will help prioritize preparation actions for the most sensitive, least resilient assets. While you may not know the answer to each question, please make your best judgment.

22. How important is the asset as an economic generator?

very somewhat not \$ _____

23. What is the value to the community?

high medium low none

24. Does the asset have features that are at-grade or below-grade, e.g., building openings (door, windows, vents) mechanical or electrical equipment, pumps, utilities, building heat, ventilation, power systems or finished basements?

no yes, _____

25. What would be the cost to repair/ replace the asset?

high medium low \$ _____

26. How many people could be affected?

region community neighborhood site none

27. Are any underrepresented/vulnerable populations affected?

no yes, (mark all that apply)

- People with limited mobility or disability
- Renters
- People of color
- Low income people
- People over 75 years old
- Institutionalized populations (hospitals, nursing homes, prisons)
- Households with limited English proficiency
- Households lacking vehicle
- Other _____

28. Are there health impacts? no yes, _____

29. Are there safety impacts? no yes, _____

30. What is the spacial extent or scale of the impact?

regional local site less than site

Thank you. This concludes the assessment questions for this asset. Is there anything else you would like to share?

BIBLIOGRAPHY

Table 133. Interviewed Agencies and Managers

PG&E	Amy Dao, Community Energy Manager, Sustainable Communities
	Kin Robles, Community Energy Manager (post interview)
	Dave Canny, Senior Manager, North Bay Division
Bel Marin Keys Community Service District	Noemi Camargo-Martinez, Manager
	P. Carey Parent, Principal, Cle Group
	Kyle Mac Donald, Cle Group
Buck's Landing	William Miller, CA State Parks
	Bree Hardcastle, CA State Parks
CA Coastal Conservancy	Marilyn Latta, Project Manager
	Kelly Malinowski, Project Manager
	Jeff Melby, Project Manager
	Matt Gerhart, Deputy Program Manager
CA Highway Patrol	Lt. Robert Mota
Canal Center	Douglas Mundo, Exec. Dir
Central Marin Police	Todd Cusimano, Chief
Central Marin Sanitation Agency	Brian Thomas, Technical Services Manager
City of Belvedere	Mary Neilan, City Manager
	Eric Banvard, Building Official
	Scott Derdenger, Public Works Mgr
City of Larkspur	Neal Toft, Director of Planning and Building
	Daryl Phillips, CBO, Phillips Seabrook Associates, Floodplain Manager and Building Official
	Scott Shurtz, Fire Chief
City of Mill Valley	Danielle Staude, Senior Planner
	Scott Schneider, Engineering Manager
	Tom Welch, MVFD
	Bob Peterson, Director of Public Works
City of Novato	Tony Williams, Planner
	Russ Thompson, Public Works Director
	Pam Shinault,
	Bob Brown,
City of San Rafael	Paul Jensen, Community Development Director

BIBLIOGRAPHY

	Doris Toy, P. E. San Rafael Sanitation District, District Manager, District Engineer
	John Bruckbauer, Emergency Management Coordinator
	Dean Allison, Director of Public Works
	Kevin McGowan, Assistant Public Works Director/City Engineer
	Cory Bytof, Sustainability & Volunteer Program Coordinator
City of Sausalito	Johnathon Goldman
County Parks	Mischon Martin, Chief of Resources and Science
	Brian Sanford, Superintendent for Parks, Southern Region
	Ari Golan, Superintendent for Parks, Northern Region
	Chris Chamberlain, Superintendent for Parks, Central Region
	Steve Petterle, Principal Landscape Architect
	James Raives, Senior Open Space Planner
County Roads	Reuel Brady
Floating Homes Association	Teddie Hathaway
	Brad Hathaway
Gross Field (airport)	Dan Jensen
Golden Gate Bridge, Hwy & Trans	Raymond Santiago, Senior Planner
	Wilson Lau, Supervising Civil Engineer
Golden Gate Ferry	Colin McDermott
	Tim Hanners, Maintenance Manager
Heath Ceramics	Robin Petravic, Owner and Managing Director
Kent Middle School	Skip Kniesche Principal
	Liz Schott, Super Intendent
Kentfield Planning Adv. Board	Board Members
Las Gallinas Valley Sanitary District	Irene Huang, Assoc. Engineer
	Mark Williams, General Manager
	William Miller
	Mike Cortez, District Engineer
Loch Lomond Marina	Betsy Oller, Office Manager
Marin Audubon	Barbara Salzman
Marin County DPW	Patrick Zuroske, Public Improvements
Marin Municipal	Kristin Cole, Water System Planning & Special Projects

BIBLIOGRAPHY

Water District	Carl A Gowan, P.E. Principal Engineer
Marin Yatch Club	Paul Simmons, Commodore
Monticello Shopping Center	Dennis Fisco, Seagate Properties, Inc.
Neil Cummins Elementary School	Wolf Gutscher, Dir. Of Facilities
North Marin Water District	Chris DeGabriele
	Drew McIntyre, Chief Engineer
	Robert Clark, Operations/Maintenance Superintendent
Novato Fire District	Dep. Chief Adam Brolan
Novato Sanitary District	Erik Brown, P.E., Technical Services Manager
	Steve Krautheim, Field Services Manager
	Sandeep Karkal, General Manager-Chief Engineer
Ross Valley Sanitary District	Greg Norby, P.E., General Manager
	Katherine Hayden, P.E. Interim District Engineer
	Steve Miksis, Acting Chief of Operations
San Rafael Airport	Bob Herbst
San Rafael School District	Dr. Mike Watenpaugh, District Superintendent
	Dr. Daniel Zaich, Director, Strategic Initiatives
	Theresa Allyn, Executive Assistant
	Chris Thomas, Chief Business Official
	Sarah, Schoening Group Inc.
SASM	Mark Grushayev, Wastewater Treatment Plant Manager
Almonte Sanitary District	Brian Robinson, Manager
Alto Sanitary District	Roger Paskett, Manager
Richardson's Bay Sanitary District	Johnny Tucker, Manager
Homestead Valley Sanitary District	Bonner Beuhlar, Manager
Tamalpais Valley Sanitary District	Jon Elam, Manager
Sanitary District No. 5, Tiburon	Tony Rubio, Manager
Sausalito -Marin	Omar Arias, Operations Supervisor

BIBLIOGRAPHY

City Sanitary District	Kevin Rahman, Associate. Engineer
Sausalito School Dist.	Alan Rothkop, Dir. of Facilities
SMART	Linda Meckel
Southern Marin Fire District	Chief Tubbs
State Fish & Wildlife	Karen Taylor, Associate Wildlife Biologist
	Tom Huffman, Bay Delta Region Director
	Larry Wyckoff, Senior Wildlife Biologist
Mill Valley Middle School/ Strawberry Point Elem School	John Binchi, Operations. Director
Strawberry Rec Center	Leanne Kreuzer, District Manager
Tamalpais Union High School Dist.	David O'Connor, Facilities Director
Town of Corte Madera	Kelley Crowe, Associate Civil Engineer, Public Works
	Phil Boyle, Senior Planner
	Adam Wolff, Director of Building and Planning
Town of Tiburon	Scott Anderson, Community Development Director
	Patrick Barnes, Director of Public Works
	Rich Pearce, Fire Chief
	Mike Cronin, Police Chief
Transportation Authority of Marin	Nick Nguyen, P.E., Principal Project Delivery Manager
	Dianne Steinhauser, P.E., Exec Director
Waste Management	Ramin A. Khany, General Manager
	Glen Roycroft, Site Engineer
Westminster Presbyterian Church	Adam Krivatsy
	Rob McClellan, Minister
	Len Ganote
	Atamp Marvais

Central California and its implications on nearshore processes. Journal of Marine Systems v. 68.

APPENDIX B

Appendix B: Public Comments

APPENDIX B

From: [Peter Hoog](#)
To: [Choo, Chris](#)
Subject: Sea Level Rise Vulnerability
Date: Wednesday, April 26, 2017 2:11:49 PM

Chris,

Many thanks for your presentation in Mill Valley last night.

The purpose of this email is to clarify the points I raised concerning the use of the words “Greenbrae Boardwalk” in the draft report.

I am a resident of Greenbrae Boardwalk, a community of 46 houses on the edge of Corte Madera Creek directly opposite the Larkspur ferry terminal and east of the railroad trestle. Based on the tables of the number of properties affected by sea level rise it appears that the draft report uses the phrase “Greenbrae Boardwalk” to refer to those portions of the unincorporated community of Greenbrae that are in the flood plain, specifically (1) the houses on Lucky Drive to the west of Highway 101, and (2) the houses on the Greenbrae Boardwalk to the east of Highway 101. These two communities are substantially different in regard to the possible impact of sea level rise.

My suggestion is that you revise the draft report by either (1) replacing the words “Greenbrae Boardwalk” with simply “Greenbrae”, or preferably (2) recognize that the houses on Lucky Drive are more similar to the houses across the water on Riviera Circle than they are to the houses on the Greenbrae Boardwalk. This would of course require significant updates to those tables with entries for “Greenbrae Boardwalk”

If you wish I would be willing to identify by page number what I consider to be misleading information in the draft report concerning the unincorporated area of Greenbrae.

I noted that the 36” impact of the 100-year storm on the sea water elevation is the same number that FEMA used for the height of ‘storm waves’ in Sausalito, Belvedere, and Tiburon in the recently updated FIRM maps. Areas protected from storm waves, e.g. Ross Valley west of Highway 101 would not be subject to the same impact as areas east of Highway 101 (e.g. the Greenbrae Boardwalk). Does your analysis recognize this?

Other sections of the report when describing areas with flood gates, e.g. Bel Marin Keys, stated that the analysis was based on the water elevations when the flood gates were “open”. This would cause a highly misleading analysis particularly because it ignores the effect for which the flood protection measures were installed. Did I misinterpret the report in this respect?

Cheers
Peter

System 20/20

APPENDIX B

Peter Hogg
President

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Construction Information Systems, Inc.

P.O. Box 1205
Mill Valley, CA 94942

Telephone: 415-785-7926

APPENDIX B

From: ArleneF@Yahoo.com
To: [Choo, Chris](#)
Subject: Hillview, Larkspur Comment re. SLR Vulnerability Assessment Public Draft Report
Date: Saturday, April 29, 2017 8:10:07 AM

Hello Chris,

In the Larkspur Community Profile section of The Sea Level Rise Vulnerability Assessment Public Review Draft Report, the SLR / Storm Surge map (Map 86) incorrectly shows that the Hillview neighborhood west of BonAir Bridge is shaded in blue which denotes only being affected by a 60" SLR + 100 yr. storm surge. This is incorrect as many residents are currently being flooded by king tides / storm events. Many residents also are required to carry flood insurance *now*. Please compare results against FEMA flood maps and groundtruthing in the area.



Photo: Cornell Avenue, Larkspur during a 2016-2017 winter storm

As Map 86 is revised, the statistics in the chart above it and elsewhere in the report will have to be revised to correctly show the number of residential homes affected.

Please note there are flood mitigation projects being evaluated in the area. But, until such drainage projects & possible pump station are *actually* completed (which may be years down the road, if at all if there is

APPENDIX B

insufficient funding), the report should show this area very vulnerable. Even if such projects are completed, the nearby levees still need to be raised and improved to protect our area from rising tides and seas. We need to be on the radar so we get funding for levees, etc.

Thank you.
Arlene Fox

<http://www.marincounty.org/main/baywave/vulnerability-assessment>

APPENDIX B

From: ArleneF@Yahoo.com
To: [Choo, Chris](#)
Subject: Re: Additional Hillview, Larkspur Comments re. SLR Vulnerability Assessment Public Draft Report
Date: Wednesday, May 10, 2017 5:41:37 PM

All comments below refer to the Draft Larkspur Community Profile of Marin Shoreline Sea Level Rise Vulnerability Assessment Report.

Page 242 & 245:
Reference to Heatherwood neighborhood should be replaced with Heather Gardens.

Page 247 / Map 87
Item 2 is incorrectly called Creekside Neighborhood. It's Hillview.

Page 248 Transportation Section & elsewhere
I suggest you include flooding impacts on Bon Air Rd. which serves as a major artery to Marin General Hospital and medical offices on South Eliseo. During January 2017 storm, Bon Air Rd. near Bon Air Bridge was covered with ~1.5 feet of water.

Page 248:
Incomplete sentence in third paragraph discussing affected transit routes.

Bullet items which follow, include Bon Air Rd.

Page 251:
In Emergency Services section, CMPD also serves San Anselmo.

In Cultural Resources section, "home" should be "homes".

[Sent from Yahoo Mail on Android](#)

On Sat, Apr 29, 2017 at 8:10 AM, ArleneF@Yahoo.com
<arlenef@yahoo.com> wrote:

Hello Chris,

In the Larkspur Community Profile section of The Sea Level Rise Vulnerability Assessment Public Review Draft Report, the SLR / Storm Surge map (Map 86) incorrectly shows that the Hillview neighborhood west of BonAir Bridge is shaded in blue which denotes only being affected by a 60" SLR + 100 yr. storm surge. This is incorrect as many residents are currently being flooded by king tides / storm events. Many residents also are required to carry flood insurance *now*. Please compare results against FEMA flood maps and groundtruthing in the area.

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Photo: Cornell Avenue, Larkspur during a 2016-2017 winter storm

As Map 86 is revised, the statistics in the chart above it and elsewhere in the report will have to be revised to correctly show the number of residential homes affected.

Please note there are flood mitigation projects being evaluated in the area. But, until such drainage projects & possible pump station are **actually completed (which may be years down the road, if at all if there is insufficient funding), the report should show this area very vulnerable. Even if such projects are completed, the nearby levees still need to be raised and improved to protect our area from rising tides and seas. We need to be on the radar so we get funding for levees, etc.**

**Thank you.
Arlene Fox**

<http://www.marincounty.org/main/baywave/vulnerability-assessment>

APPENDIX B

From: [Erik Brown](#)
To: [VanBelleghem, Bridgit](#)
Cc: [Choo, Chris](#)
Subject: RE: REMINDER: Marin Sea Level Rise Public Meeting Tomorrow!
Date: Monday, May 15, 2017 4:47:39 PM
Attachments: [02_AssetProfiles_BayWAVE_VA_17_02_20_NSD_Comments.pdf](#)

Thanks Bridgit. I have a proposed markup (attached) that I believe will answer your questions. Please let me know if you have any questions.

Thanks,
Erik

From: VanBelleghem, Bridgit [<mailto:BVanBelleghem@marincounty.org>]
Sent: Monday, May 15, 2017 11:54 AM
To: Erik Brown
Cc: Choo, Chris
Subject: RE: REMINDER: Marin Sea Level Rise Public Meeting Tomorrow!

Hi Erik:

I looked back and it seems I missed the pump station edit. I'll fix that.

The reclamation lands don't seem vulnerable if they are designed to be "sacrificed," unless the district would need to locate alternative lands. Would that be the case?

As for the initial comments on elevation, I recall your expert concluding that the assessment is accurate. Do you still have the emails of record?

Thank you,
Bridgit

From: Erik Brown [<mailto:erikb@novatosan.com>]
Sent: Tuesday, May 02, 2017 7:58 AM
To: Gurley, Margaret
Cc: Choo, Chris
Subject: RE: REMINDER: Marin Sea Level Rise Public Meeting Tomorrow!

Hi Margaret,

There are still a number of inaccuracies regarding the Novato Sanitary Districts facilities in the report. We have provided previous comments, but not all have been addressed. Will there still be an opportunity to provide comments?

Thanks,
Erik

From: Gurley, Margaret [<mailto:MGurley@marincounty.org>]

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Sent: Monday, April 24, 2017 10:05 AM
To: Gurley, Margaret
Subject: REMINDER: Marin Sea Level Rise Public Meeting Tomorrow!

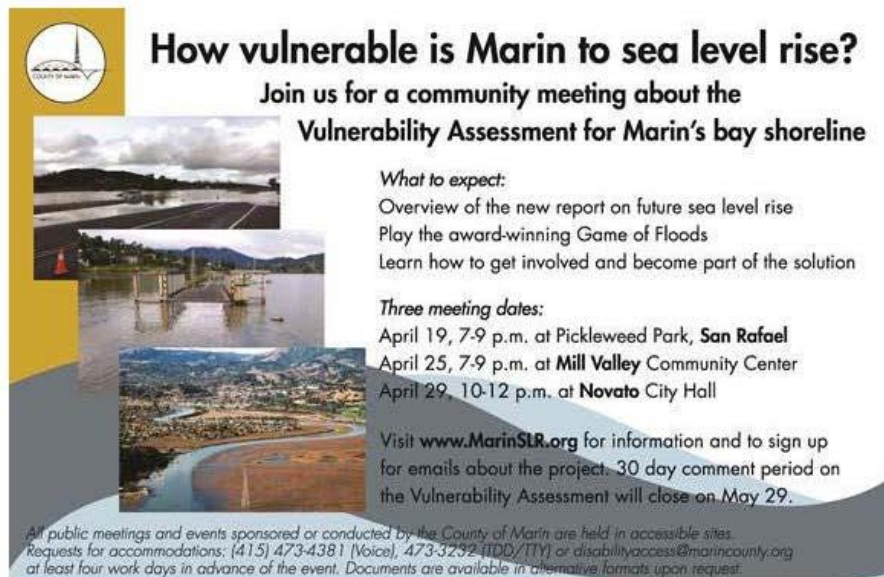
The **second** of three public meetings scheduled will take place tomorrow, Tuesday April 25th from 7pm – 9pm in the Cascade Room at the Mill Valley Community Center – 180 Camino Alto.

Please join us for a community meeting about the Vulnerability Assessment for Marin's bay shoreline. The meeting will provide an overview of the new report on future sea level rise, play the award-winning Game of Floods, and learn how to get involved and become part of the solution.

Due to parking constraints, we encourage attendees to carpool.

Visit MarinSLR.org for more information and to sign up for emails about the project.

Below is the flyer outlining the meeting dates and locations for your reference. We look forward to seeing you there!



How vulnerable is Marin to sea level rise?
Join us for a community meeting about the
Vulnerability Assessment for Marin's bay shoreline

What to expect:
Overview of the new report on future sea level rise
Play the award-winning Game of Floods
Learn how to get involved and become part of the solution

Three meeting dates:
April 19, 7-9 p.m. at Pickleweed Park, **San Rafael**
April 25, 7-9 p.m. at **Mill Valley** Community Center
April 29, 10-12 p.m. at **Novato** City Hall

Visit www.MarinSLR.org for information and to sign up for emails about the project. 30 day comment period on the Vulnerability Assessment will close on May 29.

All public meetings and events sponsored or conducted by the County of Marin are held in accessible sites. Requests for accommodations: (415) 473-4381 (Voice), 473-3232 (TDD/TTY) or disabilityaccess@marincounty.org at least four work days in advance of the event. Documents are available in alternative formats upon request.

Regards,

Maggie Gurley

County of Marin
Community Development Agency
3501 Civic Center Drive, Suite 308
San Rafael, CA 94903
415 473 2179 T

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UTILITIES

Novato Sanitary District

The Novato Sanitary District Treatment plant is vulnerable just before 3 feet of sea level rise. By scenario 5, the lower half of the plant is covered by tidal waters. Storm conditions may impact the plant sooner. Much like SASM, the first buildings to be vulnerable are the shops and garages. However, the over flow basins are impacted early on. Next to be impacted are the UV Disinfection and Final Effluent Processing buildings. By 5 feet of sea level rise, tides reach the anaerobic digestion and clarification tanks. Adding a storm surge could also flood around the primary and secondary clarifiers altogether. The water will not likely be high enough to impact the process, however, electrical components may be lower and saltwater corrosion of the tanks and buildings could take a toll. The lower half of the plant is bordered by a concrete retaining wall and berm that protect against flood waters. The wall and berm can be extended vertically to provide protection from sea level rise. A 4-foot vertical addition to the wall and a 1 foot addition to the berm would protect against scenario 6.

The district also has some facilities in Bel Marin Keys that are transitioning to submersible machines, and others at Gness Field Airport that could be vulnerable to higher tides. However, the more submersed they are, the faster wear and tear could damage the machine.

On-site Waste Water Treatment (OWTS)

The only community in the study area using OWTSs is Black Point. However, many of the built areas of these properties are at higher elevations and may be free from impacts from sea level rise. In the worst case, sea level rise could alter soil permeability and chemistry in the disposal field. If water levels are high and sustaining enough, effluent from the disposal field could contaminate the estuary waters. Even new shallow or above ground systems, with high water level kill switches, could be impacted by flood waters and affected by power outages. Erosion could also reduce land area available for percolation. Finally, if ground water rises under septic tanks it could have enough pressure to cause tanks to pop out of the ground.

These systems are privately managed by the land owner and regulated by Marin County and the Regional Water Quality Control Board. Septic systems in are regulated by the Marin Countywide Plan (CWP), the Marin County Development Code, and the State Water Control Board's Onsite

Wastewater Treatment Systems Policy. More information on regulations can be found at <http://www.marincounty.org/depts/cd/divisions/environmental-health-services/septic-systems>.

Table 37. OWTS System Vulnerabilities

Land Area	<ul style="list-style-type: none"> Erosion can reduce the land area available to percolate waste. Saltwater intrusion into the leach field could impact percolation rates and reduce useable area.
Materials/Models	<ul style="list-style-type: none"> Older single field gravity systems are more susceptible to storm flooding than modern systems equipped with "flip" switches that turn off percolation when groundwater elevates too high. Newer systems are vulnerable to power outages.

Source: Marin County Environmental Health and Safety

Comment [EB1]: We don't have any shops or garages at the lower end of the plant. Confusing us with the City's Corp Yard?

Comment [EB2]: All pump stations at BMK are submersible type, not transitioning.

Comment [EB3]: NSD does not have any facilities at Gness Field. Our northernmost facility on the east side of 101 is a gravity line that ends at the end of the cul-de-sac of Rush Landing Court.

Comment [EB4]: Suggest striking this paragraph altogether. The statement regarding submersible pumps is inaccurate. The submersible pumps are located in a wetwell (basically a deep vault) that is water tight (no groundwater infiltration). These pump stations are less susceptible than the old style wet well/dry well pump stations because the electrical components are all above ground. A vulnerability could exist if brackish water infiltrates the gravity sewer lines that drain into these pump stations. However, it is unclear from this report if that is a real possibility.

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From: [Hannah Doress](#)
To: [Choo, Chris](#)
Cc: [Terrie Green](#); [Douglas Mundo](#)
Subject: Shore Up Marin input on Vulnerability Assessment
Date: Wednesday, May 17, 2017 12:13:39 PM

Dear Chris,

Thank you for your hard work leading up the BayWave Vulnerability Assessment. As I said at the Mill Valley public meeting, we want to commend this important effort that is vital to moving all of us closer to solutions for these pressing problems. In particular we would like to commend the thoroughness of the report, especially compared to other counties choosing more of an asset estimate approach. We deeply appreciated that you interviewed Douglas Mundo and Terrie Green for the report and the care you took to analyze the social equity implications of each class of assets and vulnerabilities. We hope there will be future opportunities where you can present results of the assessment in more detail to community members and stakeholders. We appreciate and look forward to continuing our ongoing collaboration with you.

Following is input from Shore Up Marin that we hope you can incorporate into the report:

Feedback on Executive Summary (HD notes in bold)

Eight miles of road could expect tidal flooding. Many of these flooded areas already experience seasonal and king tide flooding. These are:

- Manzanita, Almonte
- Miller Avenue in Mill Valley,
- the Marinship area in Sausalito,
- US Highway 101, Corte Madera, Larkspur, and
- State Route 37 in Novato.
- **Please add “Marin City / 101 southbound lanes”**

Include More on Marin City - note the pipes and flooding impacts of SLR say that’s not in the scope of the tools and study but it is critical to access additional flooding and complimentary data to consider with the vulnerability assessment in adaptation planning.

This is expected to worsen in severity and become increasingly frequent. Tidal flooding would reach the Canal area of San Rafael, spreading to I-580. Several roads in Santa Venetia, Tamalpais, Belvedere, Mill Valley, Marin Lagoon of San Rafael, and bayfront Corte Madera and Larkspur would begin to experience seasonal, king tide, and storm surge flooding more frequently. **Include Marin City / 101 South here.**

....

Most concerning, however, is the potential inability of emergency professionals and vehicles to access people in or through flooded areas. **(mention Marin City)**

....

Recommendation: we recommend the County use “real world” measurement for communication with the public e.g. 1 foot 3 inches versus or in addition to 15” because of how people process information, visualize and make meaning out of measurements.

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Feedback on the Vulnerability Assessment in general:

The value of assessing vulnerability is in planning to address the real world experience of community members, to prevent emergencies and protect residents and assets. This real world experience includes other factors that are influenced / made more severe by sea level rise, for example the flooding in Marin City / on 101 which is worsened by tides which block drainage. As you articulated well in the Mill Valley presentation, the limitations of sea level rise models affect all vulnerability assessment. This is why we feel it is critical to include that caveat and include a list of complementary resources and datasets which institutionalize this knowledge and how to best incorporate it in sea level rise planning within the body of the report. This safeguards against many potential challenges which include:

- Future staff changes in which unstated assumptions may not be carried forward,
- Oversimplification of the issues by less topically familiar decision-makers, stakeholders and community members,
- Lack of alignment between hazard mitigation and sea level rise adaptation, and
- Potential under-prioritizing sea level rise adaptation in areas currently most impacted by flooding.

Given that sea level has increased 8 inches over the last century and during the most recent half a century flooding has worsened, is it not logical to point the finger at sea level rise as a key factor? Climate Central cites a 2014 study showing sea level rise as a significant driver of increased flooding, “Long-term trends show that minor coastal flooding along the East, Gulf, and West Coasts occurred only about once every one to five years in the 1950s, but was occurring about once every three months by 2012” <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0170949>

Given that all shoreline areas will experience below ground impacts such as more frequent blockage of drainage pipes, salinization of ground water / bay side agriculture / fresh water marshes, etc. is it not prudent to at least include those concerns and pointers to relevant data sources / best practices as a recommendation for stakeholders to consider? Should we not recommend government staff conduct additional projections to determine the vulnerability of communities when the whole water system is factored in? Here’s Climate Central on sea level rise, storms, flooding, sewers, and East Oakland: <http://www.climatecentral.org/news/sea-level-rise-oakland-sewer-17567>

If the twin goals of the vulnerability assessment are to 1. protect the public by encouraging stakeholders to initiate protective projects and 2. to engage community members to understand and support adaptation, we would argue that it undermines community engagement not to include the most severe current flooding that affects the most stakeholders.

We hope you will amend these concerns into the report so communities are not planning based on a world in which sea level rise proceeds independently of other inputs such as watershed flooding, pumps, and the broader water and infrastructure systems.

I hope you will recommend that each entity using the report to move forward with analyzing or implementing solutions will also include community-based knowledge of past flooding

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impacts and patterns, data that is available about streams, creeks and other bodies of water, available FEMA data, and perhaps actuarial data if it is helpful. We hope the report will also include an exhortation and resources to assist readers to stay up to date with the latest mapping tools, research, data and advances in the study of sea level rise, flooding and adaptation.

Thanks again for this opportunity to provide feedback and for your hard work.

Hannah
for Shore Up Marin

Hannah Doress

VP of Strategic Partnerships, The Breaking News Network |
Producer / Director CLMT News Network

Co-Director, Shore Up Marin: a multiracial coalition focused on sea level rise,
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From: [Judy Schriebman](#)
To: [Choo, Chris](#)
Subject: BayWave comments
Date: Sunday, May 28, 2017 6:37:32 PM

Hi Chris,

I just went over the part of the report on sewage agencies and have the following comments. i hope to get to the rest of the report at some time!

1. Doc page 93, was LGVSD inadvertently left off the list??? Or was there a reason?
2. Page 94, first paragraph; Hatches. I don't think we use that term anywhere. Did some other district? It would be helpful to say these "hatches" are at the treatment plants. I at first thought they were referring to manhole covers; not so.
- 3 Page 96, LGVSD bullet points—"Main Lagoon" should be "Marin Lagoon"

That was it!

400 pages to go.... :)

Judy

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From: [Jean](#)
To: [Choo, Chris](#)
Cc: [Fred Dupuis](#); [Charlie McDonald](#); [Kutter, Rhonda](#)
Subject: Comments for the draft Marin Shoreline SLR Vulnerability Assessment May 29, 2017
Date: Tuesday, May 30, 2017 11:55:35 AM
Attachments: [ChrisChoo_SLR_GIC_comments_May_29_2017.rtf](#)

Chris,
Please see our attached comments from the Greenbrae Improvement Club for the Draft Marin Shoreline Sea Level Rise Vulnerability Assessment. Thank you for your work, and for taking our comments. We look forward to working together on Sea Level Rise on the Adaptability phase.

Jean

Jean Severinghaus
Greenbrae Improvement Club, Chair Environment and Planning Committee
Greenbrae Boardwalk
415-577-3227

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Dear Chris Choo,

Thank you for meeting with leadership of the Greenbrae Improvement Club (GIC) and Supervisor Rodoni on May 3rd, 2017, taking our input on the draft Marin Shoreline Sea Level Rise Vulnerability Assessment (SLR Vulnerability Study), and clarifying a number of our questions.

Fred Dupuis, GIC President, Charlie MacDonald, Executive Board Member, and Jean Severinghaus, Chair, Environment and Planning Committee appreciate your making corrections to the conclusions regarding the Greenbrae Boardwalk.

The community would like you to

a) locate our community correctly, separating out the Lucky Drive homes and the Incorporated Redwood Highway North Larkspur areas from the Greenbrae Boardwalk, and redo all the data tables to reflect the corrections so the SLR Vulnerability Study becomes comprehensible—thank you for agreeing to do that. The Greenbrae Boardwalk is 100% EAST of 101 and has 48 total homes. (Summary Page 305)

b) correct that 100% of our HOUSES (Buildings, pages 302-303) are already elevated, and are generally able to be elevated higher, so are adaptable (not as assumed p.306 on 'pylons driven deep into the mud'). The recent FEMA Flood map update names the BFE here as 10': a few homeowners are in the grant application pool to elevate their homes in response. It would be very helpful for the County to be sure the grant program gets followed thru.

c) restate the adaptability of communities residing above living salt-marshes to SLR — (see Methods, Phase 3, Adaptive Capacity p. 6)—the salt marshes adapt to daily flooding “without human intervention”, so both the Larkspur Boardwalk One and the Greenbrae Boardwalk PARCELS (Parcels, page 300) vulnerability to flooding should be corrected. The parcels are adaptable. (Please correct also Summary pages 305-306). In 2015-16 El Nino, we experienced 6” to 12” of increased tide height due to the heat in the ocean, presumably a preview to that much sea level rise, now back to predicted levels. The parcels seemed to be fine and so were the homes despite several flood events.

c1) Utilities, page 322: The GB utilities have been successfully adapted to the past century of sea level rise and salt water intrusion thanks to efforts of the GIC: the gas, electric and water lines are elevated and the sewer is buried with three elevated pumps. The parking lot is raised four feet above Redwood Highway North.

c2) GB appears three times in Table 132—please correct (Page 341)

c3) Marin Park (Page 342) is in incorporated Larkspur and has 350 residents and serves as the City of Larkspur's Low Income Housing. All of the industrial businesses and mobil homes of Redwood Highway North in Larkspur are currently vulnerable to flooding, and are mainly protected by a few residents of the Greenbrae Boardwalk inflating a dam during storm events. This should be listed. This could be corrected by

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raising the GB easements to stop the flooding during tidal events while allowing continued access and staging for the GB in the rest of the times. The dam does not help the GB itself in any way but is a service to the neighborhood.

c4) (Page 312) Do the FEMA damage cost estimates in Table 127 apply to the GB or to both the Lucky Drive, Redwood Hwy North and GB altogether?

c5) Page 308, please correct maps and inserts to separate out GB from Lucky Drive.

d) Please restate the science of living salt marshes with sea level rise. The SLR Vulnerability report should state that salt marshes accrete or rise vertically and adapt to SLR without human intervention. They do so by growing vegetation falling and adding to mud sediments. Storm flood events with landslides and lots of mud in the water are particularly contributory to the continued health of the salt marshes with sea level rise. The boardwalks communities' parcels of land have adapted over the last 100 years of 8" of SLR by accreting vertically (the Greenbrae Boardwalk community has been here since 1903). Aside from being visible under the historic foundations this is documented locally on the adjacent Corte Madera Ecological Reserve (CMER) by two recent US Geological Survey and SF State University mud core, elevation, and sedimentation studies. The salt marsh, if it continues to be protected from the human-caused vulnerabilities of ferry erosion and of removal of natural sediments from Corte Madera Creek and SF Bay, should continue to adapt to SLR for quite some time.

BCDC recognizes the issue of endangering the SF Bay's marshes by over-removal of sediments from the system and is looking to address it. The salt marshes need more sediments now and as sea level rises.

To this point about sediments, how can the nine planned District 9 flood detention basins on the Corte Madera Creek be constructed so as not to remove the storm sediments from the Creek which this and other SF Bay salt marshes critically need as sea level rises?

e) We could use help with study from a hydrologist of the potential vulnerability of the salt marsh to increasing tidal prism as sea level rises: there are six meanders that nourish the marsh. They appear to be deepening and widening and several small new ones are forming. Is there a vulnerability to the buildings along these six meanders and to the survival of the salt marsh with this geomorphologic change? Should they be protected? The unprotected meanders to the north across the creek by the ferry appear to be removing the entire marsh: it is expected to disappear within 20 years.

f) The marsh belonging to the CMER east along the Creek to the Bay entrance facing the ferries is unprotected and has eroded an estimated 50 feet in the past 36 years, with 6' lost in the past 5 years alone. Once the marsh is gone it's gone. The face should be protected with some kind of revetment/living shoreline now before SLR worsens the ferry impact. (25 Year Monitoring Study of the revetment shoreline protection project, GGBHTD)

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g) The GGBHTD was lead agency and installed a rock revetment shoreline protection in 1989 after nine years of discussions with environmentalists, the BCDC, USACE, CMER and Boardwalk: BCDC documented 12-24 feet of loss of marsh face. The revetment was designed to break up the ferry waves and engine surges at a design height just at the mud-vegetation edge elevation. The revetment has been highly successful per the studies, both in its action as living shoreline protection, healed over by mud and vegetation, supporting the living salt marsh, and by preventing further landward loss of the half mile or so of private properties. The MHHW tidal elevation line in a recent survey approximately follows the top of the rock revetment. Now we have 3 inches of sea level rise at the Golden Gate since the revetment's installation and its design height is being overtopped. The 25 Year Study above measured elevations on transects: it showed on several transects, where the revetment had been disturbed by the Spartina Removal Project, new erosion as much as 18 feet landward. This would appear to presage a vulnerability that will soon need to be addressed; i.e. renewed ferry erosion of the boardwalk properties and the Corte Madera Ecological Reserve salt marshes behind them as sea level rise overtops the successful protection. The face of the marsh will need to be protected, possibly by simply adding six inches of rock, or another solution, protecting the parcels and the many services the salt marsh provides the larger communities.

In sum, we very much appreciated meeting with you regarding this Vulnerability Study and look forward to working together with you on sea level rise Adaptation issues.

Best wishes,

Fred Dupuis
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From: [Elizabeth Clark](#)
To: [Choo, Chris](#)
Subject: Comments on Draft BayWAVE Vulnerability Study
Date: Tuesday, May 30, 2017 12:01:47 AM
Attachments: [ResiliencyPlanv.EFMfinal.pdf](#)

Dear Ms. Choo,

I've spoken to you on a couple of occasions at meetings where you presented the Draft BayWAVE Study to the public. I haven't done an exhaustive review of the study, but, as I live in Larkspur, I read the separate section pertaining to Larkspur and parts of the larger study, and would like to comment on several things I have concerns about.

I'm concerned that the BayWAVE study may have categorized our home (and those in our boardwalk community) by the same criteria by which the vast majority of homes were assessed, which would yield, in my view, an inaccurate result. Our homes, elevated on fixed piers above a tidal salt marsh, are different from conventional homes, as they are designed to accommodate natural flooding. Corte Madera Creek stormwater and Bay tidal waters flow under our homes, none of which flood. The marsh around us and our lots flood naturally, but our homes do not.

A conventional home's floor elevation might be at 9.5' and maybe a foot or so above its surrounding lot. Floor elevations of homes on Larkspur's Boardwalk One, where I live, are typically in a range above 9.5' up to maybe 12' elevation, with surrounding lot elevations of 4-8' elevation, which is comprised of tidal salt marsh habitat and sloughs/drainage channels. My concern is that the criteria used in the BayWAVE Study, that resulted in our boardwalk homes being judged as highly/immediately vulnerable, were possibly based on low marsh elevations around our homes, rather than, or averaged with, estimated elevations of the homes themselves. Our lots **by nature and by definition** flood; the boardwalk homes have been here for decades, DO NOT flood, because they're raised above the surrounding marsh, and can be raised higher. We live WITH floods, not in opposition to them.

I realize higher water from sea level rise and precipitation is coming, to which we will be vulnerable. However, our homes are adaptable in a way that other buildings and homes on Corte Madera Creek are not. On a map that shows future flooding, our homes and boardwalk would be islands, rather than shown as submerged. Our homes can be raised fairly inexpensively, compared to other homes/apartment buildings on the creek, or new foundations that enable flotation. Some examples of other innovative adaptations that make homes more resilient can be found on this website - <https://www.niftyhomestead.com/blog/floating-homes>.

Therefore, I think it's fair to ask that an explanation be included in the final study that describes the criteria that were used to assess **our boardwalk homes**. They are THAT unique, such that I don't think they should be treated or assessed in the same way as conventional buildings. If the criteria used for our home were the same as those for other/conventional homes, which I'm guessing was based on some average of the elevation of our lots and estimated floor elevations, that would not be an accurate assessment, as it makes it look like our HOMES flood, when it's the properties that flood – by definition. One could argue that Greenbrae Boardwalk homes might be treated separately from conventional homes, as well. Perhaps houseboat communities would also warrant a special set of criteria for vulnerability assessment, as well.

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I feel it's important to comment about this because your document should, if it's not going to recommend any solutions, at least not discourage thinking of new solutions, by hastily condemning a unique community that happens to be very adaptable to flooding. Our boardwalk community is a potentially resilient example of coexisting WITH future flooding, rather than an example of the most vulnerable to flooding and therefore the first to be destroyed by flooding. A high vulnerability assessment designation may convey automatically that our homes, let alone the marsh habitat we live on, are not worth protecting, buying or insuring, when in actuality, they have much more value being adaptable than most nearby homes along the creek.

I'm asking you to make a note in the BayWAVE study about our community, describing that it is a community uniquely adapted to flooding, similar to a houseboat community, except our homes are fixed, above the tides, and can be raised. The marsh will always be flooded, but our homes can be adapted to rising tides.

SPECIFIC COMMENTS BY PAGE:

P. 242 – Map 86 is not interactive nor “zoomable”, so one cannot see detail. I live within an area that is completely red, a 30-acre area of red – highest vulnerability. That is because it is a marsh. Marshes are vulnerable to flooding, but they also are supposed to flood by definition, and some are resilient, but some will need to be restored and adapted with human help.

p. 242 – “*Housing along Corte Madera Creek canals, sloughs, and lagoons could be vulnerable in the near- to medium-terms, this includes, **Boardwalk 1**, the multi-family units across the canal on Larkspur Plaza, the southern portion of the Heatherwood neighborhood, and some housing west of S. Elisea Drive.*” COMMENT: It's inaccurate to include Boardwalk One homes in the same category with conventional homes that will flood with no adaptability. Boardwalk One homes are eminently adaptable to living with floods; conventional homes/bldgs. are not.

GENERAL COMMENTS:

1. Not at all meant as criticism, but you may want to know that there are quite a few typos in the draft assessment that hopefully won't be there in the final.
2. Piper Park Marsh is not named specifically where other marshes are NAMED in the BayWAVE Study. “Piper Park” is named, and the marsh is mentioned, but not by name. The reason I mention this is because two partners and I in the Environmental Forum of Marin Master Class, are currently trying to get the City of Larkspur to take stewardship of Piper Park Marsh, which is not currently zoned as open space or marsh conservation. This effort is needed, because several times over the years, the City has tried to fill in parts of the marsh (to create a city corporation yard), and/or the Larkspur Corte Madera School District has proposed installing night lights around the sports field adjacent to the marsh. Boardwalk One residents have objected to both and other actions that compromise the marsh. The City has not assumed stewardship, nor acknowledged that it's an important asset to the City and its residents. So, calling it by name, Piper Park Marsh, in the BayWAVE study would be a helpful step toward acknowledging it as an important, known asset. My partners and I, as part of an Environmental Forum of Marin project, created the Piper Park Marsh Resiliency Proposal, attached for your perusal, which we are currently working on with the City's DPW Director, Julian Skinner, and which we will be presenting to the City Council in June.

I commend you on this very thorough and important study, and hope to hear a response to my comments. Question: is this draft study similar to an EIR, in which comments will be incorporated, as written, into the final document, or how are public comments used to improve your final document?

Thank you for your time and dedication, and hopefully in advance for a reply.

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Elizabeth A. Clark



Elizabeth A. Clark

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