BayWAVE COMMUNITY PROFILES

SAUSALITO

Municipality Profile: Sausalito

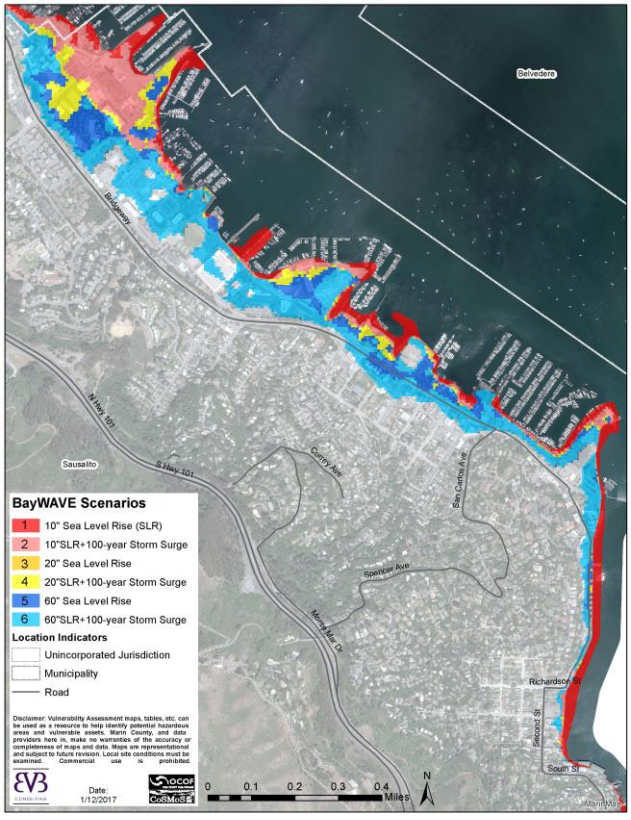
Sausalito, the southernmost community on the Marin shoreline, is situated just across the Golden Gate Bridge from San Francisco, along Richardson's Bay. In the near-term, twenty-six acres could be exposed to sea level rise. In the long-term, 84 acres could be exposed to sea level rise; and150 acres could be exposed with an additional 100-year storm surge. The following assets in the low lying areas primarily east of Bridgeway may be vulnerable to storm surges and sea level rise:

- Northerly access to Sausalito could be blocked in the Waldo Point community. Shifting highway access to the narrow windy hillside roads.
- The Marinship area in northern Sausalito is built on fill and is vulnerable to subsidence and flooding. This is the primary employment area.
- Shoreline homes in Old Town could be impacted by erosion, storm surges, and high tides.
- Bridgeway leading to Old Town is vulnerable in the long-term. The main wastewater force main leading to Sausalito Marin City Sanitary District treatment plant is under this roadway.
- Swede's and Tiffany beaches, and all other shoreline parks, could be vulnerable in the near-term.
- The Golden Gate Ferry's Sausalito Ferry landing is vulnerable in the near-term.
- The fire rescue boat in a vulnerable marina could also be impacted in times of need.
- Several shoreline restaurants, hotels, and business could be vulnerable to flooding in the near-term.
- Inflow and infiltration of tide waters into underground pipes could increasingly burden the wastewater treatment facilities.
- Several small shoreline parks and festival areas at Schoonmaker Point could flood, degrading public facilities and impeding public use.
- Several residents live in boats in marinas and unauthorized boats out in Richardson's Bay that are especially vulnerable during storms and could be vulnerable to damage at the marina's that host them.
- Tens of historic sites could be vulnerable across the BayWAVE scenarios.

IMPACTS AT-A-GLANCE: SCENARIO 6

150 acres	7,000+ people
265 living units	18 commercial parcels
3.5 miles of roads	
Extreme event impacts already occur	Property Owners City of Sausalito SMCSD Southern Marin Fire District GG's Sausalito Ferry
$400 million in assessed property value, $61,000 in single-family home market value[159]	

Map 46. Sausalito BayWAVE Scenarios



[159] 2016 dollars

SAUSALITO

Vulnerable Assets

Land

Sausalito is primarily built out and land locked by Richardson's Bay and the Marin Headlands. Most of the development is elevated on a hillside, however, the narrow strip of low-lying land near the shoreline is where most of the city's employment, tourist, cultural, bay access, and maritime assets are located.

Acres

Because of Sausalito's hilly nature, very little acreage could be flooded relative to the total area of the city, and to other communities in the study area. In near-term scenario 1, ten inches of sea level rise could flood 26 acres during average high tide several times a month. These 25 acres are dispersed along the shoreline and account for two percent of all acreage in Sausalito. An additional 100-year storm surge could double the acreage, though the added area would face temporary flooding only. In medium-term scenario 3, ten more aces and one additional percentage of the community could be exposed. With a storm surge these numbers could rise to 65 acres for five percent of the community. In long-term scenario 5, size percent of the community or 84 acres could expect tidal exposure. These and another 65 acres could face 100-year storm surge flooding as well.

Parcels

Land is divided into parcels for ownership and development purposes. Parcels are assigned land uses and tend to stay true to that designation, though many sites could feature multiple uses, such as commercial with housing included. Examining parcels can provide a window into how many land uses and human activities may be vulnerable.

The parcels that could flood tidally in the near-term are in the Marinship neighborhood, and extend all along the shoreline to Old Town Sausalito. Several of the parcels along the shoreline already extend into water by design. In the near-term 40 parcels could face tidal flooding. A 100-year storm surge at this sea level could temporarily flood another 20 or so parcels, and flood the first 40 parcels even more.

Table 48. Sausalito Exposed Acres

Scenarios		Acres	
		#	%
Near-term	1	26	2
	2	52	4
Medium-term	3	35	3
	4	65	5
Long-term	5	84	6
	6	149	11

Source: MarinMap, CoSMoS

Table 49. Sausalito Vulnerable Parcels

Scenarios		Parcels	
		#	%
Near-term	1	40	1
	2	61	2
Medium-term	3	48	1
	4	68	2
Long-term	5	88	3
	6	358	11

Source: MarinMap, CoSMoS

In the medium-term, 8 or so more parcels in Marinship and along the shoreline could flood in each scenario. In long-term scenario 5, around three percent of parcels in Sausalito could face tidal inundation, and an additional 100-year storm surge on top of five feet of sea level rise could flood an another 8 percent of Sausalito parcels. Overall, 11 percent of parcels could face storm surge flooding.

Vulnerable parcels account for nearly ten percent of all commercial parcels, though less than one percent of percent of residential parcels in the community. Note, however, a few of the marinas along the Bay allow people to live on their boats in slips. While these are not residential parcels, these are residential spaces that could be highly vulnerable during storm surges especially. Commercial buildings include a grocery store, offices, restaurants, and professional practices. Industrial operations are generally related to boating and craftsmanship.

More concerning is that Sausalito could lose 41 percent of industrial parcels to tidal flooding and an additional 20 percent to 100-year storm surge

flooding in the long-term. Twenty to 30 percent of industrial parcels could suffer 100-year storm surge impacts before this time. This, while only a few parcels is a significant contribution to the city's employment base. Note that while several places along the shoreline have armoring, they may not be adequate to hold back the potential flood waters. The only historic landfill site in Sausalito is Dunphy Park. The park could become completely covered with high tide waters at a sea level rise of 60 inches.

Buildings

The Sausalito Bayfront is highly developed with industrial and maritime oriented businesses, facilities, and residences. Buildings in the Marinship neighborhood are likely to flood as are, bay front homes on pilings in Old Town. The properties could be susceptible to undercutting from strong wave activity during storms, and from consistently higher high tides. In addition, Marinship and a few other sites along the shore were filled prior to construction and are prone to subsidence. The flooded buildings account for a small percentage of the building in the community.

In the near-term, 21 buildings could be compromised to flooding, however, a 100-year storm surge at this increased sea leave could flood nearly 115 buildings with bay water. In the medium-term scenario 3 and 4, 67, and 133 buildings respectively could experience flooding. In the long-term, five percent, or about 150 buildings could be subject of tidal flooding on a monthly basis, while an additional five percent could experience storm surge flooding. While, these numbers are relatively low compared to many communities in the study area, the Sausalito shoreline is one of the biggest destinations in the county and its loss would have significant impacts on the economy and culture of Marin County residents and visitors. In fact, several of the vulnerable buildings are part of Sausalito's Historic Downtown and are irreplaceable. To learn about these assets see the Cultural Resources Profile.

Table 53 divides potentially vulnerable buildings by the amount of water they could be flooded with at MHHW. For example, this table shows how many buildings flooded in scenario 1 could flood with one, two, or ten feet of water at the average highest high tide. A 100-year storm surge combined with these sea levels could add one to three feet of water on top of these levels.

Table 50. Sausalito Vulnerable Residential and Commercial Parcels

Land Use	Scenarios					
	1		3		5	
	Near-term		Medium-term		Long-term	
	#	%	#	%	#	%
Residential	9	0	11	0	12	0
Commercial	4	2	6	3	18	10
Industrial	3	21	8	30	41	62

Source: MarinMap, CoSMoS

Table 51. Sausalito Vulnerable Land Uses

Land Use	Scenarios					
	1		3		5	
	Near-term		Medium-term		Long-term	
	#	Ac.	#	Ac.	#	Ac.
Commercial Improved	3	0.6	5	3	16	14
Commercial Unimproved					2	0.12
Industrial Improved	2	1	5	2	24	17
Industrial Unimproved					4	1
Single-family Attached					3	0.03
Single Family Residential Improved	6	0.4	8	1	9	1
Tax Exempt	25	7	26	7	30	11

Source: MarinMap, CoSMoS

Table 52. Sausalito Vulnerable Buildings

Scenarios		Buildings	
		#	%
Near-term	**1**	21	1
	2	113	4
Medium-term	**3**	67	2
	4	133	4
Long-term	**5**	154	5
	6	299	10

Source: MarinMap, CoSMoS

In scenario 1, about ten buildings are could face three feet or shallower depths, and ten could be

vulnerable to waters over three feet, with most vulnerable to over six feet to seven feet. In the medium-term, several buildings are expected to flood with up to two feet of water, with ten more that could be flooded with three feet of water. About twice as many buildings could be vulnerable to over three feet of water than in the near-term. In the long-term, over fifty buildings could be vulnerable to less than or equal to 3 feet of water, and seventy buildings could be vulnerable to more than three feet of water. Across all of the scenarios, a small percentage of the buildings stock could face tidal flooding; however, these buildings are a significant portion of the city's commercial and industrial base.

Table 54 estimates damage costs using FEMA tagging designations for buildings and their contents. This analysis assumes every vulnerable building experiences the same level of damage under scenario 6 conditions. At minor levels of damage, up to $5 million[160] in damages could occur. If all of the buildings impacted under scenario 6 were to become unusable, over $200 million in assessed structural value could be lost.[161]

The maps on the following pages illustrate vulnerable buildings by scenario. The areas in the call out circles enable the reader the see areas that are difficult to see on the large scale map. The circles do not indicate that these areas are more vulnerable than others along the shoreline.

The Spinnaker. Sausalito. Credit: E. Snow

Table 53. Number of Sausalito Vulnerable Buildings by Flood* Level at MHHW

Flood Depth (feet)	Scenarios		
	1	3	5
	Near-term	Medium-term	Long-term
0.1-1		2	3
1.1-2	2	19	20
2.1-3	6	9	32
3.1-4	2	5	22
4.1-5		3	32
5.1-6	1	3	6
6.1-7	6	8	7
7.1- 8	2	4	3
8.1-9	2	2	5
9.1- 10		0	3
10.1+		4	9

** Flood depth data is not available for every vulnerable building. Buildings that already exist beyond mean sea level are not included.*

Source: MarinMap, CoSMoS

Table 54. Sausalito Vulnerable Buildings FEMA Hazus Storm Damage Estimates in Long-term Scenario 6

Buildings in Scenario 6	299
Yellow Tag-Minor Damage **$5,000 minimum**	$1,495,000
Orange Tag- Moderate Damage **$17,001 minimum**	$5,083,299
Red Tag-Destroyed **Assessed structural value**	$228,617,482

Source: MarinMap, CoSMoS; 2016 dollars

[160] 2016 dollars
[161] 2016 dollars

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Map 47. Sausalito Vulnerable Buildings

Vulnerable Assets

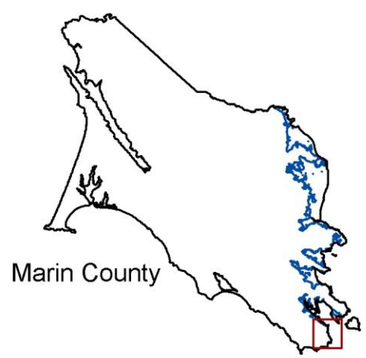
- Fire Station
- District Office

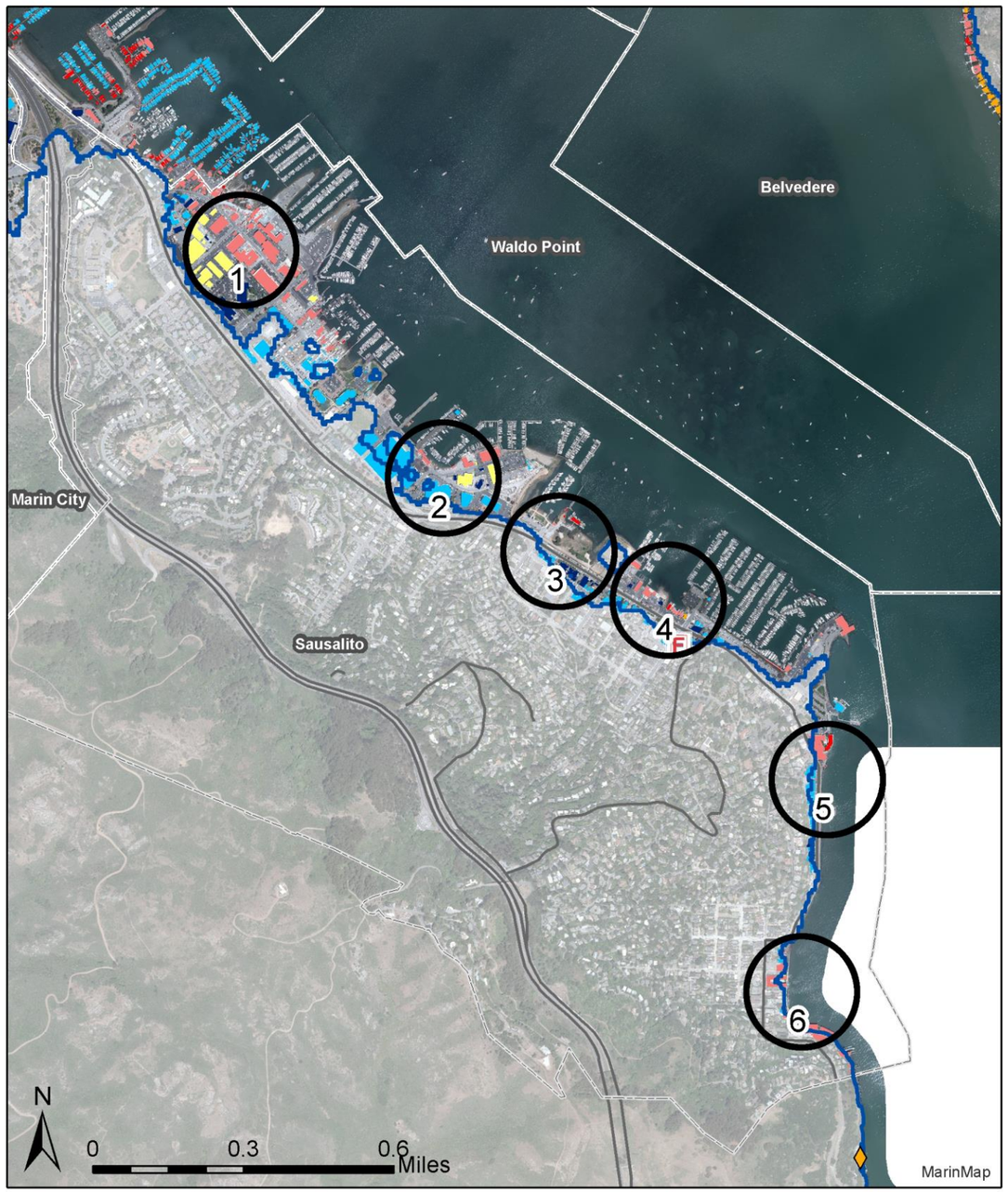
Vulnerable Buildings

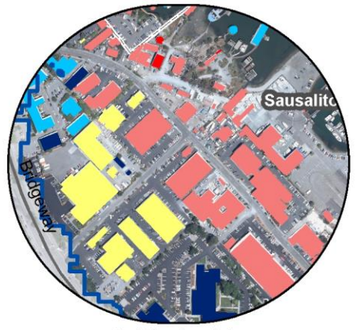
- Scen. 1: 10" Sea Level Rise (SLR)
- Scen. 2: 10" SLR+Storm Surge
- Scen. 3: 20" Sea Level Rise
- Scen. 4: 20"SLR+Storm Surge
- Scen 5: 60" Sea Level Rise
- Scen. 6: 60"SLR+Storm Surge

Location Indicators

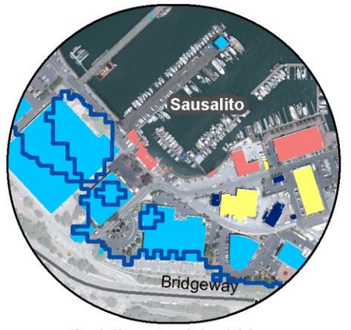
- Unincorporated
- Municipality
- Road
- Inland Extent: Sea Level @ 60"+100-year Storm



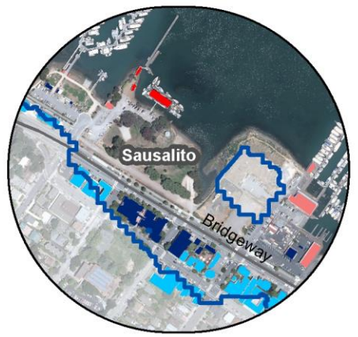




1: Marinship

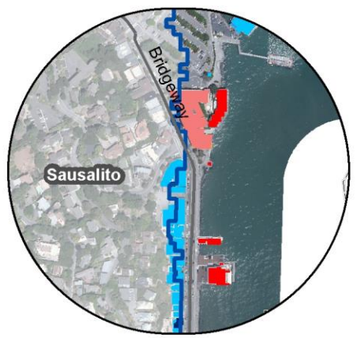


2: Libertyship Way

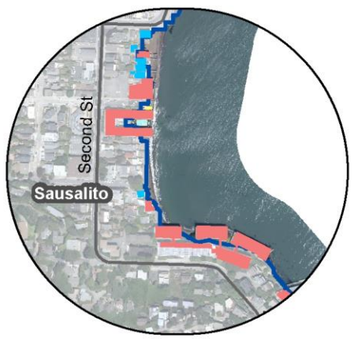


3: Dunphy Park

4: Southern Marin Fire Department



5: Bridgeway



6: Old Town

Date: 1/15/2017

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.

Transportation

In near-term scenario 2, sea level rise with a 100-year storm surge, several streets in the Marinship area could flood more frequently than they already do causing reduced access to jobs and businesses there. In this time period with a 100-year storm, about one half of a mile could flood temporarily. By the medium-term, streets near Dunphy Park could become vulnerable. By this time, about 1.14 road miles could expect tidal impacts. With a 100-year storms surge coincidence, nearly one mile could experience bay surge flooding. In the long-term, Bridgeway could be vulnerable in the low lying areas downtown and along the southern shoreline. In addition, Johnson Street, where the Fire Station No. 1 is located, and Litho Street could be vulnerable. Overall, these roads miles add up to nearly one and one half of a mile. An additional two miles, and several other roads in the downtown area could be flooded by 60 inches with the 100-year storm surge.

Golden Gate Transit routes 2, 4, 10, 17, 22, 70, 80, 91, and 92 could be impeded by tidal and storm surge flooding along the vulnerable roadways. Floodwaters could reach the following stops:

- Bridgeway and Napa St.,
- Bridgeway and Pine St.,
- Bridgeway and Turney St., and
- Bridgeway and Ensign St.

In addition to roads, the Sausalito/Mill Valley Path and Bay Trail could be vulnerable to sea level rise in the Marinship and downtown areas. While these pathways could likely withstand low levels of irregular flooding, frequent flooding could prevent travel by foot, bike, or other non-motorized vehicles. This could have significant impacts on commuting and safe public access to recreational opportunities in the area.

Finally, though likely able to adjust in the near- and medium terms, several marinas, boat launches, boat slips, and other boating facilities could be flooded out during storms and eventually, tidal waters. During storms, the boats themselves could also be damaged. A significant vulnerable water transportation facility is the GGF Sausalito Ferry to and from San Francisco. The GGF Sausalito Ferry operates on a float system, and could likely withstand sea level impacts into the latter half of the century. However, the land the dock connects to and the parking lot could be flooded with deep water at MHHW in the near-term. Impacts to this facility would affect commuting and tourism. The following marine facilities are in the exposed area:

- Sausalito Shipyard and Marina, including residents,
- Cass Gidley Marina (public),
- Five Star Yacht,
- Liberty Ship Marina,
- Marina Plaza Harbor,
- Pelican Yacht Harbor,
- Bridgeway Marina,
- Sausalito Yacht Harbor, and
- Schoonmaker Point Marina.

Boats in Marina. Sausalito. Credit: City of Sausalito Photo Gallery.

Sausalito Yacht Club. Credit: E. Snow

Table 55. Sausalito Transportation Routes Vulnerable to Sea Level Rise and a 100-year Storm Surge

Near -Term		Medium -Term		Long -Term	
Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**	**Scenario 5**	**Scenario 6**
None	**0.5 miles**	**0.14 miles**	**0.8 miles**	**1.4 miles**	**3.5 miles**
	Anchor Street [P] Coloma St [L] Gate 5 Rd [L, P] Harbor Dr [L] Heath Wy [L] Liberty Ship Wy [P] Spinnaker Dr [P] Varda Landing Rd [P]	Roads in scenario 2	Roads in scenario 2 Humboldt Ave [L, P] Turney St [L]	Roads in scenarios 1-4 Bridgeway [L] Johnson St [L] Litho St [L] Locust St [L] N Bridge Blvd [L] Napa St [L] Road 3 [P]	Roads in scenarios 1-5 Bay St [P] Bee St [L] Caledonia St [L] El Portal St [L] Ensign St [L] Marina Plaza [P] Marinship Wy [L, P] Napa St [L] Pine St [L] Princess St [L] Richardson St [L] San Carlos Ave [L] Tracy Wy [L] Wateree St [P]

M = Marin County; C = State of California; L = Local Municipality; P = Private. Source: MarinMap, CoSMoS

The maps on the following pages illustrate vulnerable transportation features. The areas in the call out circles enable the reader the see areas that are difficult to see on the large scale map. The circles do not indicate that these areas are more vulnerable than others along the shoreline.

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Map 48. Sausalito Vulnerable Transportation Assets

Vulnerable Assets

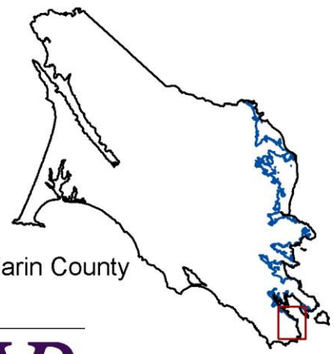
- Bike path
- Bay Trail
- Trail
- GGT Bus Stop
- Marina
- Ferry
- Boat Launch

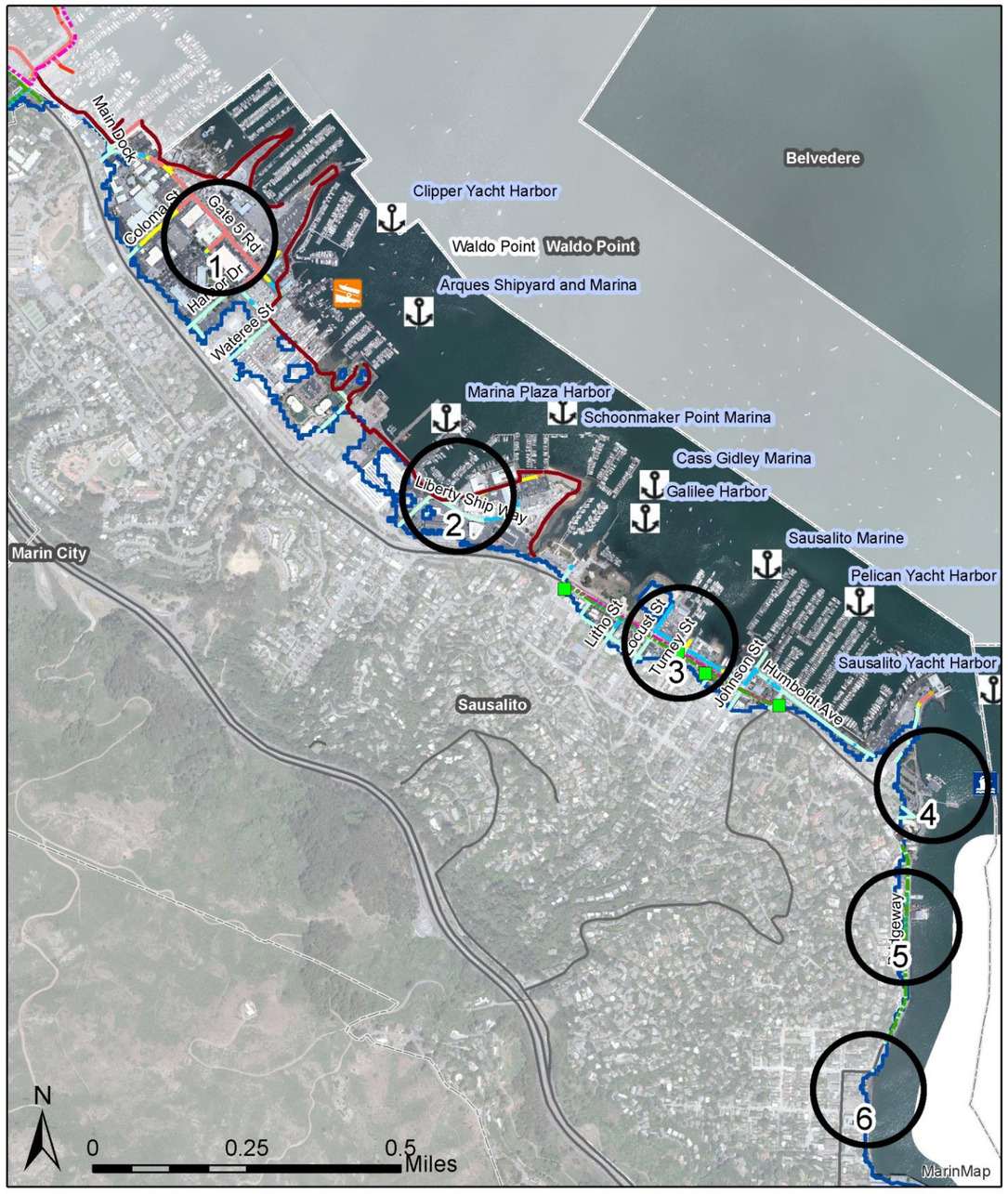
Vulnerable Roads

- @10" Sea Level Rise (SLR)
- @10"SLR+ 100-year Storm Surge
- @20" Sea Level Rise
- @20"SLR+ 100-year Storm Surge
- @60" Sea Level Rise
- @60"SLR+ 100-year Storm Surge

Location Indicators

- Unincorporated
- Municipality
- Road
- Inland Extent: Sea Level @ 60"+100-year Storm





1: Northern Marinship

2: Southern Marinship

3: Bridgeway

4: Golden Gate Ferry.

5: Bridgeway

6: Old Town

Date: 1/15/2017

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.

Utilities
Individual buildings that flood could face on site electrical, potable water, stormwater, and wastewater issues. If these sites, especially those closest to the shoreline, become regularly inundated, services could be permanently cut off.

These properties could also become sources of excess water into the pump stations for flood control and the waste treatment system. This could place a burden on the equipment, chemical use, and energy conservation.

Potential Sausalito Marin City Sanitary District (SMCSD) vulnerabilities impacting all residents in Sausalito are:

- The Main Street pump station and pipeline. The pipeline collects and transports 95 percent of the effluent brought to the treatment plant and borders the shoreline under a vulnerable portion of Bridgeway.
- The Locust Street pump station could become burdened with tidal water infiltration.
- The Anchor Street pump station could become burdened.
- The pump station, 500 block of Bridgeway could become burdened, and controls across the street near the Trident Restaurant could be flooded.
- The Drake pump station could become burdened with tidal water infiltration.
- The Gate 5 Road pump stations could become increasingly burdened by tidal water infiltration and could also be vulnerable to subsidence.
- The access hatches along effluent pipes extending into Richardson's Bay could be overtopped frequently preventing employee access.
- The below grade electrical motors at the treatment plant could be flooded in the long-term at high tides with a 100-year storm surge.

In addition, Sausalito is vulnerable to issues common to all of the communities such as:

- Underground pipes face compounding pressure forces from water and the road,
- Road erosion and collapse with underlain pipes,
- Increasing saltwater inflow and infiltration causing inefficiencies in wastewater treatment,
- Continuously subsiding soils or fill, and
- Escalating activity, capacity demands, energy consumption, and wear and tear on pump stations in stormwater and wastewater systems,
- Aging individual site connections for water, sewer, and electrical, and
- Flood waters interrupting access for employees to reach work sites.

Available PG&E data did not reveal any major gas and electric assets that could be vulnerable in the study area. The same may be true for potable water infrastructure. Digitized geographic stormwater data was not available at the time of this assessment. Wastewater data is provided on Map 49.

Working Lands
Fishing habitats and facilities could be impacted. See the transportation section for a list and map of marinas and boat launches in Sausalito.

Natural Resources
Beaches are among the most vulnerable habitats, susceptible to higher tides, flooding, erosion, and sand shift.[162] Swede's and Tiffany beaches are very narrow with minimal habitat value and no opportunity to migrate landward. Beaches and rocky areas are home to many seabirds and several unique fish species swim just off shore.

A 2008 study found that Richardson's Bay supports extensive beds of eelgrass. [163]Eelgrass was observed in the open water immediately northeast of Dunphy Park and Cass Gidley Marina and within the Richardson Bay Navigation Channel.[164] Eelgrass beds are among the most productive aquatic ecosystems known. Eelgrass beds are recognized by both federal and state agencies as sensitive and essential habitat for Pacific salmon and

[162] Hutto, S.V., K.D. Higgason, J.M. Kershner, W.A. Reynier, D.S. Gregg. 2015. Climate Change Vulnerability Assessment for the North-central California Shoreline and Ocean. Marine Sanctuaries Conservation Series ONMS-15-02. US Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Silver Spring, MD.
[163] Merkel & Associates, Inc. May 2008. Baseline Eelgrass Study, San Francisco Bay, California. Prepared for Marin Baylands Advocates/Audubon Society, May 5, 2008
[164] These features are not mapped. Their absence does not indicate a lack of vulnerability, rather a lack of digitized data.

groundfish.[165] Eelgrass beds are much larger and closer to shore than the mapped habitats on Map 52.

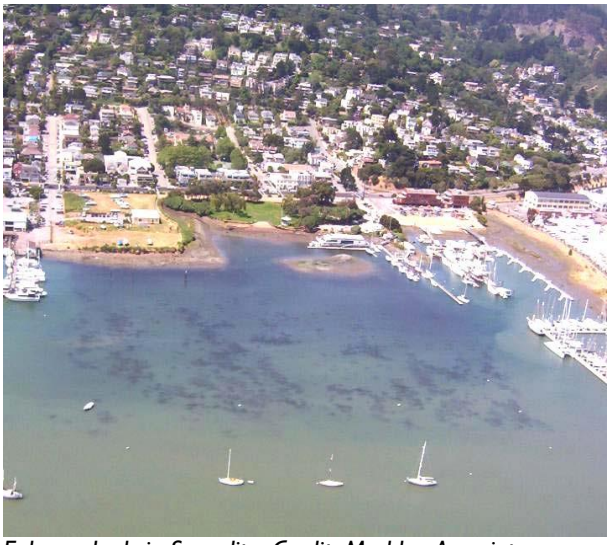
The longfin smelt is the only listed species recorded in this area. The smelt is listed as threated on the California list and a candidate on the federal list. The largest longfin smelt population occurs in the San Francisco Estuary and Sacramento-San Joaquin Delta. This species occupies bay waters throughout summer and moves into lower reaches of rivers in fall to spawn. Other important fish species sensitive to changes in environmental conditions that could occur in Richardson's Bay are:

- Chinook salmon
- Delta smelt:
- Green sturgeon
- Pacific herring, and
- Steelhead.

Listed bird species that could be found in or moving through the Sausalito shoreline are the Ridgway's rail and the Western snowy plover. The Ridgway's rail is one of the largest rails in North America. The Ridgway's rail is very secretive and occurs primarily in salt and brackish marshes with pickleweed and cordgrass. Richardson's Bay is known to support a small number of Ridgway's rails.[166] The Western snowy plover is a small shorebird that nests on and near the shores of the San Francisco Bay and may forage in Richardson's Bay. Other unique and valuable bird species common in the area are:

- California brown pelican,
- California least tern,
- Double-crested cormorant,
- San Francisco common yellowthroat, and
- San Pablo (Samuels) song sparrow.

Additional migratory birds are reported and some may occur within the project site on a regular basis or on occasion (e.g., Allen's hummingbird, marbled godwit, Nuttall's woodpecker, western grebe).



Eelgrass beds in Sausalito. Credit: Merklen Associates

And while not listed as threatened or endangered, a unique and valuable species that travels through the San Francisco Bay is the Southern sea otter, also known as the California sea otter. These mammals are, are among the smallest of marine mammals and may live for 15-20 years in the wild. Insects, such as the Monarch butterfly, could also be vulnerable to impacts to their habitats. To learn more about these species, see the Natural Resources Profile.

Lastly, special status plants with habitats that are expected to be vulnerable to sea level rise are:

- Franciscan thistle,
- Hairless popcornflower.
- Marin western flax,
- Oregon polemonium,
- Point Reyes salty bird's-beak,
- Tiburon buckwheat,
- Tiburon paintbrush, and
- White-rayed pentachaeta.[167]

Recreation

Based on the CoSMoS model results, beaches and shoreline parks could disappear in the near to medium-terms. A few shoreline hotels, restaurants, and other guest serving facilities could also face higher tides. Turney Street Boat Ramp, the only public boat launch on Richardson's Bay, and other

[165] NOAA Fisheries West Coast Region. 2014. The Importance of Eelgrass. Updated fall 2014. http://www.westcoast.fisheries.noaa.gov/stories/2014/04_11072014_eelgrass_mitigation.html. Accessed 1/18/17

[166] Wood, J., L. Salas, N. Nur, M. Elrod, J. McBroom. 2013. Distribution and population trends for the Endangered California Clapper Rail. State of the Estuary Conference, 26 October 2013, Oakland, CA.

[167] Prunuske Chatham, Inc. March 2016. Draft Biological Resources Assessment: Dunphy Park Improvement Project Sausalito, Marin County.

private marinas could also become compromised more frequently during high tides, especially by long-term scenario 5. Nearly all of the shoreline trails, including the Bay Trail and bicycle trails could also flood out and require increased maintenance from repeated saltwater exposure.

In the long-term flooding could impact Bridgeway and historic buildings lining its west side. Credit: Marin County CDA

Emergency Services

Access for emergency services to the Marinship area and other shoreline areas east of Bridgeway are the primary concern for police, fire, and ambulatory services. The Southern Marin Fire Rescue boat Liberty could also be vulnerable during severe storms and impacted by disrupted marina function. This would also be true for Sausalito Police Department's two boats, Marine 1, berthed at Schoonmaker Marina, and Marine 2, berthed at the US Army Corps of Engineer's dock. Fire Station 1 and the Sausalito Police Department station could expect 100-year storm surge impacts by the end of the century, and access issues east of Bridgeway sooner. Finally, according to local asset managers, the Army Corps of Engineers facility off Bridgeway and Liberty Ship Way also serves as an emergency shelter. The large facility hosts the Bay Model Visitors Center and serves as the Navigation Branch for the M/V Raccoon and M/V John A.B. Dillard, Jr. at its dock in Sausalito.[168]

The maps on the following pages illustrate vulnerable utility, natural resource, recreation, emergency and historic features. The areas in the call out circles enable the reader the see areas that are difficult to see on the large scale map. The circles do not indicate that these areas are more vulnerable than others along the shoreline.

[168] J. Goldman. Dec. 20, 2016. Personal Communication. B. Van Belleghem

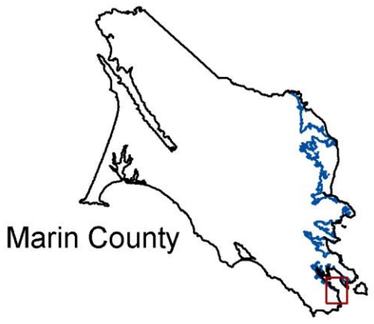
Map 49. Sausalito Vulnerable Wastewater Assets

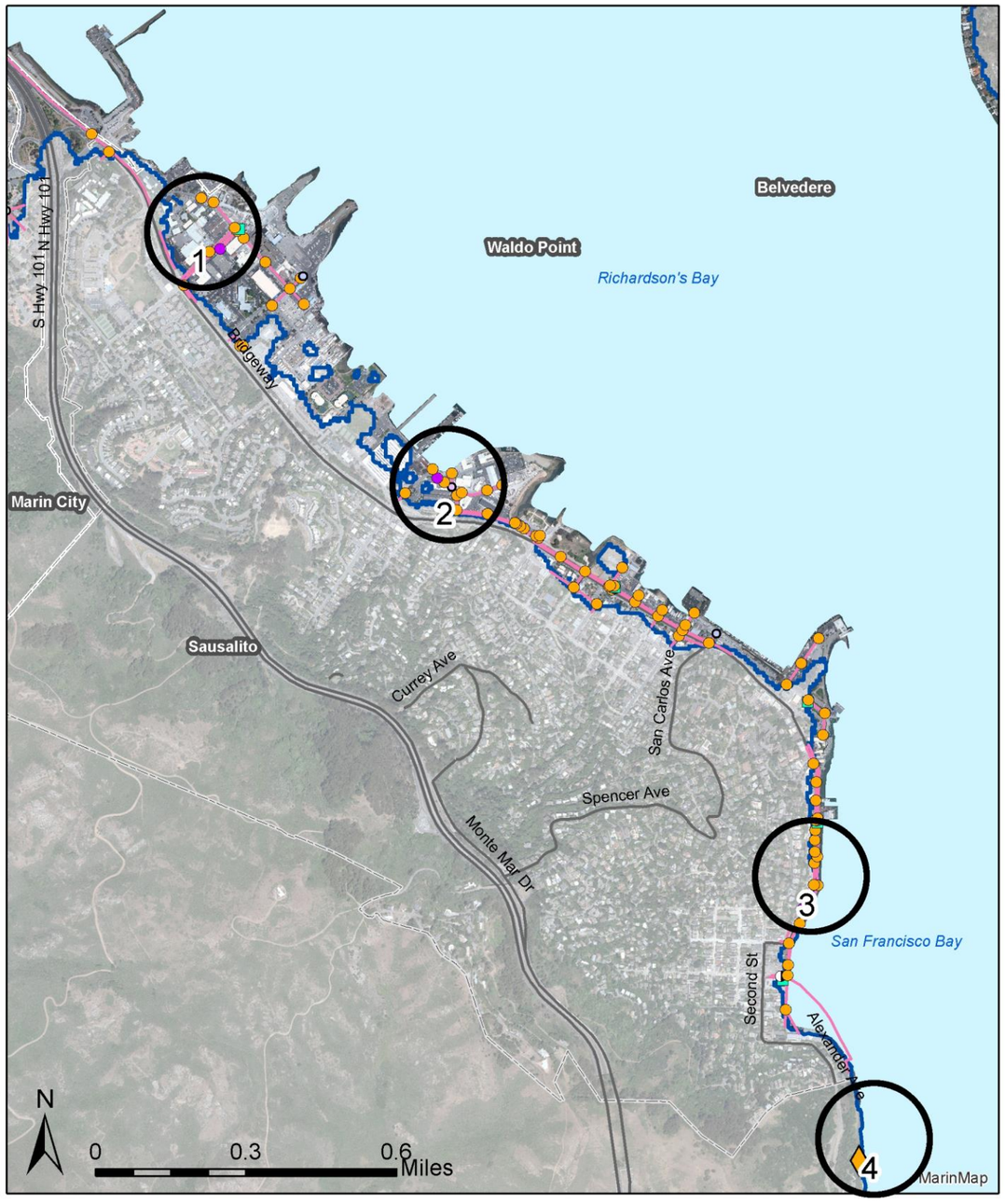
Vulnerable Assets

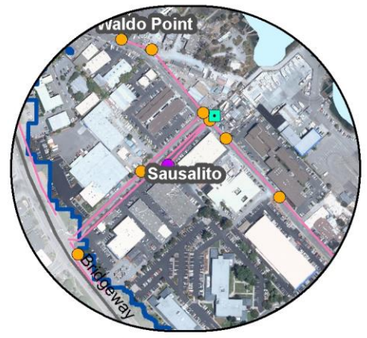
- Pump Station
- BT
- GV
- LH
- Manhole
- RC
- Residential Lateral
- Pipe
- Treatment Plant

Location Indicators

- Unincorporated
- Municipality
- Road
- Bay
- Inland Extent: Sea Level @ 60"+100-year Storm Surge

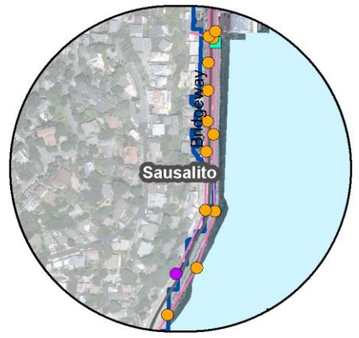






1: Marinship

2: Liberty Ship Way



3: Bridgeway

4: Sausalito Marin City Wastewater Treatment Plant

Date: 2/9/2017

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.

SAUSALITO

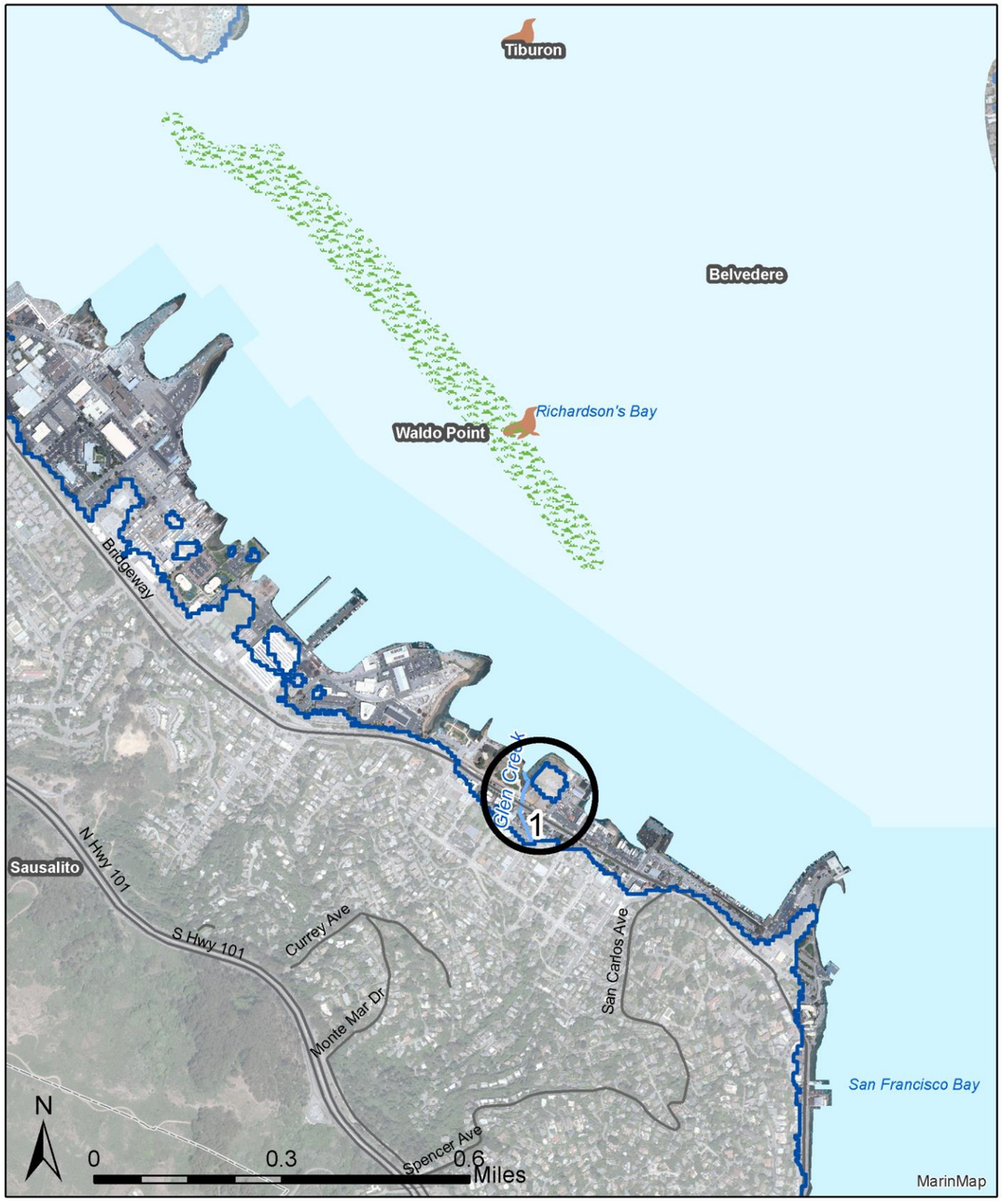
Map 50. Sausalito Vulnerable Natural Resource Assets

Vulnerable Assets

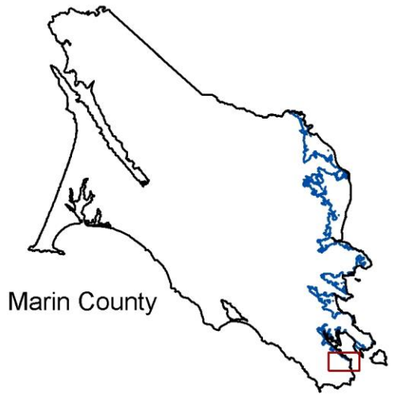
- Eelgrass
- Streams

Location Indicators

- Unincorporated
- Municipality
- Road
- Bay
- Inland Extent: Sea Level @ 60"+100-year Storm



1: Glen Creek



CA Dept. of Fish & Wildlife

Date: 1/24/2017

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SAUSALITO

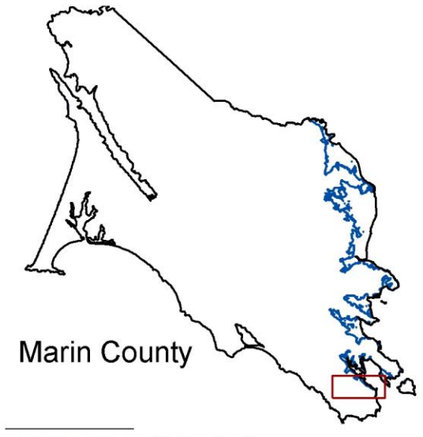
Map 51. Sausalito Vulnerable Recreation Assets

Vulnerable Assets

- Ferry
- Public Boat Launch
- Marina
- Bay Trail
- Trail
- Bikeway
- Park

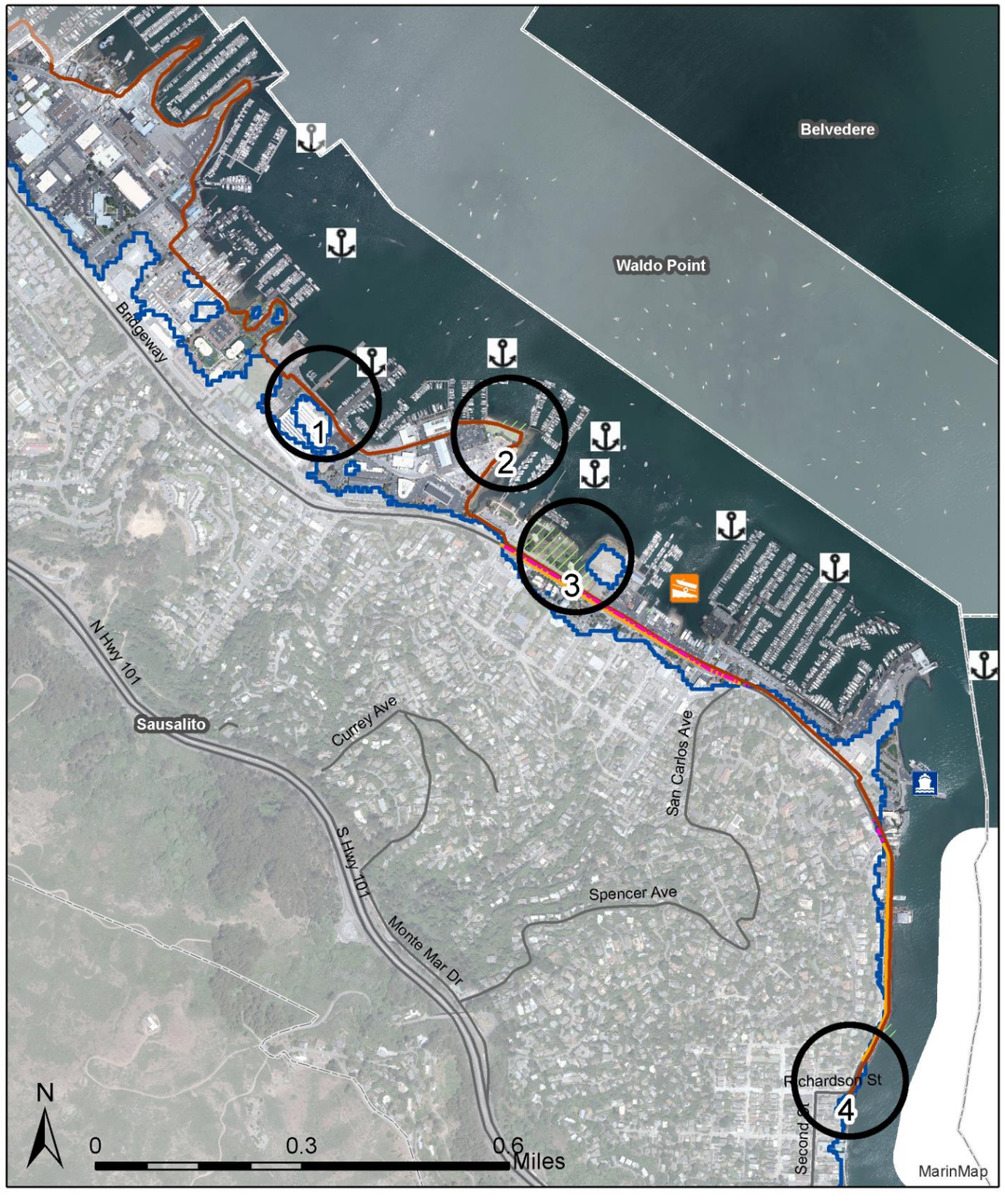
Location Indicators

- Unincorporated
- Municipality
- Road
- Bay
- Inland Extent: Sea Level @ 60"+100-year Storm



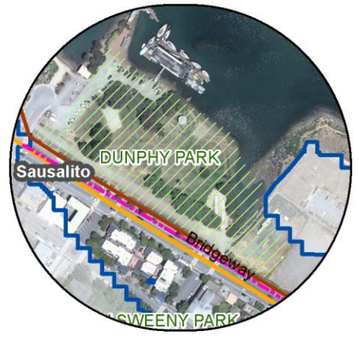
CA Dept. of Fish & Wildlife

Date: 4/3/2017



1: Marina Plaza Harbor & Bay Model Visitor's Center

2: Shoonmaker Beach

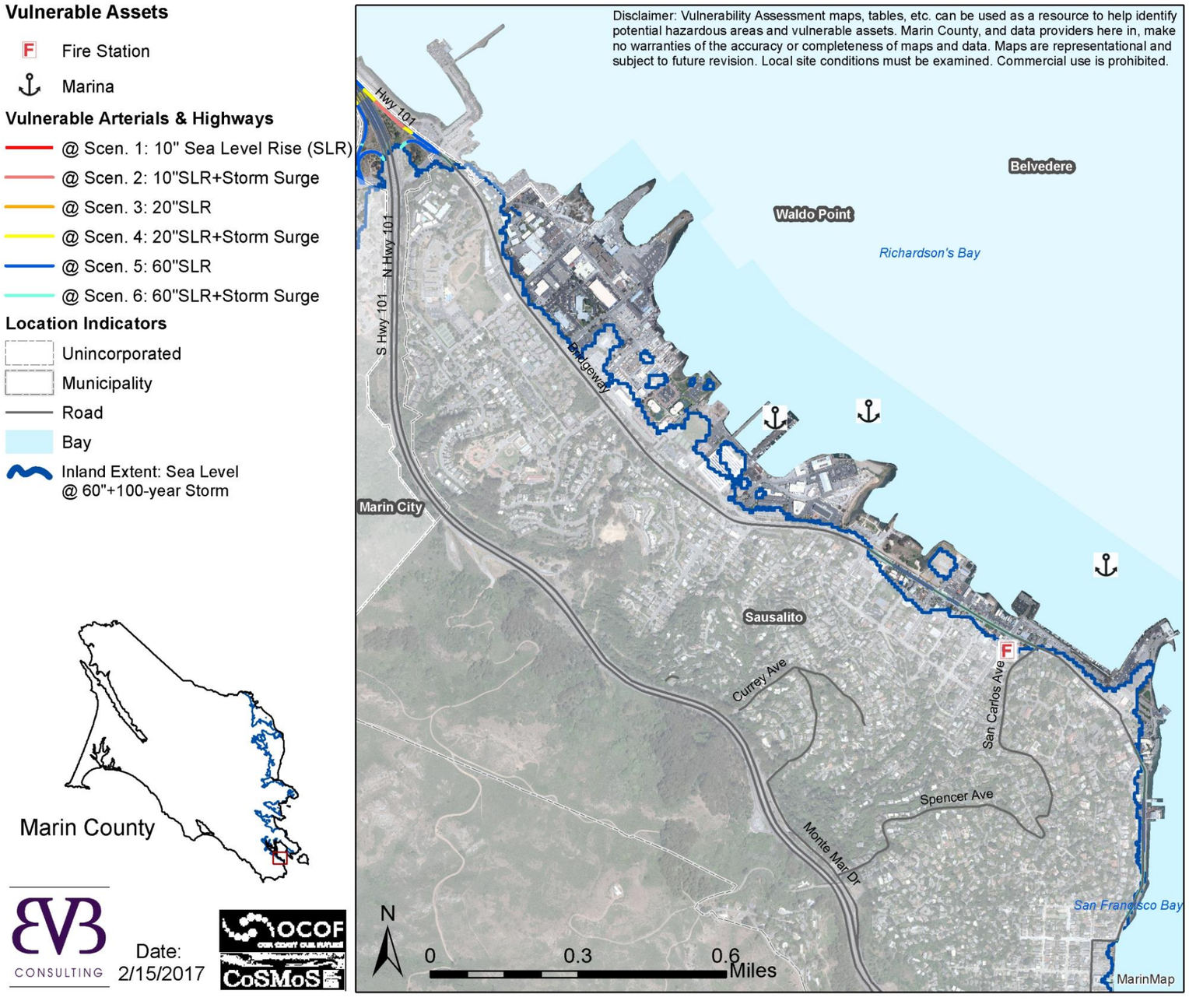


3: Dunphy Park

4: Tiffany & Swedes Beach

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.

Map 52. Sausalito Vulnerable Emergency Service Assets



Map 53. Sausalito Vulnerable Cultural Resource Assets

Vulnerable Historic Buildings

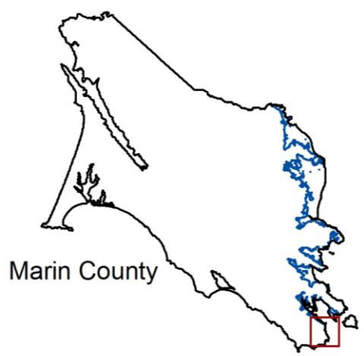
- Scen. 1: 10" Sea Level Rise (SLR)
- Scen. 2: 10" SLR+Storm Surge
- Scen. 3: 20" Sea Level Rise
- Scen. 4: 20" SLR+Storm Surge
- Scen. 5: 60" Sea Level Rise
- Scen. 6: 60" SLR+Storm Surge

Location Indicators

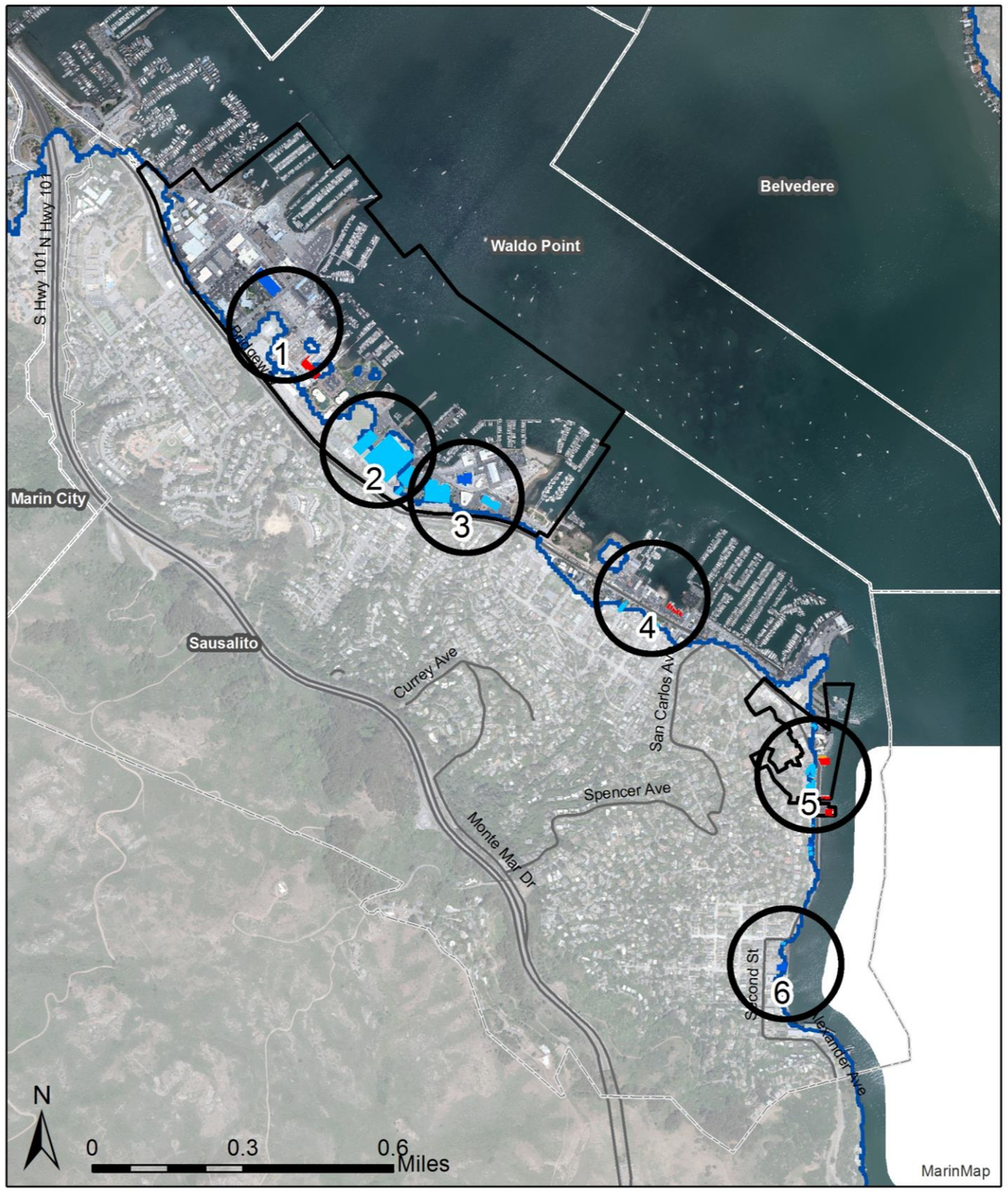
- Municipality
- Major Road
- Inland Extent: Sea Level @ 60"+100-year Storm

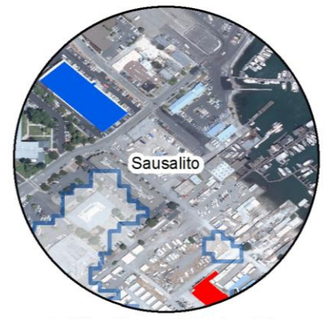
Source: Marin Map, CoSMoS, City of Sausalito, Historic Resource Inventory Listing, Marinship Historic Context Statement.

Archaeological resources may be present.



Date: 2/17/2017



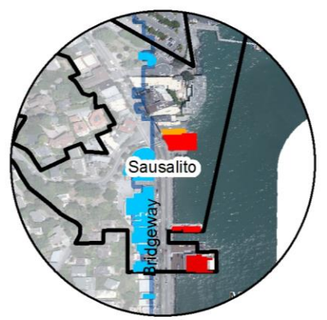


1: Northern Marinship

2: Central Marinship

3: Southern Marinship

4: Ark Row District



5: Downtown Historic District

6: Old Town

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.

Cultural Resources
Vulnerable Resources: 26 National register district contributing sites, 17 noteworthy structures, 2 landmark buildings
Scenarios: All
Flood Depths: 09'04''+100-year storm surge
Primary Building Materials: Wood, concrete, brick, stucco, concrete

Both water and land access routes to Sausalito's historic properties could be vulnerable in the near-term. The historic GGF Sausalito Ferry landing could face inundation in the near-term. In the long-term, parts of Bridgeway could be tidally flooded, and impacts could worsen with storms.

A handful of private properties, including two major districts (Downtown Historic District and Ark Row District) on the city's Historic Resources Inventory could also be vulnerable across the BayWAVE scenarios. Sausalito's Ark Row District includes seven noteworthy properties that could be flooded with more than six feet of tidewaters in the near-term, and nine feet in the long-term. An additional ten other properties could be vulnerable in the long-term, including the original firehouse, with eight of the ten only subject to storms. Additionally, two of Sausalito's landmark buildings, Castle by the Sea and Ice House, could be vulnerable to a 100-year storm surge in scenario 6.

Marinship
Vulnerable Resources: 10 potential historic resources
Scenarios: All
Flood Depths: 2'1'' - 2'8''+100-year storm surge; flood depth data limited
Primary Building Materials: Concrete, wood, stucco, steel

The former Marinship yard, an approximately 210-acre site, was one of six Emergency Shipyards in the San Francisco Bay Area established during World War II. Marinship was built on bay fill, and some areas, such as Heath Way, have experienced approximately five feet of subsidence since 1943 based on photographic records.[169] In 2010, the Marinship Historic Context Statement inventoried and recorded every major World War II era building and structure. The effort concluded:

- Marinship retains a higher degree of architectural integrity then any of the other Bay Area World War II emergency shipyards,
- Eight surviving buildings could form a California Register eligible district in the southernmost portion of the district,
- Two sites are individually eligible for the National Register of Historic Place, and
- Four sites are individually eligible for the California Register of Historic Places.

Since the report was released, the WWII machine shop has received National Historic Landmark designation. The site is slated for renovation and repair. The remaining sites can be considered potential historic resources.

In the near term, shipways that are part of Building 23, the Marinship Shipways and Offices, could be vulnerable to 10 inches of sea level rise. More detailed analysis would be necessary to fully evaluate structural integrity impacts that could occur.

In the long-term, two buildings, the Marinship Maintenance Garage and the Marinship Mold Loft and Yard Office, could be vulnerable to tidal flooding at depths deeper than two feet. Both buildings were erected in 1942 with cinderblock construction and could be vulnerable to standing water. The Mold Loft could be eligible for the California Register, and the Maintenance garage could support a California register-eligible district.

Seven other properties could be vulnerable to the 100-year storm surge by the long-term scenario including Building 29, the Marinship Warehouse. This building now serves as the Bay Model Visitors Center which houses the US Army Corps of Engineers Bay Model, a working hydraulic scale model of the SF Bay-Delta, completed in 1957.[170] The model is no longer used for research, but open to the public for educational purposes.

Downtown Historic District
The Downtown Historic District is a National Register of Historic Places and on the City of Sausalito Historic Resources Inventory Listing. Overall, there

[169] Robin Petravic (Heath Ceramics), personal communications. July 2016.

[170] US Army Corps of Engineers Bay Model. Last updated August 18, 2016. en.wikipedia.org/wiki/U.S._Army_Corps_of_Engineers_Bay_Model

are 26 National Register District contributing sites, that could experience over nine feet of sea level rise flooding and additional storm surge flooding in the long-term.

Sausalito was an important hub for rail, car and ferry traffic before the Golden Gate Bridge was constructed. During World War II, the city developed rapidly as a shipbuilding center. The Downtown Historic District centers on a ferry terminal with service to San Francisco, is an important area for commerce, and a popular visitor destination. The district is a National Park Service Certified Historic District.[171]

Sea level rise is projected to inundate parts of Sausalito's historic district in the near-term, with storms expanding the vulnerable area and exacerbating impacts. By the long-term scenario with a 100-year storm surge, 26 National Register District contributing sites could be vulnerable. Further analysis could determine specific vulnerability to each building based on location, flood depth, height above grade, materials, etc.

Archaeological Resources
Archaeological resources may be present in the exposure zones.

Table 56 lists example vulnerable assets in Sausalito by onset and flood depth at MHHW. Maps throughout the profile illustrate the developed and natural assets vulnerable to sea level rise and the 100-year storm surge. A 100-year storm surge could add an additional 1 to 3 feet of water to these properties. Note also, above average high tides could impact more properties than accounted for in this analysis.

Table 56. Example Sausalito Vulnerable Assets by Onset and Flooding at MHHW

Asset	Scenarios		
	1	3	5
	Near-term	Medium-term	Long-term
Sausalito Ferry Facilities	No data		
Swedes Beach	Flooded at existing high tides		
Tiffany Beach	Flooded at existing high tides		7'
Marinship Neighborhood	0-13'	4"-14'2"	11"-36'
Marina Plaza Harbor	5'7"	8'6"	21'9"
Dunphy Park	5'1"	5'8"	13'8"
Shops and restaurants	3'6"	4'6"	11'6"
Sausalito Yacht Harbor	4"	1'	3'
Mill Valley/ Sausalito Pathway		0-8'5"	1"-11'8"
Schoonmaker Beach		7'2"	10'1"
Schoonmaker Point Marina		3'3"	8'2"
Clipper Yacht Harbor		2'5"	6'3"
Gate 5 Road		0-2'2"	10"-4'10"
Cass Gidley Marina		2'	3'2"
Turney Street Boat Ramp			8'8"
Yee Tock Chee Park			2'11"
Bay Trail			7"-2'3"
Bridgeway			7"-2'

Source: MarinMap, OCOF, Asset Manager Interviews

[171] Office of Historic Places, accessed July 14, 2016. http://ohp.parks.ca.gov/?page_id=27283

MILL VALLEY

Community Profile: Mill Valley

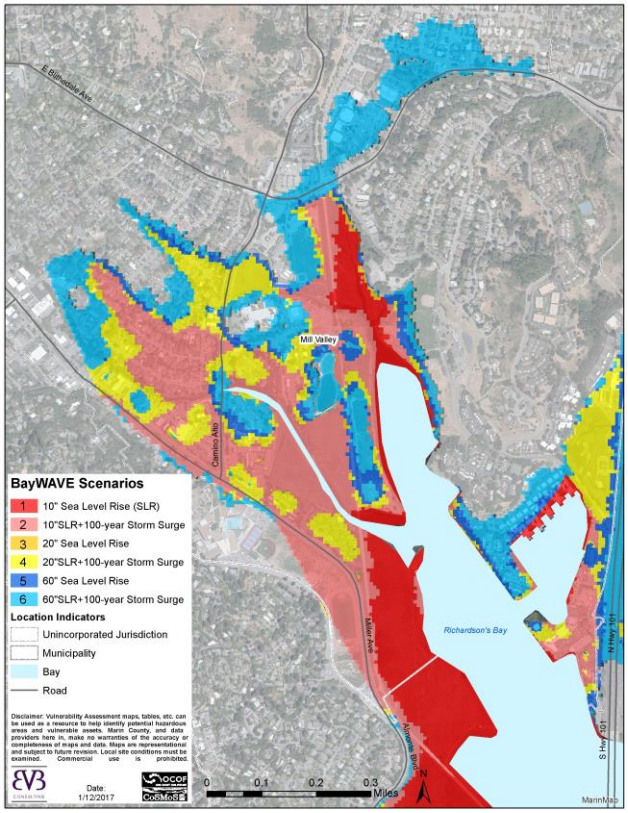
Just north east of Sausalito is Mill Valley. Mill Valley borders Richardson's Bay and extends into the narrow valley. While only a small area of the community could flood tidally, several key access routes and public facilities used by entire communities are in the exposed low lying areas surrounding the Bay. Key issues in Mill Valley are:

- Miller Avenue could be flooded in the near-term. This area already experiences seasonal flooding that extends to Tamalpais High School fields.
- Homes and businesses along and near Shelter Cove, Hamilton Drive, and the Frontage Road could expect near-term flooding impacts.
- The Redwoods, a retirement community, is exposed and completely surrounded, and therefore vulnerable in the medium-term.
- Sanitary Association of Southern Marin (SASM) treatment plant, serving six sanitary districts and 30,000 people, including Mill Valley residents, could expect flooding impacts between the medium and long-term scenarios.
- The Mill Valley-Sausalito Path could flood a majority of the year during average high tides in the medium-term.
- Mill Valley Middle School could expect sea level rise impacts to the grounds, and could expect flood waters reach the buildings with the 100-year storm coincidence.
- Bothin Marsh habitat could transition to mudflats without adequate sediment supply because the marsh does not have options for inland migration.
- Mill Valley Recreation Center fields could be vulnerable to sea level rise in the long-term. A 100-year storm surge could impact nearly the whole site.
- Camino Alto, between Miller and Blithedale Avenues, and the neighborhood north of it, could expect flooding in the long-term.

IMPACTS AT-A-GLANCE: SCENARIO 6

1,000+ living units	13,500+ people
273 acres exposed	25 commercial parcels
5.6 miles of roads	
Storm and tidal impacts already occur	
Nearly $550 million of assessed property value and $830 million in single-family market value vulnerable[172]	Property Owners SASM City of Mill Valley Mill Valley School District

Map 54. Mill Valley Sea Level Rise and 100-year Storm Surge Scenarios



[172] 2016 dollars

MILL VALLEY

Vulnerable Assets

Mill Valley's most vulnerable assets are Miller Avenue, Shelter Bay area, the Sanitary Association of Southern Marin (SASM) treatment plant, and Bothin Marsh. However, by the long-term both the western and northern access routes in to the community could be vulnerable to flooding during a 100-year storm surge. Combined with existing storm water issues, storm impacts from rain and from the bay, or even a king tide, could have devastating impacts on natural and built assets in low-lying areas closest to the shoreline.

Land

Much like other communities in the region, Mill Valley has extensive development upland in the valley and along the valley hillsides. Thus, developable Bayfront land is minimal and intensely utilized. In addition, Mill Valley is fronted with Bothin and Sutton Marshes that serve valuable ecological and physical buffering functions. The areas contribute greatly to the acreage counted.

Acres

In near-term scenario 1, 44 acres of mostly marsh and water's edge land could be vulnerable to monthly tidal flooding at MHHW. In near-term scenario 2, a 100-year storm could flood these and sixty more acres, amounting to 3 percent of Mill Valley's land area. In medium-term scenario 3, roughly 20 more acres could anticipate tidal flooding, and nearly triple this could anticipate storm surge flooding in scenario 4. By the long-term, tidal flooding could extend beyond the marshes and their borders into developed areas. In scenario 5, 190 acres, or 6 percent of acres in the community may be exposed to tidal flooding. In scenario 6, with the additional 100-year storm surge, these 190 acres, plus nearly 100 more could experience storm surge exposure. This indicates that ten percent of the Mill Valley's land area could be exposed to five feet of sea level rise and a 100-year storm surge.

Parcels

Land is divided into parcels for ownership and development purposes. Parcels are assigned land uses and tend to stay true to that designation, though many sites could feature multiple uses, such as commercial with housing included. Examining parcels can provides estimate of how many land uses and human activities may be vulnerable.

Table 57. Mill Valley Exposed Acres by Scenario

Scenarios		Acres	
		#	%
Near-term	1	44	1
	2	103	3
Medium-term	3	62	2
	4	183	6
Long-term	5	190	6
	6	273	9

Source: MarinMap, CoSMoS

Table 58. Mill Valley Vulnerable Parcels by Scenario

Scenarios		Parcels	
		#	%
Near-term	1	80	1
	2	195	3
Medium-term	3	80	1
	4	338	6
Long-term	5	361	6
	6	741	13

Source: MarinMap, CoSMoS

Sutton Marsh habitat and Mill Valley Recreation Center. Credit: Marin County DPW

MILL VALLEY

Table 59. Mill Valley Vulnerable Residential and Commercial Parcels

Land Use	Scenarios					
	1		3		5	
	Near-term		Medium-term		Long-term	
	#	%	#	%	#	%
Residential	74	1	169	1	308	6
Commercial	3	1	3	1	25	10

Source: MarinMap, CoSMoS

Table 60. Mill Valley Vulnerable Parcels by Land Use

Land Use	Scenarios					
	1		3		5	
	Near-term		Medium-term		Long-term	
	#	Ac.	#	Ac.	#	Ac.
Commercial Improved	3	14	3	14	19	27
Commercial Unimproved					6	9
Exemption Improved					4	14
Multi-Family Residential Improved					1	0.13
Single Family Attached	73	1	71	1	184	3
Single Family Residential Improved					122	17
Single Family Residential Unimproved	1	3	1	3	1	3
Tax Exempt	1	6	3	8	21	63

Source: MarinMap, CoSMoS

In scenario 1, exposed acreage is divided into 80 vulnerable parcels. These parcels are essentially all parcels that directly border the water's edge. These consist of several large publically owned parcels and smaller residential parcel. A small number of commercial parcels are impacted. With a 100-year storm surge, scenario 2, 195 parcels, or three percent of all parcels in Mill Valley could be vulnerable to storm surge flooding. In medium-term scenario 4, up to six percent of parcels could be vulnerable to storm surge flooding. These parcels are also likely to experience tidal flooding impacts by long-term scenario 5. Over twice this amount may experience 100-year storm surge flooding by scenario 6.

As shown in Table 59 and Table 60, by land use, less than 1 percent of residential and commercial parcels could experience flooding in the near- and medium-terms. The primary vulnerable land use is tax exempt, or publicly owned. These include parkland, two schools, and a waste water treatment facility. In the long-term, however; several hundred residential parcels, accounting for six percent of all residential parcels in Mill Valley, could be vulnerable to tidal impacts. Residential parcels include the Redwoods retirement community, homes on the Shelter Bay inlet, and homes north or Camino Alto at roughly Sycamore Avenue By this time 25 commercial parcels, 10 percent of commercial parcels in Mill Valley, along Camino Alto and Redwood Highway Frontage Road could also experience tidal flooding.

In long-term scenario 6, even more homes north of Camino Alto could flood, as could the shopping centers east of Blithedale Avenue. With a 100-year storm surge in scenario 6, nearly fifteen percent of residential parcels, and one-third of the commercial parcels could be vulnerable to temporary flooding. Commercial properties that could experience flooding are the Mill Valley Shopping Center in the long-term and the Alto Shopping Center in the long-term with a 100-year storm surge, scenario 6.

Buildings

Many of the vulnerable parcels contain one or more buildings. Flooding to buildings and their contents could result in significant amounts of building and material damage, or worse loss. Relative to other East Marin communities, Mill Valley has a low number of buildings vulnerable to sea level rise and a 100-year storm surge. However, several areas already vulnerable to stormwater backups could expect these conditions to worsen with added saltwater.

Table 61 summarizes the vulnerable buildings in the study area. As shown, in the near-term, a few buildings could expect tidal flooding. In scenario 2, ten inches of sea level rise with a 100-year storm surge; more than 200 buildings could be vulnerable. With respect to sea level rise, the medium-term is similar to the near-term; however, the 100-year storm surge could impact more than a 100 more buildings. In the long-term, the same buildings impacted in scenario 4, could now experience tidal flooding at MHHW. These buildings account for roughly five percent of Mill Valley's building stock. In the long-term with a 100-year storm surge, these figures nearly double over scenario 5 figures to over 500 buildings. Most of these buildings are on residential parcels, though Mill Valley Middle School, the SASM treatment plant, the Mill Valley Recreation Center, and Tamalpais High School are also vulnerable. Vulnerable residential parcels now include homes in the southern end of the Sycamore neighborhood. In addition, buildings in the commercial center buildings along Camino Alto and East Blithedale could face storm flooding.

Most of Mill Valley's buildings are wood-framed. While it is unclear how many buildings are older than 30 years, many in the low-lying areas are. Newer buildings typically have drilled piles 20-30 feet deep with reinforced steel cages and concrete to connect the homes to the foundation. This feature can help buildings withstand lateral forces from wind and water. However, even if buildings remain structurally intact, utility-related equipment could be vulnerable. Moreover, material and content damage from water and salt could occur.

Table 62 divides the vulnerable buildings into flood depth intervals, showing how many buildings could be flooded with one, two or ten feet of tidal flooding during MHHW. This analysis reveals that flood depths are shallow through medium-term. However, by the long-term, nearly 250 buildings could flood with three feet of water, and seventy could be impacted by more than three to five feet of water.

Table 63 estimates costs using FEMA tagging designations for damage to buildings and their contents. This analysis focuses on scenario 6 sea level rise and storm surge conditions, the worst case storm scenario analyzed. If every vulnerable building experienced minor levels of damage, up to $9 million[173] in damages could occur. If all of the buildings impacted under scenario 6 were to become unusable, over $300 million in assessed structural value could be lost.[174] Reality would likely reflect a mix of damage levels. The deterioration and destruction of Mill Valley's commercial and public buildings would have significant impacts on the local economy and sense of place. Having to rebuild or repair buildings after flooding can be traumatic and costly for tax paying residents and business owners.

Table 61. Mill Valley Vulnerable Buildings

Scenarios		Buildings	
		#	%
Near-term	1	5	0
	2	207	3
Medium-term	3	7	0
	4	325	5
Long-term	5	329	5
	6	536	8

Source: MarinMap, CoSMoS

Table 62. Mill Valley Vulnerable Buildings' Average Flood Depth MHHW Estimates

Flood Depth (feet)		Scenarios		
		1	3	5
0.1-1	#		1	32
1.1-2	#		1	96
2.1-3	#			127
3.1-4	#			59
4.1-5	#			12

Source: MarinMap, CoSMoS

** Flood depth data is not available for all exposed assets.*

[173] 2016 dollars
[174] 2016 dollars

Table 63. Mill Valley Vulnerable Building's FEMA Hazus Damage Cost* Estimates for Long-term Scenario 6

Buildings Scenario 6	536
Yellow Tag: Minor Damage **$5,000 minimum**	$2,680,000
Orange Tag: Moderate Damage **$17,001 minimum**	$9,112,536
Red Tag: Destroyed **Assessed structural value**	$300,215,511

*Source: MarinMap, CoSMoS. *2016 dollars*

The maps on the following pages illustrate vulnerable buildings by scenario. The areas in the call out circles enable the reader the see areas that are difficult to see on the large scale map. The circles do not indicate that these areas are more vulnerable than others along the shoreline.

MILL VALLEY

Map 55. Mill Valley Vulnerable Buildings

Vulnerable Assets

- Emergency Shelter
- District Office
- School

Vulnerable Buildings

- Scen. 1: 10" Sea Level Rise (SLR)
- Scen. 2: 10" SLR+Storm Surge
- Scen. 3: 20" Sea Level Rise
- Scen. 4: 20"SLR+Storm Surge
- Scen 5: 60" Sea Level Rise
- Scen. 6: 60"SLR+Storm Surge

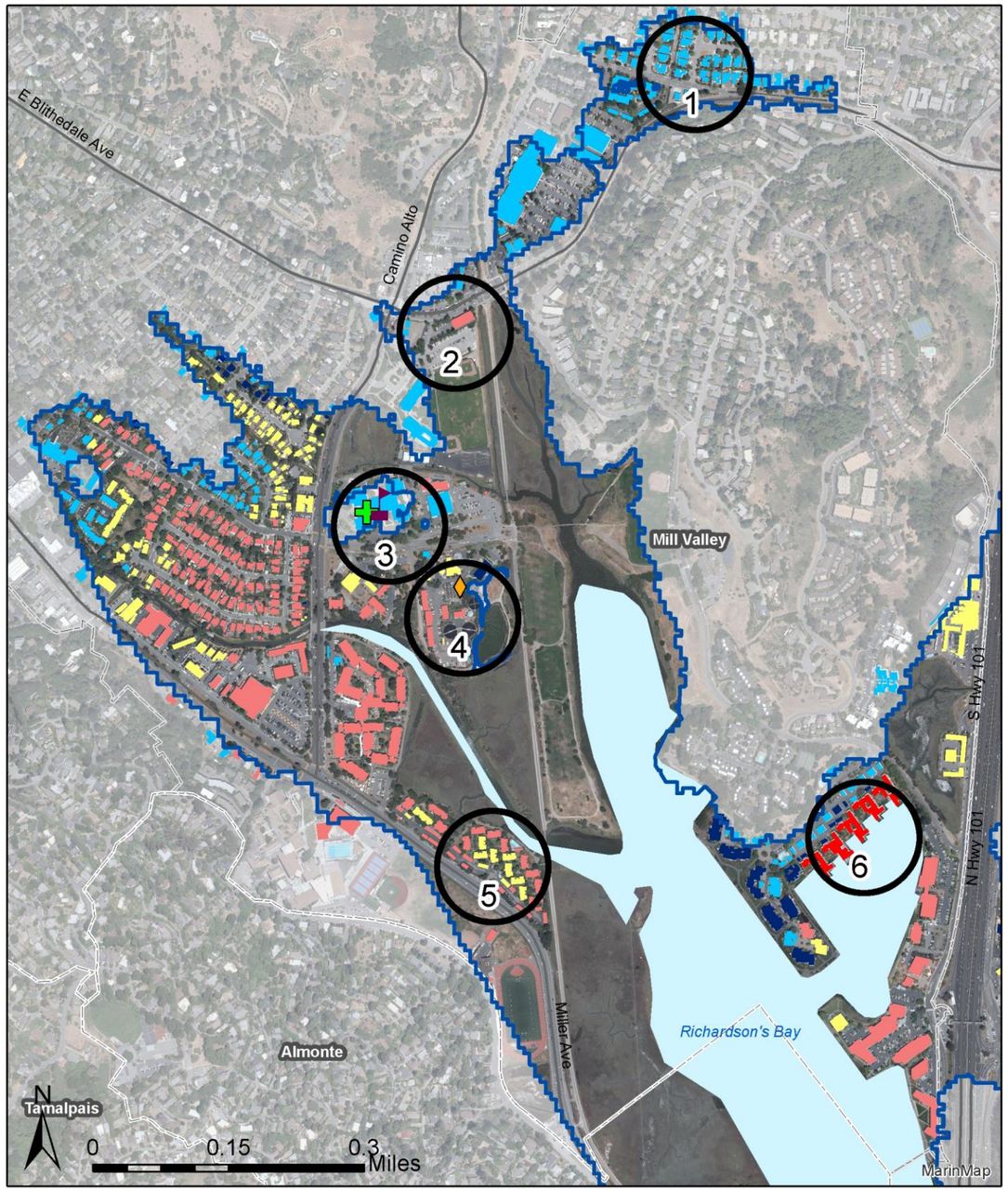
Location Indicators

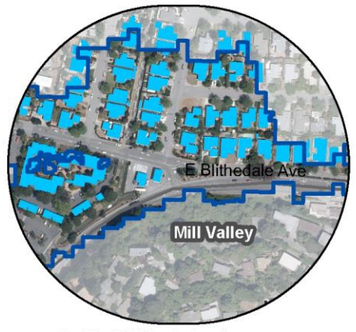
- Unincorporated
- Municipality
- Road
- Bay
- Inland Extent: Sea Level @ 60"+100-year Storm

CONSULTING

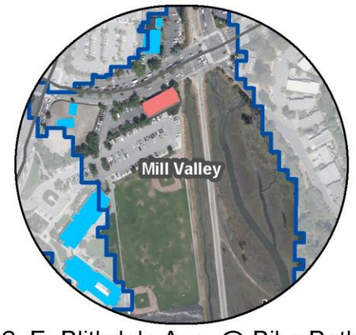
Date: 1/15/2017

CoSMoS

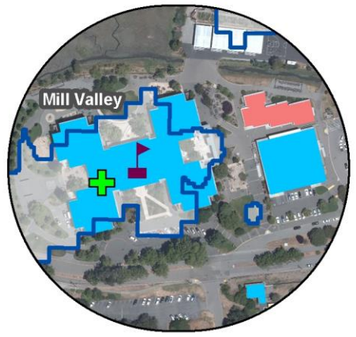




1: E. Blithdale Avenue



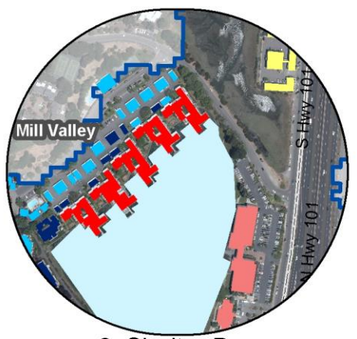
2: E. Blithdale Ave. @ Bike Path



3: Mill Valley Middle School

4: SASM Wastewater Treatment Plant

5: Mill Creek Meadows



6: Shelter Bay

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MILL VALLEY

Mill Valley-Sausalito Path. Credit: J. Poskazner

Transportation

Miller Avenue is the only southwestern access road to Mill Valley, and is vulnerable in the near-term. In fact, this area already experiences seasonal flooding that extends into Tamalpais High School athletic fields, especially combined with rain events. Portions of the road are on a narrow strip of land between businesses, the hillside, and Richardson's Bay, offering little room for inland relocation. Moreover, Miller Avenue is connected to the freeway system through Shoreline Highway in the frequently flooded Manzanita area in Almonte. Miller Avenue serves high school students, commuters, service providers, and suppliers that would face difficulties making it through the narrow corridor when flooded.

The Mill Valley/Sausalito Path for non-vehicular traffic faces a similar fate, though likely sooner due to its marshland location. In addition, the Redwood Highway Frontage Road along U.S Highway 101 southbound is vulnerable in the near-term. In the long-term, Camino Alto, between Miller and Blithedale Avenues**,** could be vulnerable to tidal flooding, as could several smaller neighborhood streets to the north, though with the 100-year storm surge, this area could be impacted temporarily in the medium-term. Blithedale Avenue could expect minor high tide flooding by scenario 5, with more severe flooding with a 100-year storm surge.

Transit routes 4, 8, 17, and 22 could expect tidal and/or temporary storm surge flooding and result in a reduction in service during average high tides at the following Golden Gate Transit bus stops:

- Miller Ave. and Reed St.,
- E Blithedale Ave. and Lomita Dr.,
- E Blithedale Ave. and Roque Moraes Dr.,
- Miller Ave. and Camino Alto, and
- Miller Ave. and Almonte Blvd.

The maps on the following pages illustrate vulnerable transportation features. The areas in the call out circles enable the reader the see areas that are difficult to see on the large scale map. The circles do not indicate that these areas are more vulnerable than others along the shoreline.

Table 64. Mill Valley Vulnerable Transportation Routes

Near-term		Medium-term		Long-term	
Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**	**Scenario 5**	**Scenario 6**
None	**1.5 miles**	**None**	**2 miles**	**3 miles**	**6 miles**
	Redwood Hwy [L] Camino Alto [L] Amicita Ave [L] Gomez Way [P] Miller Ave [L] Nelson Ave [L] Oxford Ave [L] Park Ter [P] Plymouth Ave [L] Frontage Rd [L] Surrey Ave [L] Sycamore Ave [L] Tamalpais Commons Ln [P] Valley Cir [L]		Roads in scenario 2 Hamilton Dr [L] Ryan Ave [L]	Roads in scenarios 2 and 4 E Blithedale Ave [L] Plymouth Cir [L] Roque Moraes Dr [L]	Roads in scenarios 2, 4, and 5 Ashford Ave [L] La Goma St [L] Leyton Ct [L] Lomita Dr [L] Matilda Ave [L] Meadow Rd [L] Nelson Ave [L] Shelter Bay Ave [L] Somerset Ln [L]

M = Marin County; C = State of California; L = Local Municipality; P = Private. Source: MarinMap, CoSMoS

MILL VALLEY

Map 56. Mill Valley Vulnerable Transportation Assets

Vulnerable Assets

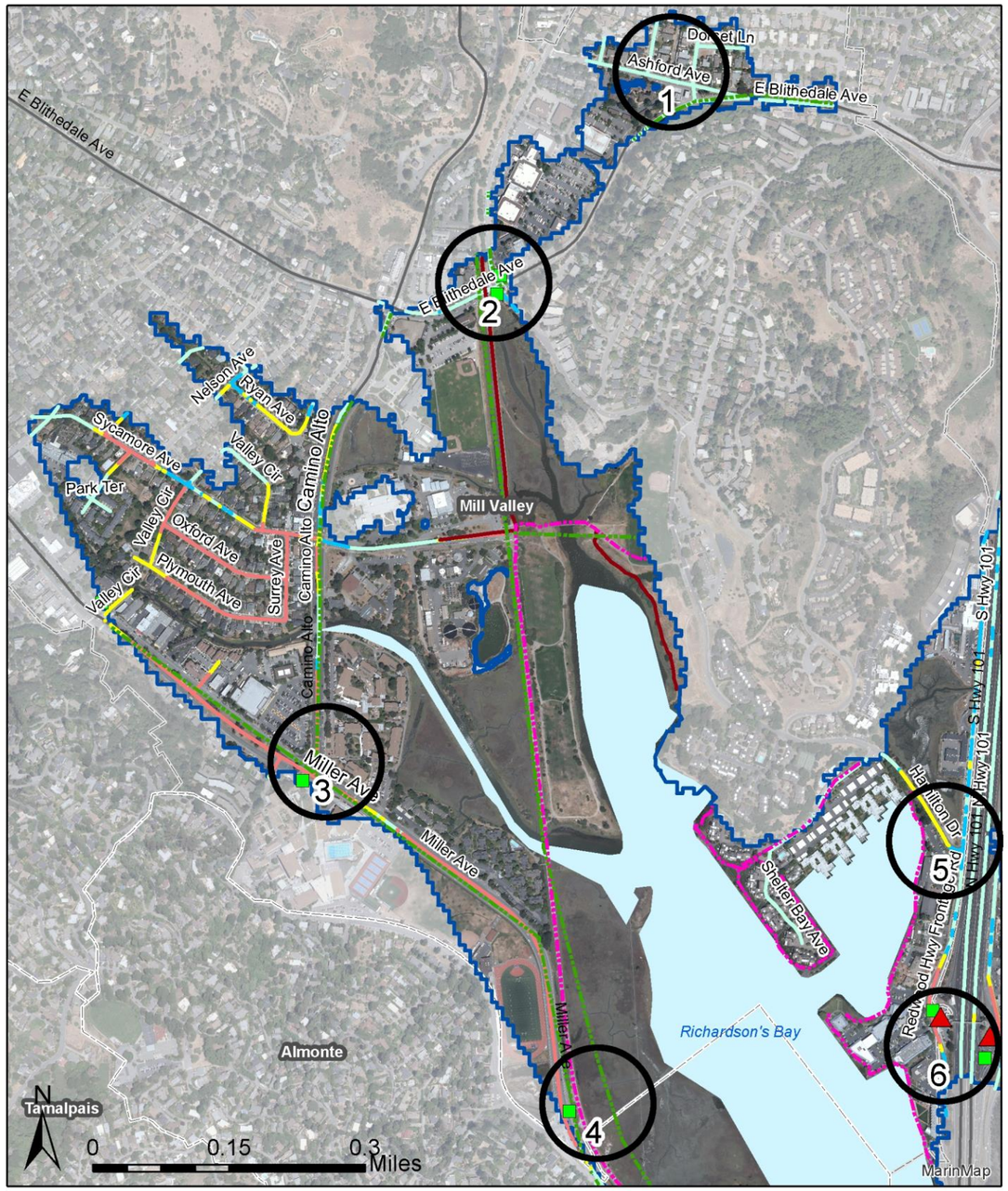
- Bike path
- Bay Trail
- Trail
- GGT Bus Stop

Vulnerable Roads

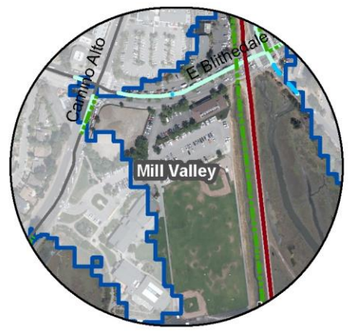
- @10" Sea Level Rise
- @10"+ Storm Surge
- @20" Sea Level Rise
- @20"+Storm Surge
- @60" Sea Level Rise
- @60"+Storm Surge

Location Indicators

- Unincorporated
- Municipality
- Road
- Bay
- Inland Extent: Sea Level @ 60"+100-year Storm

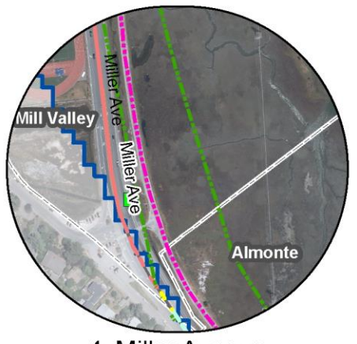


1: E. Blithdale Avenue

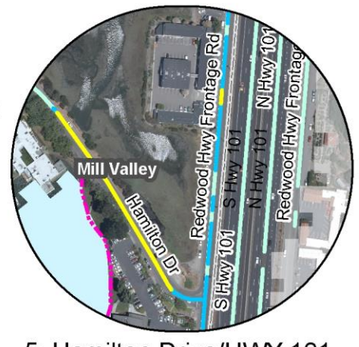


2: E. Blithdale at Bike Path

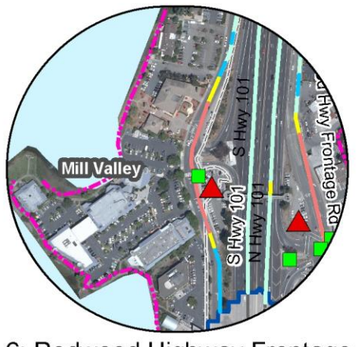
3: Camino Alto @ Miller Avenue



4: Miller Avenue



5: Hamilton Drive/HWY 101



6: Redwood Highway Frontage Road @ HWY 101

Date: 1/15/2017

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MILL VALLEY

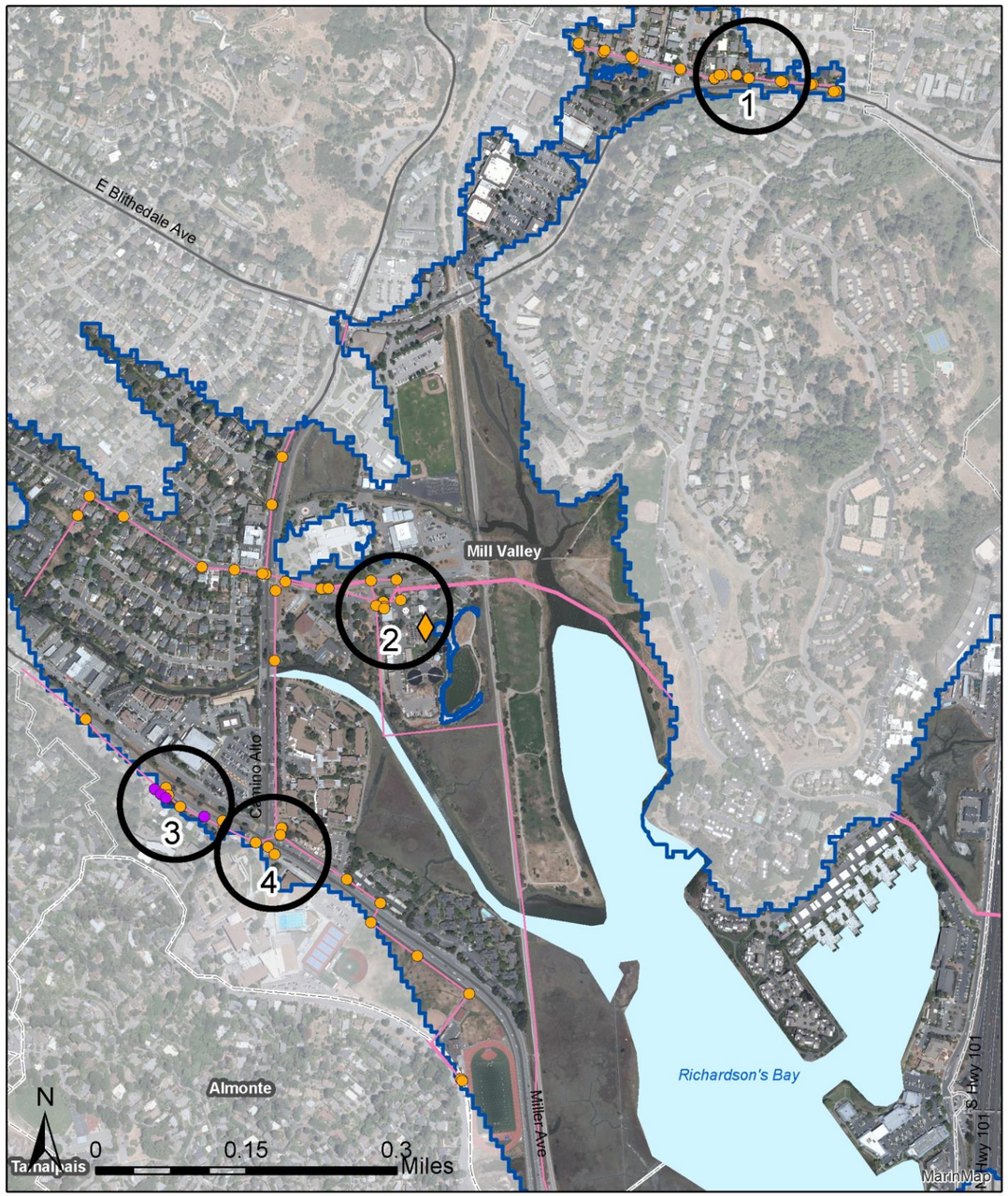
Map 57. Mill Valley Vulnerable Sanitary Sewer Assets

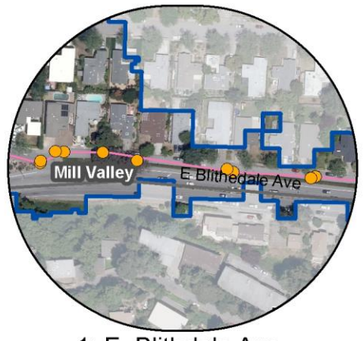
Vulnerable Assets

- Residential Lateral
- Manhole
- Pump Station
- Pipe
- Treatment Plant

Location Indicators

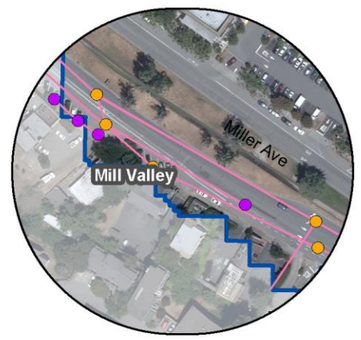
- Unincorporated
- Municipality
- Road
- Bay
- Inland Extent: Sea Level @ 60"+100-year Storm Surge



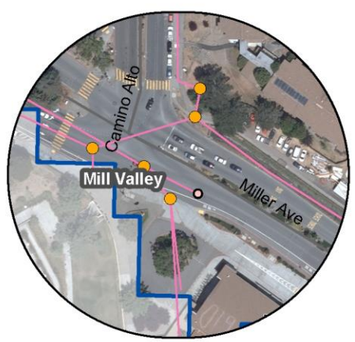


1: E. Blithdale Ave.

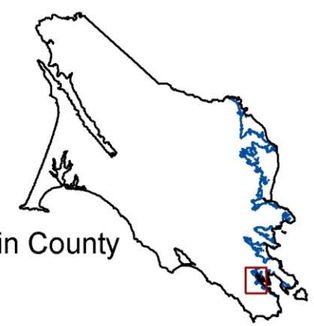
2: SASM



3: Miller Ave.



4: Miller Ave. @ Camino Alto



EVB CONSULTING

Date: 2/9/2017

OCOF CoSMoS

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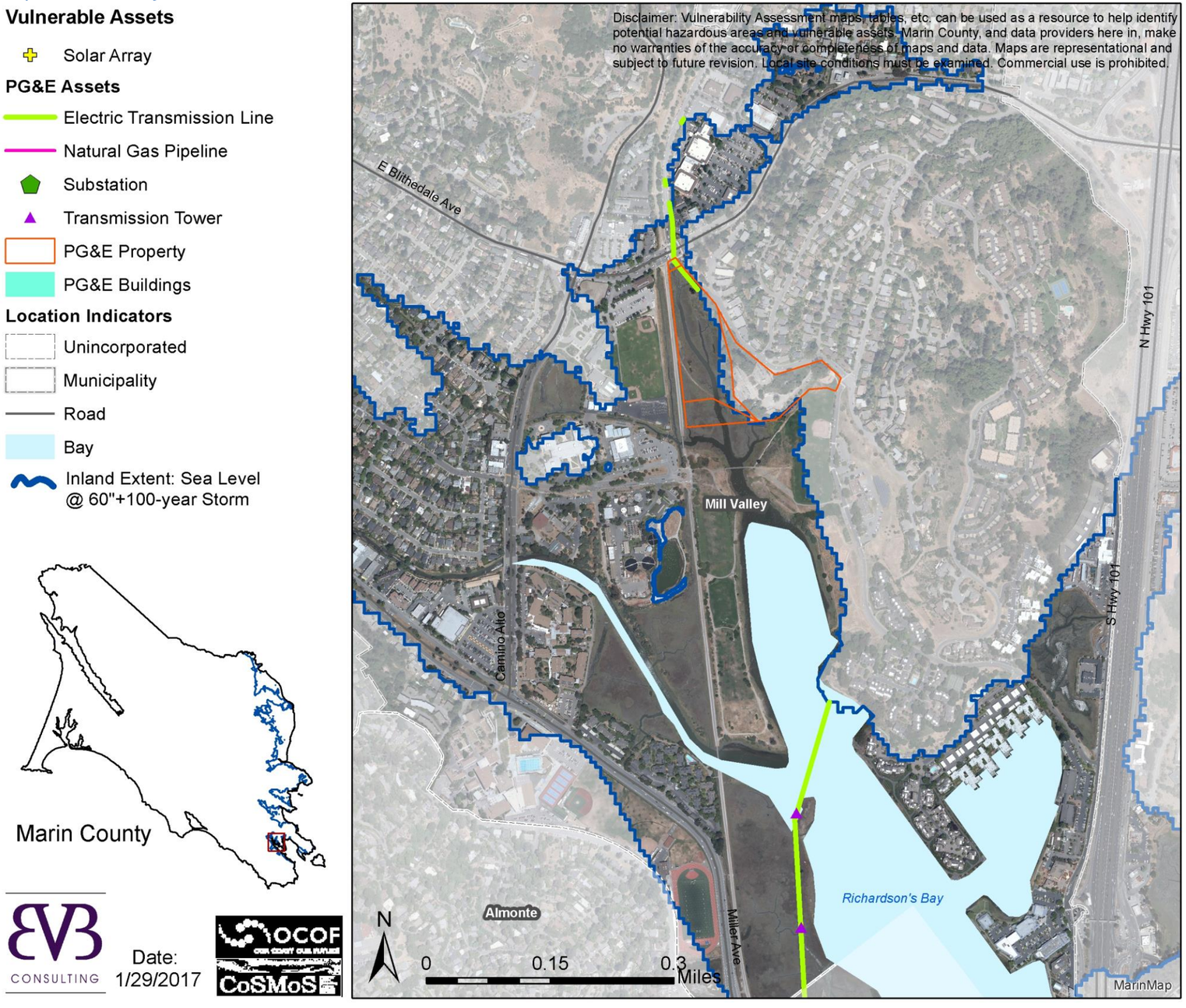
MILL VALLEY

Map 58. Mill Valley Vulnerable Gas & Electric Assets



MILL VALLEY

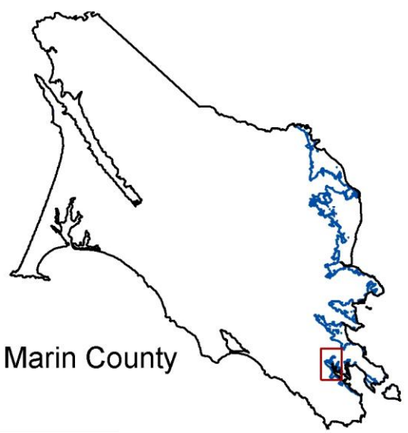
Map 59. Mill Valley Vulnerable Stormwater Assets

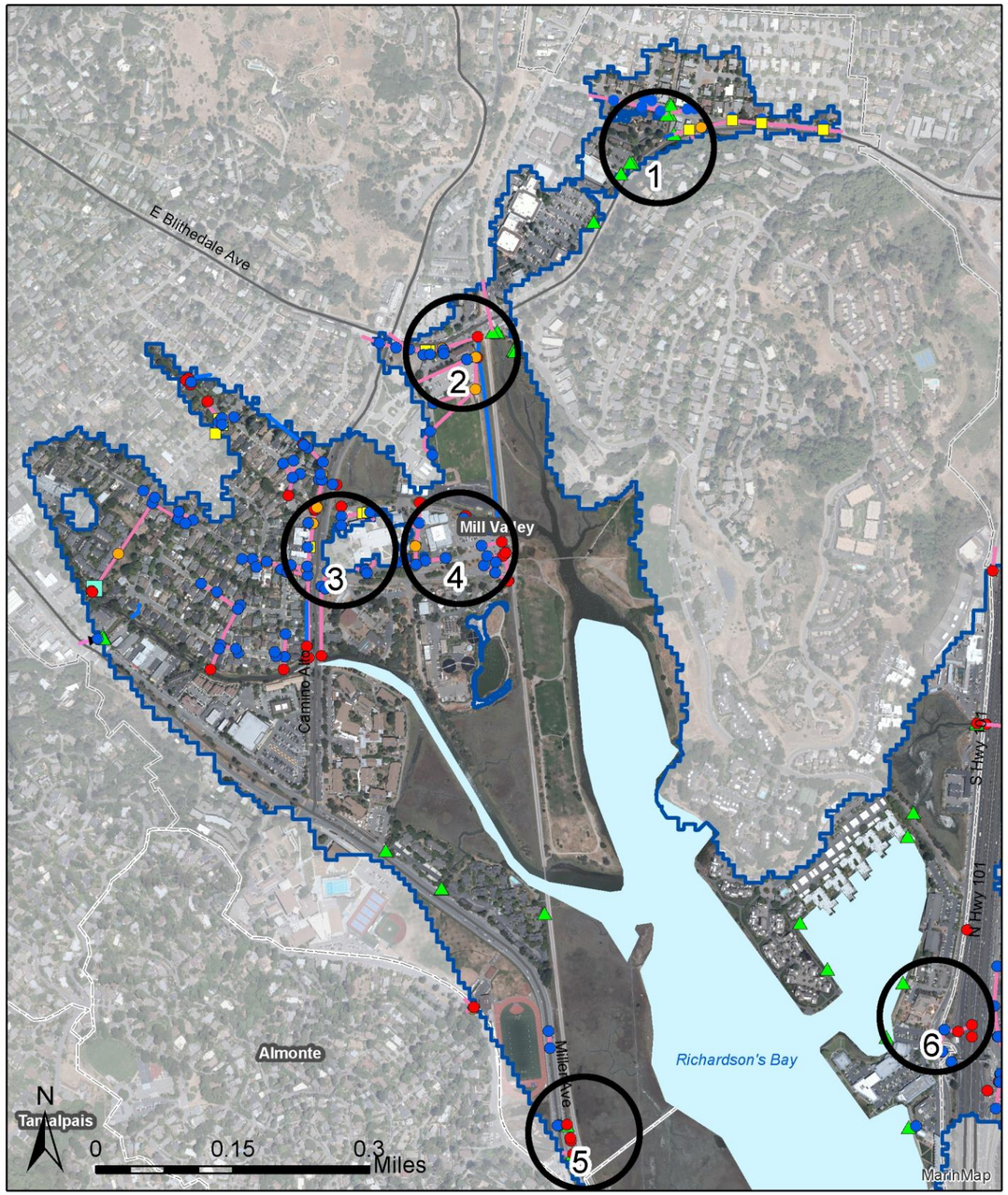
Vulnerable Assets

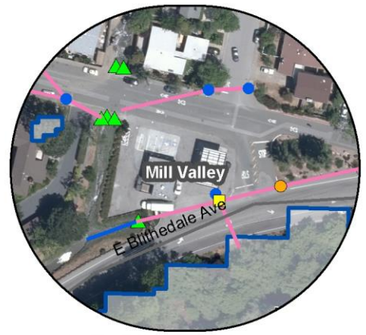
- Catch Basin
- Manhole
- Structures
- Pipe Inlet/Outlet
- Culvert
- Channel
- Stormwater Pipe

Location Indicators

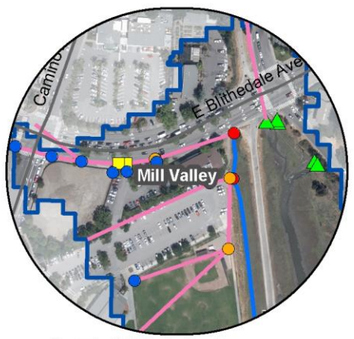
- Unincorporated
- Municipality
- Road
- Bay
- Inland Extent: Sea Level @ 60"+100-year Storm





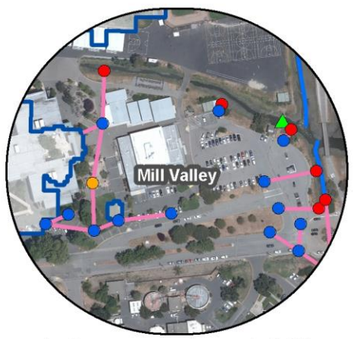


1: E. Blithdale Avenue

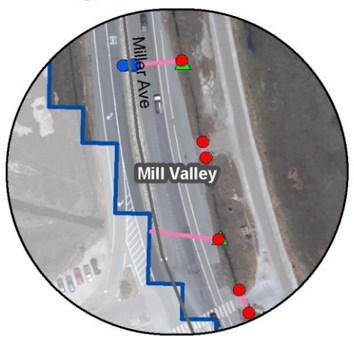


2: E. Blithdale Avenue @ Camino Alto

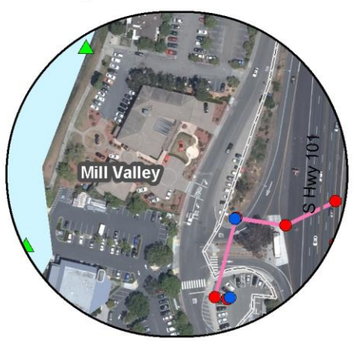
3: Camino Alto @ Sycamore Ave.



4: Sycamore Ave. @ Mill Valley/Sausalito Bike Path



5: Miller Avenue



6: Redwood Highway Frontage Rd.

Date: 1/28/2017

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Utilities
The key vulnerable utility asset is the SASM treatment plant. This plant serves tens of thousands of people at their homes, business, and places of study, work, and worship. If the treatment plant is compromised, even dry hillside homes could suffer breakdowns in the system if no action is taken to protect or relocate the plant. For more information on SASM vulnerabilities see the Utilities Profile.

Other concerns include those common to other communities, such as:

- Underground pipes face compounding pressure forces from water and the road,
- Road erosion and collapse with underlain pipes,
- Saltwater inflow and infiltration causing inefficiencies in wastewater treatment,
- Continuously subsiding soils or fill, and
- Escalating activity, capacity demands, energy consumption, and wear and tear on pump stations in stormwater and wastewater systems,
- Aging individual site connections for water, sewer, and electrical, and
- Flood waters interrupting access for employees to reach work sites.

The maps on the previous pages illustrate vulnerable utility features. The areas in the call out circles enable the reader the see areas that are difficult to see on the large scale map. The circles do not indicate that these areas are more vulnerable than others along the shoreline.

Natural Resources
Bothin Marsh and its smaller connected marshes, such as Sutton Marsh, and Shelter Bay habitats could be vulnerable to sea level rise in the near-term. The habitat serves for bird, rodent, insect, and water loving species. Factors that could impact the habitat are increased salinity, higher water levels, increased erosion, and road and building barriers to inland migration.

The longfin smelt and Ridgway's Rail are the listed species recorded in Bothin Marsh. The smelt is listed as threated on the California list and a candidate on the federal list. The largest longfin smelt population occurs in the San Francisco Estuary and Sacramento-San Joaquin Delta. This species occupies bay waters throughout summer and moves into lower reaches of rivers in fall to spawn. Other important fish species sensitive to changes in environmental conditions that could occur in Richardson's Bay are:

- Chinook salmon
- Delta smelt:
- Green sturgeon
- Pacific herring, and
- Steelhead.

The Ridgway's rail is one of the largest rails in North America. The Ridgway's rail is very secretive and occurs primarily in salt and brackish marshes with pickleweed and cordgrass. Rails were detected in Bothin Marsh Preserve, Mill Valley.[175] The Western snowy plover is a small shorebird that nests on and near the shores of the San Francisco Bay and may forage in Richardson's Bay. Other unique and valuable bird species common in the area are:

- California brown pelican,
- California least tern,
- Double-crested cormorant,
- San Francisco common yellowthroat, and
- San Pablo (Samuels) song sparrow.

Insects, such as the Monarch butterfly, could also be vulnerable to impacts to their habitat. Finally, numerous special status plants with habitats that are expected to be vulnerable to sea level rise are:

- Franciscan thistle,
- Hairless popcornflower,
- Marin western flax,
- Oregon polemonium,
- Point Reyes salty bird's-beak,
- Tiburon buckwheat,
- Tiburon paintbrush, and
- White-rayed pentachaeta.[176]

To learn more about these species, see the Natural Resources Profile.

[175] Wood, J., L. Salas, N. Nur, M. Elrod, J. McBroom. 2013. Distribution and population trends for the Endangered California Clapper Rail. State of the Estuary Conference, 26 October 2013, Oakland, CA.
[176] Prunuske Chatham, Inc. March 2016. Draft Biological Resources Assessment: Dunphy Park Improvement Project Sausalito, Marin County.

Recreation
The vulnerable Mill Valley marshes are a popular recreational destination for locals and visitors alike. This loss could have negative effects on the sense of place and local economy. The Mill Valley-Sausalito pathway through the marshes could be flooded out more often and degraded more quickly. Strong enough storm waters could even damage the wooden pathways structural integrity. Capacity reductions would impact bikers, skaters, runners, and walkers of all ages.

The Mill Valley Recreation Center could expect impacts to the ball fields and some ancillary buildings from long-term sea level rise. A 100-year storm could flood out the majority of the property and access could be compromised. The primary buildings are elevated beyond MHHW; however, by the end of the century, they could be impacted by the highest high tides, especially during and immediately following a rain event.

In addition, the guest serving Acqua Hotel on Shelter Bay and the Travel Lodge may be vulnerable in the long-term, and nearby restaurants may be vulnerable in the medium-term.

Emergency Services
The primary concern for Mill Valley emergency services is vehicular access to and through flooded areas in emergencies. Delayed service could lead to worse injury or worse, loss of life.

Cultural Resources
Mill Valley's inventoried historic assets are located outside of the exposure zones.

Example assets are presented Table 65 and described in the subsequent sections. A 100-year storm surge would add an additional 1 to 3 feet of water to these properties. Note also, above average high tides could impact more properties than accounted for in this analysis. The maps on the following pages illustrate vulnerable natural resource, recreation, emergency and historic features. The areas in the call out circles enable the reader the see areas that are difficult to see on the large scale map. The circles do not indicate that these areas are more vulnerable than others along the shoreline.

Table 65. Example Mill Valley Assets Vulnerable to Sea Level Rise by Onset and Flood Depth at MHHW

Asset	Scenarios		
	Near-term	Medium-term	Long-term
	1	3	5
Hwy 101 commercial	0-4"	9"-1'3"	2'-3'2"
Mill Valley/ Sausalito Pathway		0-8'5"	1"-11'8"
Bay Trail		0-8'	3"-12'5"
Mill Valley Shopping Center		1'2"-7'	6"-2'6"
Sycamore neighborhood		2"-2'2"	4"-4'7"
Miller Avenue		0-1'7"	2'-4'8"
SASM treatment plant		6"-11"	1'2"-2'5"
Shelter Bay neighborhood		2"-9"	6"-1'10"
The Redwoods		7"	1'7"
Sycamore Ave			0-4'7"
Camino Alto (between Miller and Blithedale Avenues)			2"-3'6"
Mill Valley Middle School temp buildings			1'2"
E. Blithedale Avenue			1"
Tamalpais High fields	No data		
Bothin Marsh	Floods at existing high tides		
Arroyo Corte Madera Del Presidio	Water resource		

Source: MarinMap, CoSMoS

MILL VALLEY

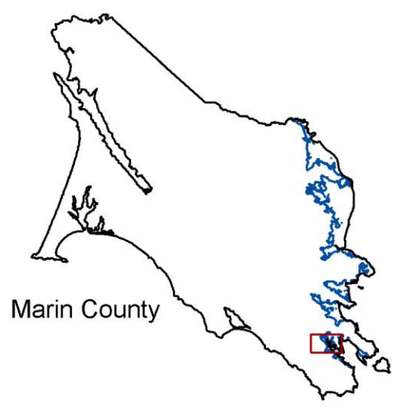
Map 60. Mill Valley Vulnerable Natural Resource Assets

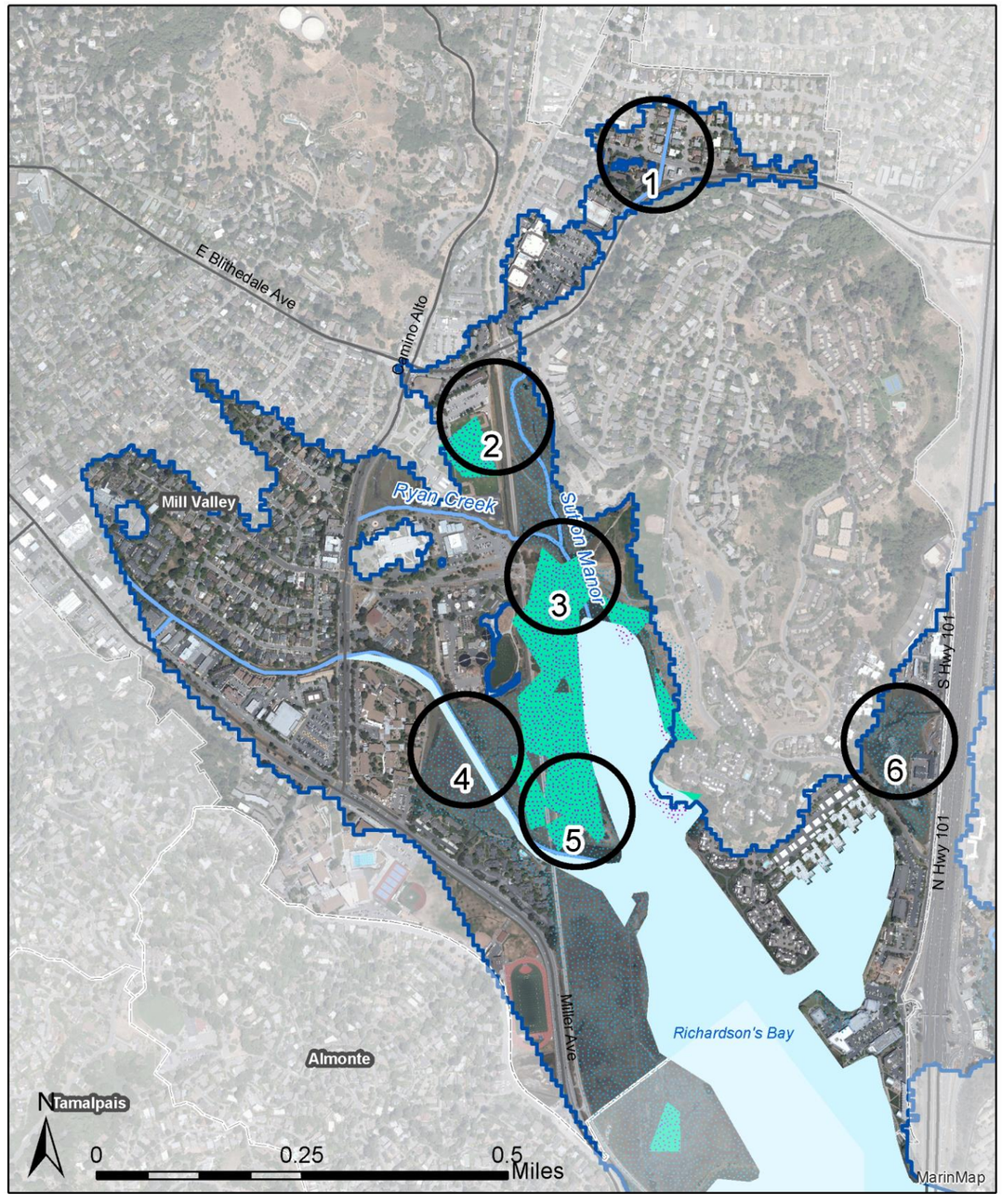
Vulnerable Assets

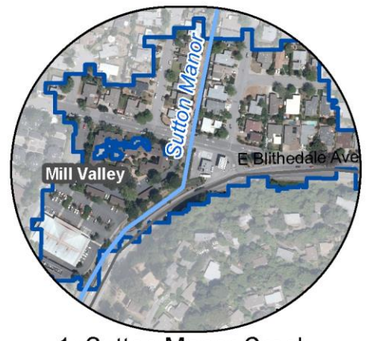
- Streams
- Marsh
- Estuary
- Wetland

Location Indicators

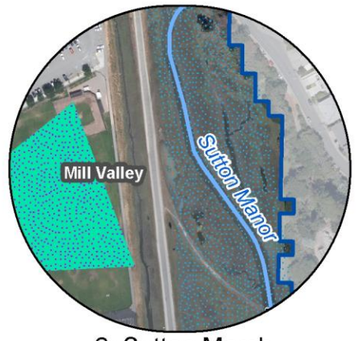
- Unincorporated
- Municipality
- Road
- Bay
- Inland Extent: Sea Level @ 60"+100-year Storm



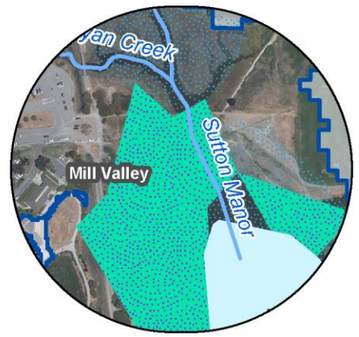




1: Sutton Manor Creek

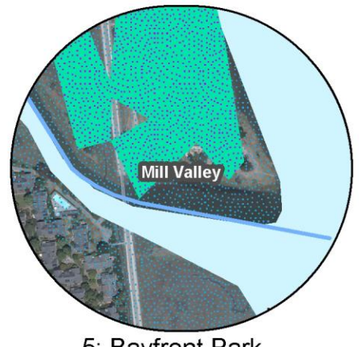


2: Sutton Marsh

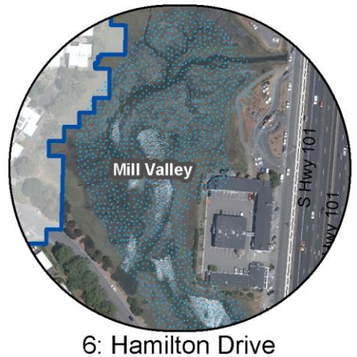


3: Bayfront & Hauke Parks

4: Arroyo Corte Madera del Presidio



5: Bayfront Park



6: Hamilton Drive

Date: 1/24/2017

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MILL VALLEY

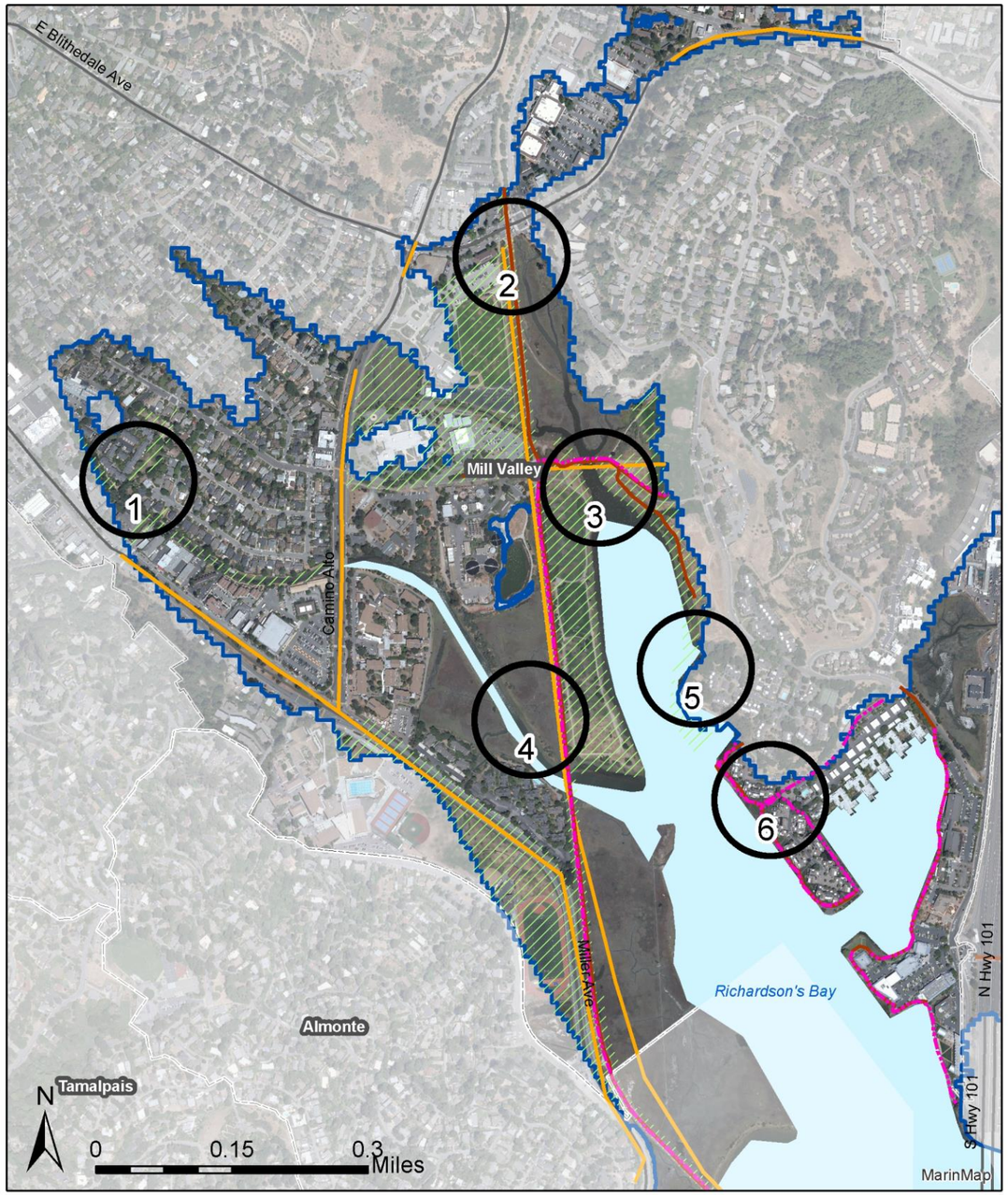
Map 61. Mill Valley Vulnerable Recreation Assets

Vulnerable Assets

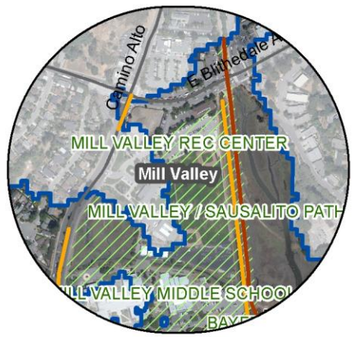
- Bay Trail
- Trail
- Bikeway
- Park

Location Indicators

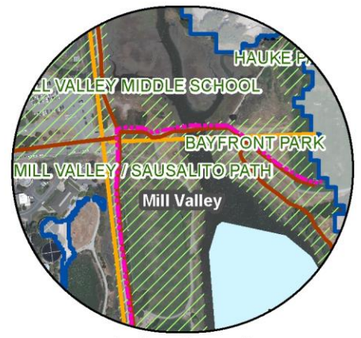
- Unincorporated
- Municipality
- Road
- Bay
- Inland Extent: Sea Level @ 60"+100-year Storm



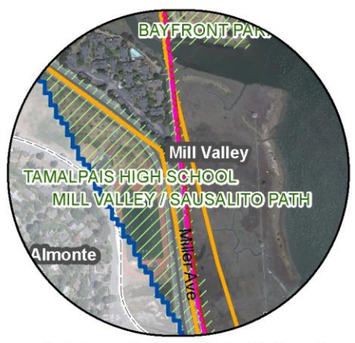
1: Sycamore Park



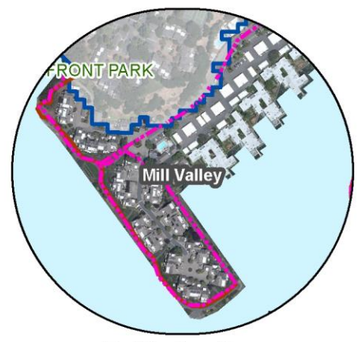
2: Mill Valley Recreation Center



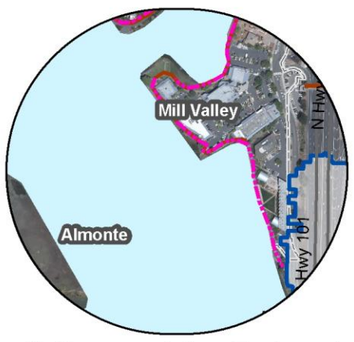
3: Bayfront & Huke Parks



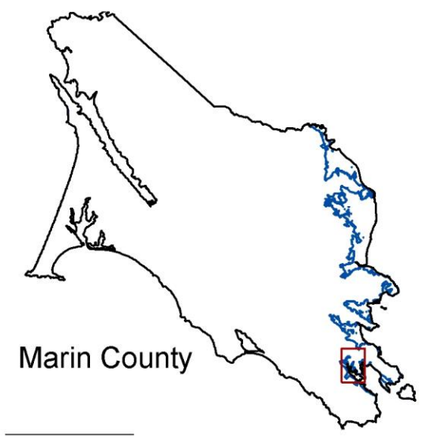
4: Tamalpais High School



5: Shelter Bay



6: Commercial on Redwood Hwy. Frontage Rd.



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MILL VALLEY

Map 62. Mill Valley Vulnerable Emergency Services

Vulnerable Assets

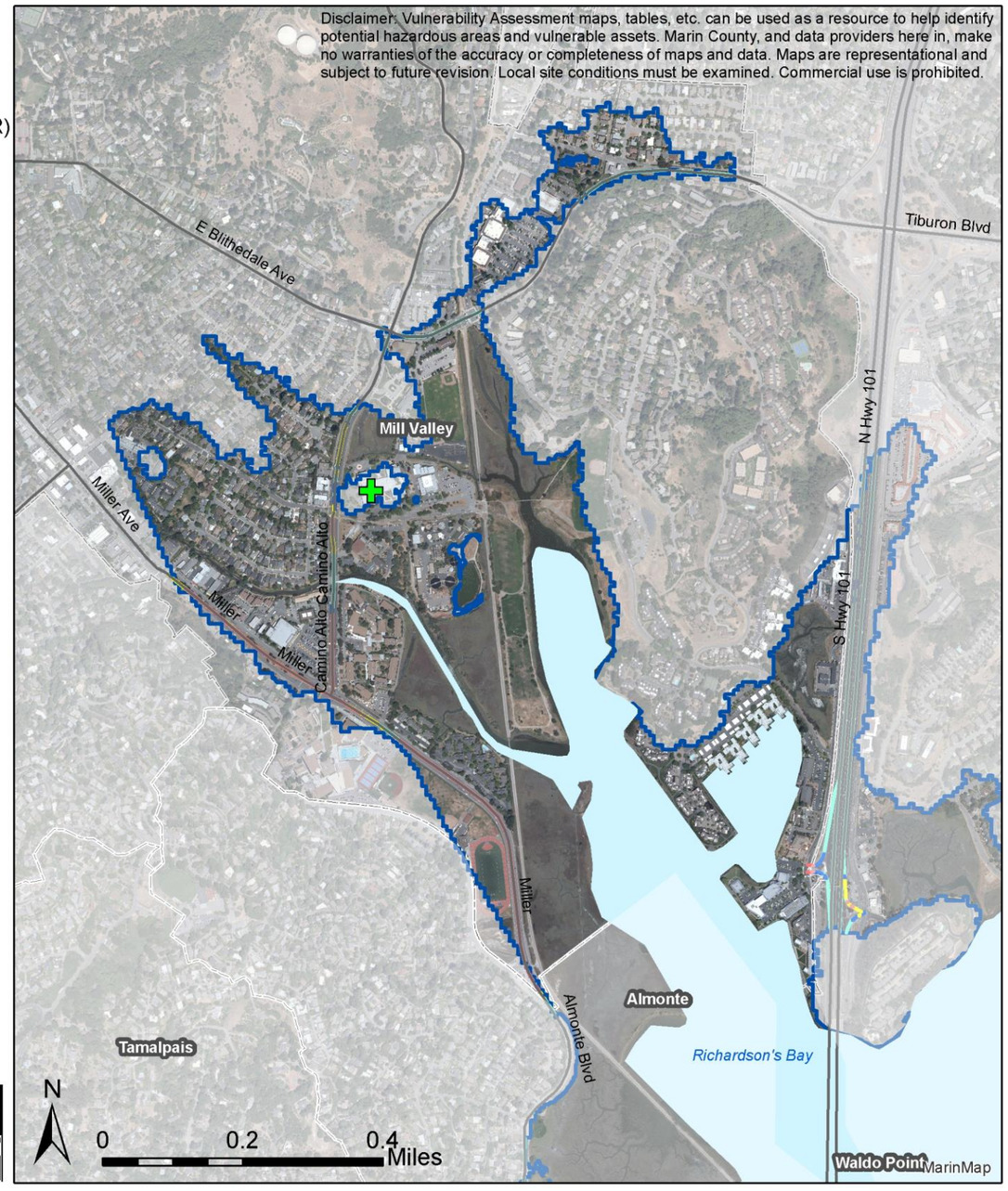
Emergency Shelter

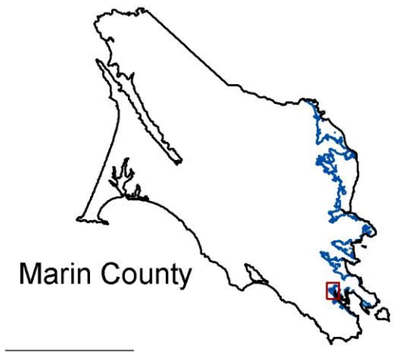
Vulnerable Arterials & Highways

@ Scen. 1: 10" Sea Level Rise (SLR)
@ Scen. 2: 10"SLR+Storm Surge
@ Scen. 3: 20"SLR
@ Scen. 4: 20"SLR+Storm Surge
@ Scen. 5: 60"SLR
@ Scen. 6: 60"SLR+Storm Surge

Location Indicators

Unincorporated
Municipality
Road
Bay
Inland Extent: Sea Level @ 60"+100-year Storm





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BELVEDERE

Community Profile: Belvedere

Belvedere is a unique shoreline community, because it used to be an island before fill was used to create the lagoon, or flats, neighborhood. The primary impacts here are to housing. In the near-term, 24 acres could be exposed to sea level rise. By the long-term, 169 acres could be exposed to sea level rise and 180 acres could be exposed with an additional 100-year storm surge. Key sea level rise vulnerabilities include:

- San Rafael Avenue could be impacted after the medium-term, cutting off the first access point to the community.
- Shoreline homes along West Shore and Beach Roads could expect impacts to utilities in the near and medium-terms, and potential structural impacts to any in water structures during storms, especially in the long-term.
- Homes in the flats would be vulnerable to sea level rise flooding if the levees are overtopped. Note that the homes on the lagoon could also flood, however the model may overestimate the flooding intensity. These homes are also vulnerable to worsening subsidence.
- The Belvedere Corp Yard could be vulnerable to storm surge flooding in the near-term and tidal flooding in the long-term.
- The City Hall, Community Center, and Police Department share the same buildings that could expect impacts in the long-term, especially during storms. The park facility and roads fronting the building could expect flood waters sooner, creating potential access issues.

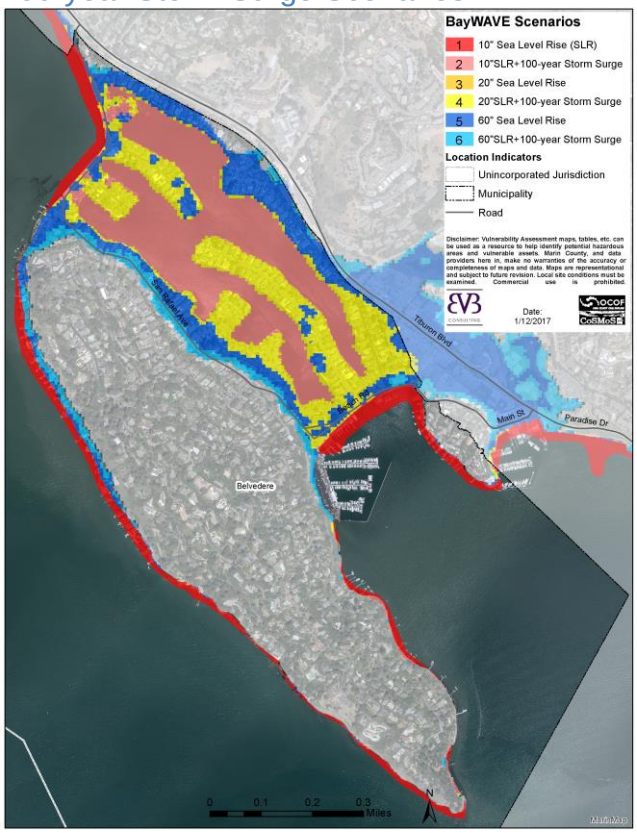
Vulnerable Assets

The assets most vulnerable to sea level rise and storm surges in Belvedere are single-family residential homes and San Rafael Avenue. With respect to the impacts to lagoon side homes, it is important to note that the CoSMoS model treats the tide gate closing the lagoon from incoming tide waters as open. This assumption may overestimate flooding levels and prematurely estimate onset of flooding. The following sections detail these vulnerabilities.

IMPACTS AT-A-GLANCE: SCENARIO 6

550 living units	2,000+ people
180 acres exposed	4 commercial parcels
3.7 miles of roads	
Seasonal storm flooding already occurs	
$8.6 million in assessed property; $1.4 billion in single-family housing market value[177]	Property Owners City of Belvedere

Map 63. Belvedere Sea Level Rise and 100-year Storm Surge Scenarios



Source: MarinMap, CoSMoS. Credit: BVB Consulting LLC

[177] 2016 dollars

BELVEDERE

Belvedere Lagoon homes. Credit: Wiki Commons

Table 66. Belvedere Exposed Acres

Scenarios		Acres	
		#	%
Near-term	1	24	2
	2	85	6
Medium-term	3	24	2
	4	130	9
Long-term	5	169	12
	6	180	12

Source: MarinMap, CoSMoS

Table 67. Belvedere Vulnerable Parcels

Scenarios		Parcels	
		#	%
Near-term	1	51	5
	2	56	6
Medium-term	3	52	5
	4	210	21
Long-term	5	356	36
	6	495	50

Source: MarinMap, CoSMoS

Land

Belvedere was an island until it was connected to Tiburon with fill on bay mud. Because of this several homes in the lagoon neighborhood could be vulnerable to subsidence and several have sunk below mean sea level. Much of this area is protected from the Bay by a levee wall on the north and a wall with tides gates to the south. The tide gates allow water into a central lagoon. Note that the CoSMoS model treats these gates open, when city engineers have the ability to close the gates to reduce tidal influences on the internal lagoon.

Acres

Belvedere is essentially two hill side and top neighborhoods and a lagoon neighborhood. The first acreages claimed by tidal waters are those along the bluff side of Belvedere Island. In time, the lagoon area and the area extending into Tiburon could face tidal and storm surge flooding.

In near-term scenario 1, two percent, or 24 acres of Belvedere could face tidal flooding at MHHW. Flooded acreage could more than triple with the onset of a 100-year storm surge. The same acreage could be vulnerable in the medium-term as the near-term due to sea level rise alone. A 100-year storm surge could impact almost ten percent of the acre sin Belvedere. In long-term scenario 5 and 6, less than 200 acres, or 12 percent of Belvedere could be vulnerable to sea level rise and a 100-year storm surge, including the entire lagoon neighborhood.

Parcels

This land area is divided into parcels. Most parcels in the community are residential in use; however, a few commercial and public parcels are also vulnerable. As shown in Table 67, in the near-term, 51 water's edge parcels on Belvedere and Corinthian Islands could be vulnerable to sea level rise, as are a few on the southern end of the Belvedere lagoon. A significant jump in parcels could flood in the medium-term with a 100-year storm surge, when levee protecting the lagoon neighborhood are overtopped. In long-term scenario 5, sea levels are high enough at mean higher high water to over top the levee walls and flood most of the lagoon area, amounting to more than 30 percent of the parcels there. With a 100-year storm nearly every parcel in low-lying Belvedere could flood, accounting for a striking half of all parcels in the community.

BELVEDERE

Table 68 shows that over 30 percent of residential and commercial parcels in Belvedere could be vulnerable to sea level rise. The majority of these properties are in the low lying lagoon area. Thirty percent of residential parcels would be a considerable loss of over 300 parcels. Most of these parcels are single family residential. Some multi-family parcels could be vulnerable as well.

Table 68. Belvedere Vulnerable Residential and Commercial Parcels

Land Use	Scenarios					
	Near-term		Medium-term		Long-term	
	1		3		5	
	#	%	#	%	#	%
Residential	46	5	47	5	324	37
Commercial					4	33

Source: MarinMap, CoSMoS

Table 69. Belvedere Vulnerable Parcels by Land Use

Land Use	Scenarios					
	1		3		5	
	Near-term		Medium-term		Long-term	
	#	Ac.	#	Ac.	#	Ac.
Commercial Improved					4	3
Common Area					10	64
Exemption Improved					2	0.4
Residential	46	10	47	10	324	70
Multi-Family Improved	3	2	3	2	14	12
Single Family Attached					4	0.1
Single Family Improved	40	8	41	8	303	57
Single Family Unimproved	3	0.3	3	0.4	3	0.5
Tax Exempt	5	1	5	1	16	3

Source: MarinMap, CoSMoS

Buildings

The most vulnerable buildings are in the flats, or lagoon area, and those directly above the bay on the bluff edge on West Shore Road and Beach Road. Some may extend over the water on piers or feature overhanging decks. According to Belvedere managers, some of these homes have vents and other utility lines under the homes that could be vulnerable to increased saltwater exposure. In the low-lying areas, homes in the area could be vulnerable in the medium to long-term time horizon if the levees are overtopped and the lagoon is left under tidal influence. Even if the lagoon is managed well enough to keep those homes bordering it dry, these homes may become isolated if tidewaters overtop the levees lining San Rafael Avenue and Beach Road, or Tiburon's downtown streets. Looking at the CoSMoS model interactive map, the levees surrounding the lagoon area are topped at 3 feet of sea level rise, though significant impacts could occur between scenarios 3 and 5. In the lagoon area, many of the original homes were, or are being, replaced with newer construction.

In addition, the city corporation yard is vulnerable in the medium-term to low levels of flooding and over one foot of flooding at MHHW in the long-term. The remaining community center, police department, and city hall, which share a building, could expect impacts during storms to the surrounding property, face access issues in the medium-term, and flood with up to four feet of tide waters by scenario 5.

As seen in Table 70, in the near-term, 32 buildings could be compromised. The number of buildings impacted by 20 inches of sea level rise doubles, and nearly three times as many are impacted by the 100-year storm surge in scenarios 2 and 4. In the long-term, from sea level rise alone, around 400 buildings could be vulnerable to sea level rise.[178] Table 71 divides the vulnerable buildings by flood depth in one-foot intervals, showing how many buildings could flood with one, two, or ten feet of salt water at MHHW. A 100-year storm surge would add 1 to 3 feet of water.

[178] The CoSMoS model may over predict flooding in the lagoon system. The model treats the lagoon as tidal, when, in fact, the lagoon water levels are managed through tide gates for seasonal water fluctuations.

BELVEDERE

Table 70. Belvedere Vulnerable Buildings

Scenarios		Buildings	
		#	%
Near-term	1	32	2
	2	84	5
Medium-term	3	65	4
	4	90	5
Long-term	5	423	24
	6	470	27

Source: MarinMap, CoSMoS

Table 71. Belvedere Tidal MHHW Flood Depth* Estimates for Vulnerable Buildings

Flood Depth (feet)	Scenarios		
	Near-term	Medium-term	Long-term
	1	3	5
0.1-1	10	6	8
1.1-2	14	16	31
2.1-3	13	14	65
3.1-4	5	10	52
4.1-5	3	2	89
5.1-6	2	3	124
6.1-7		1	46
7.1-8			5
8.1-9			1
9.1-10			1

**Flood depth data is not available for all exposed assets.*
Source: MarinMap, CoSMoS

Table 72. Belvedere Vulnerable Buildings FEMA Hazus Damage Cost Estimates in Long-term Scenario 6

Buildings Scenario 6	470
Yellow Tag-Minor Damage **$5,000 minimum**	$2,350,000
Orange Tag: Moderate Damage **$17,001 minimum**	$7,990,470
Red Tag-Destroyed **Assessed structural value**	$356,209,805

Source: MarinMap, CoSMoS
**2016 dollars*

In near-term scenario 1, of the buildings with an associated flood depth, ten buildings could expect 1 foot of flooding. If a building is elevated from the ground by more than this amount the floor boards of the building may remain dry, however, any equipment, and the property in general, would be wet and could be damaged on a regular basis. Thirty buildings could face flood levels of over one to three feet, and an addition al ten could experience up to six feet of flood water. In the medium-term, most buildings could flood with more than 1 foot to three feet of salt water, with 20 buildings experiencing flooding deeper than three feet up to seven feet. In long-term scenario 5, flooding could exceed seven feet and reach up to 10 feet at MHHW. Roughly 300 buildings could expect saltwater flooding over three feet up to seven feet. About 100 buildings could anticipate less than three feet of saltwater flooding at MHHW. Tidal flooding at these levels may require a dramatic shift in use and design is use of the properties is still desired moving forward.

Applying the FEMA post-storm damage tagging levels described in the Buildings Profile reveals that minor damage to all of the buildings flooded in scenario 6, the worst case scenario, could add to $8 million.[179,180] If total destruction were to occur for each building vulnerable to five feet of sea level rise and a 100-year storm, over $356 million in assessed building value[181,182] could be lost in a storm. Reality will likely reflect a mix of these damage levels. These figures are summarized in Table 72.

If sea level rise occurs at these levels much a Belvedere's lagoon area could be lost to sea. This would also present major complications for those who travel through the lagoon neighborhood on San Rafael Avenue to get to their homes or jobs on Belvedere Island. The maps on the following pages illustrate vulnerable buildings by scenario. The areas in the call out circles enable the reader the see areas that are difficult to see on the large scale map. The circles do not indicate that these areas are more vulnerable than others along the shoreline.

179 ArcGIS. FEMA Modeling Task Force (MOTF)-Superstorm Sandy Impact Analysis. Last update June 22, 2015. http://www.arcgis.com/home/item.html?id=307dd522499d4a44a33d7296a5da5ea0
180 2016 dollars
181 Market value is typically higher than assessed value.
182 2016 dollars

BELVEDERE

Map 64. Belvedere Vulnerable Buildings

Vulnerable Assets

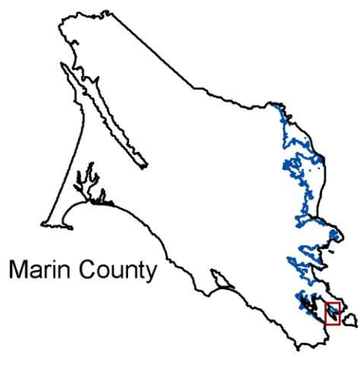
- City Hall
- Fire Station
- Post Office

Vulnerable Buildings

- Scen. 1: 10" Sea Level Rise (SLR)
- Scen. 2: 10" SLR+Storm Surge
- Scen. 3: 20" Sea Level Rise
- Scen. 4: 20"SLR+Storm Surge
- Scen 5: 60" Sea Level Rise
- Scen. 6: 60"SLR+Storm Surge

Location Indicators

- Unincorporated
- Municipality
- Road
- Inland Extent: Sea Level @ 60"+100-year Storm



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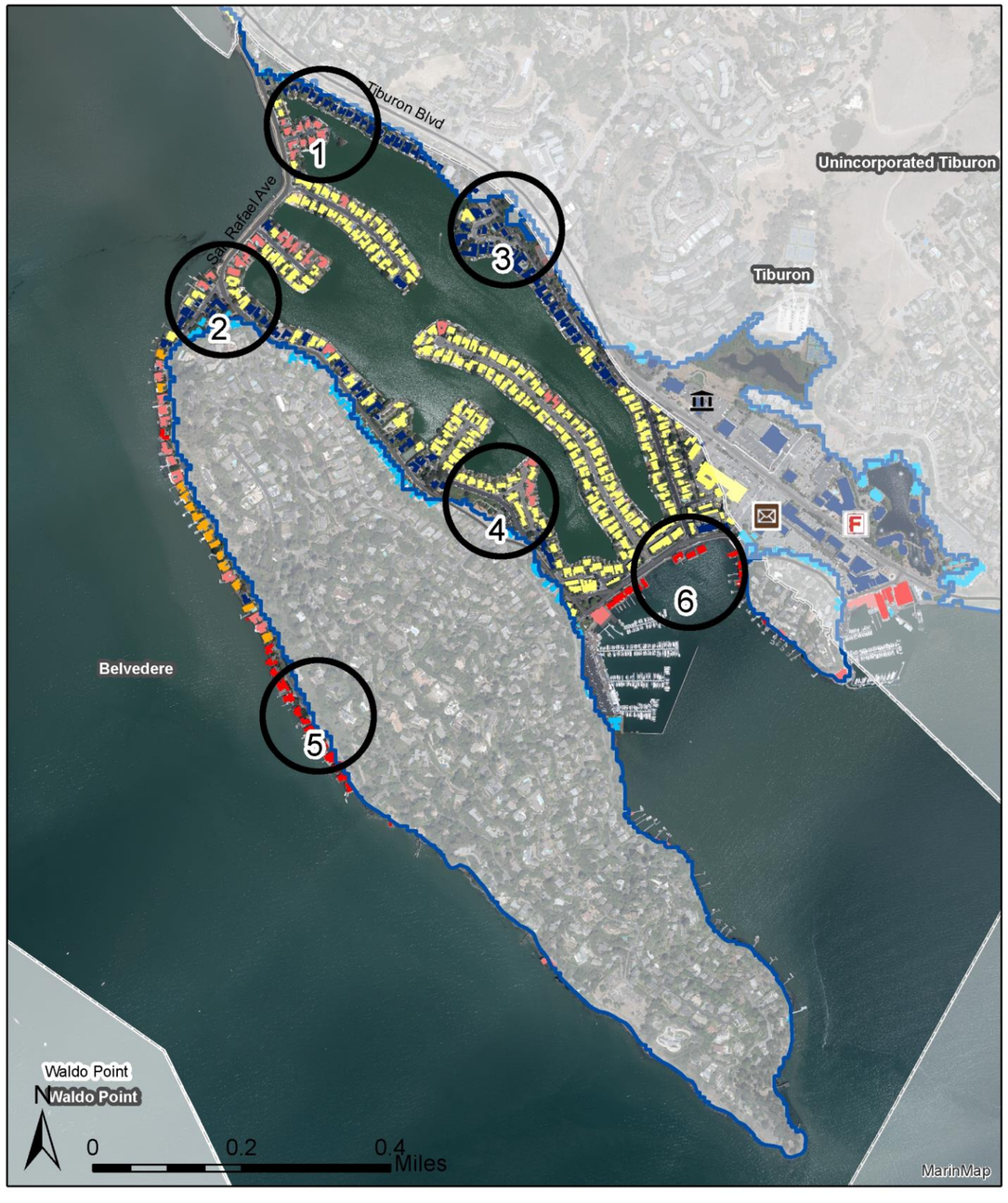
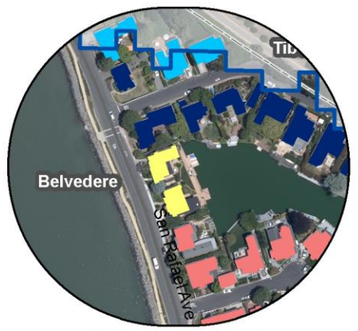
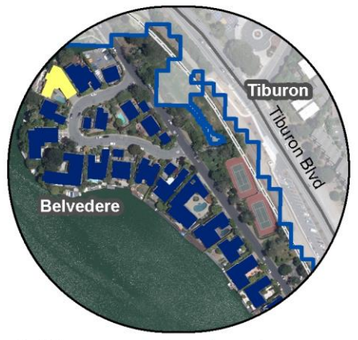


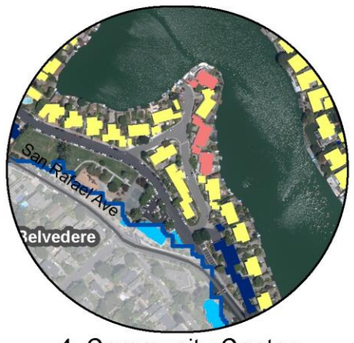


1: Entry to Belvedere

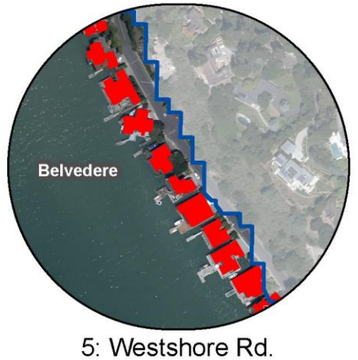
2: San Rafael Ave. @ Westshore Rd.



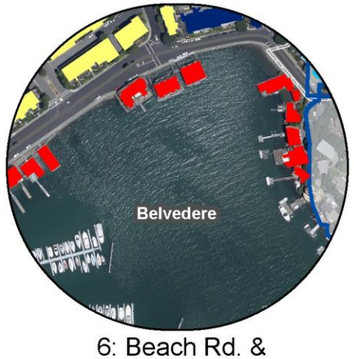
3: Homes on Eastern Lagoon



4: Community Center & Park



5: Westshore Rd.



6: Beach Rd. & Corinthian Hill

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BELVEDERE

Transportation

The primary access road to Belvedere, San Rafael Avenue, is vulnerable to overland flooding after three feet of sea level rise. The levee lining the shoreline here may protect the avenue from sea level rise for a couple decades; however, when combined with storm surges, the armoring could be compromised sooner. The lagoon area roads may experience increasing subsidence issues in addition to, and even before, flooding. In time, several additional roads in the lagoon area could be impacted by high tides on a regular basis. If the low lying roads are compromised, people who live in the homes on Belvedere Island could become isolated or prevented through travel for several hours several days a month.

Table 73 lists roads and trails that could be vulnerable to sea level rise and a 100-year storm surge. Golden Gate Transit route 8 along Beach Road, and along its route connecting to Belvedere, could experience service reductions during high tides and/or a 100-year storm at the following stops:

- Beach Rd. and San Rafael Ave, and
- Beach Rd. and Juanita Ln.

If public transportation gets cut off because roads are inundated, people who travel through or to the area for work would be cut off. Similarly, people with mobility or health constraints will be affected.

Water transportation for recreational purposes is a major use of the San Francisco Yacht Club Marina off Belvedere Island. As sea level rises, the facility may need to make some adjustments or relocate. Several private piers and docks could also be damaged in storms and/or may need to be elevated.

The maps on the following pages illustrate vulnerable transportation features. The areas in the call out circles enable the reader the see areas that are difficult to see on the large scale map. The circles do not indicate that these areas are more vulnerable than others along the shoreline.

San Francisco Yacht Club facing Corinthian Hill in Belvedere. Credit: F .Higgins

Table 73. Belvedere Roads Vulnerable to Sea Level Rise and a 100-year Storm Surge

Near-term		Medium-term		Long-term	
Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**	**Scenario 5**	**Scenario 6**
None	**0.1** miles	**None**	**1.5** miles	**3** miles	**4** miles
	San Rafael Ave [L] Hilarita Cir [L] Edgewater Rd [L]		Roads in Scenario 2 Barn Rd [P] Beach Rd [L] Community Rd Cove Rd [L] Cove Road Pl [L] Leeward Rd [L] Mallard Rd [P] Peninsula Rd [L] Teal Rd [P] Windward Rd [L]	Roads in scenarios 2 and 4 Embarcadero Dr [P] Lagoon Rd [L] Maybridge Rd [L] West Shore Rd [L]	Roads in scenarios 2, 4, and 5 Bellevue Ave [L] Golden Gate Ave [L]

M = Marin County; C = State of California; L = Local Municipality; P = Private.
Source: MarinMap, CoSMoS

BELVEDERE

Map 65. Belvedere Vulnerable Transportation Assets

Vulnerable Assets

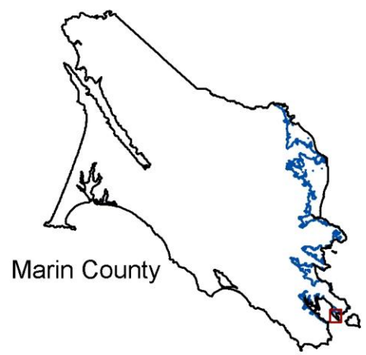
- Bike path
- Bay Trail
- GGT Bus Stop
- Marina
- Ferry

Vulnerable Roads

- @10" Sea Level Rise (SLR)
- @10"SLR+ 100-year Storm Surge
- @20" Sea Level Rise
- @20"SLR+ 100-year Storm Surge
- @60" Sea Level Rise
- @60"SLR+ 100-year Storm Surge

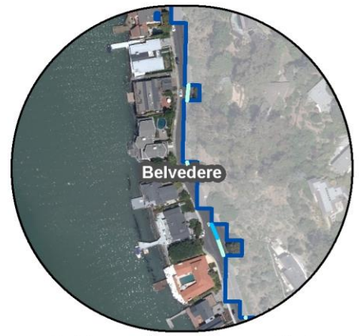
Location Indicators

- Unincorporated
- Municipality
- Road
- Inland Extent: Sea Level @ 60"+100-year Storm

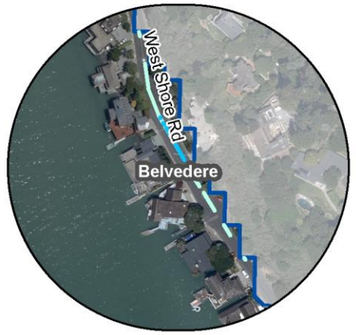


1: San Rafael Ave.

2: San Rafael Ave. @ Westshore Rd.



3: Upper Westshore Rd.



4: Lower Westshore Rd.

5: Beach Rd. @ San Rafael Ave.

6: Beach Rd.

Date: 1/15/2017

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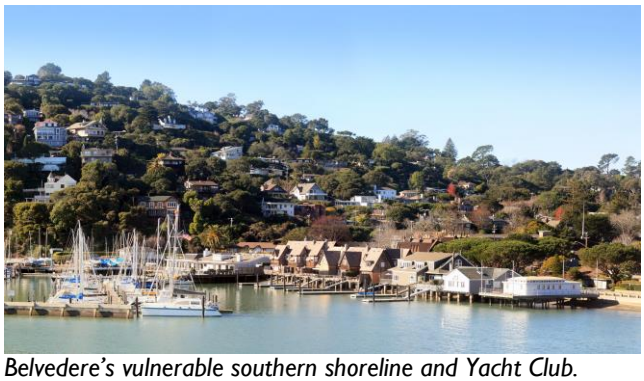
BELVEDERE



Belvedere's vulnerable southern shoreline and Yacht Club. Credit: WikiMedia

Utilities
Primary concerns include those common to other communities in the study area such as:

- Underground pipes face compounding pressure forces from water and the road,
- Road erosion and collapse with underlain pipes,
- Saltwater inflow and infiltration causing inefficiencies in wastewater treatment,
- Continuously subsiding soils or fill, and
- Escalating activity, capacity demands, energy consumption, and wear and tear on pump stations in stormwater and wastewater systems,
- Aging individual site connections for water, sewer, and electrical, and
- Flood waters interrupting access for employees to reach work sites.

Natural Resources
Much of Belvedere is developed with housing and boating facilities. Nevertheless, the Belvedere lagoon and Corinthian Bay provide ample bird and marine life habitat.

Just off the shores of Belvedere Island is a relatively large patch of eelgrass that serves as critical shallower water habitat. Eelgrass beds are recognized by both federal and state agencies as sensitive and highly valuable habitat for a suite of species. They are managed under the Magnuson-Stevens Fishery Conservation and Management Act. Eelgrass beds are listed as a Habitat Area of Particular Concern because they are susceptible to degradation, especially ecologically important, and/or located in an environmentally stressed area. As mean low tide rises, creating deeper waters in the bay, these plants could be denied the sunlight required to generate energy and sustain them. The loss of eelgrass beds would have significant ripple effects on other species in the Bay eco-system. Eelgrass beds are much larger and closer to shore than the mapped habitats on Map 69.

The longfin smelt is the only listed species recorded in this area. The smelt is list as threated on the California species list and a candidate for the federal list. The San Pablo Song sparrow, though not listed, is unique to the area, and has potential habitat in the vulnerable area.

Recreation
Access to the water could be compromised at the yacht club and private residential facilities. Trails around and leading to the area could also be compromised by flooding and erosion. Finally the Belvedere Community Center and Park could be vulnerable to sea level rise alone in the long-term, especially if the tide gates managing the lagoon water level fail.

Cultural Resources
Vulnerable resources: *1 California Register of Historic Places site, 4 additional locally registered historic sites*
Scenarios: All
Flood Depths: 6''- 3'2'' + 100-year storm surge
Primary Building Materials: Wood

Belvedere was first settled in the late 19th century as a fishing community, and incorporated in 1896.[183] Vulnerable historic resources in Belvedere include:

- Properties on Beach Road, along the northwest edge of Belvedere Cove are exposed, including several in the near term. A handful of these properties were designed by well-known architect Albert Farr including the Farr cottages/Farr apartments and the Belvedere Land Company. Additionally the China Cabin lies along this vulnerable waterfront stretch. This saloon was once housed by the S.S. China, built in 1866 to carry passengers from San Francisco to Asia, though the rest of the ship was burned for scrap metal.[184]
- The Belvedere Presbyterian Church/City Hall/Community Center.

[183] Belvedere, CA. Last updated January 9, 2017. en.wikipedia.org/wiki/Belvedere,_California
[184] Belvedere-Tiburon Landmarks Society, China Cabin. Accessed January 18, 2017. landmarkssociety.com/landmarks/china-cabin/

BELVEDERE

The 1905 Belvedere Land Company building reflects designer Albert Farr's signature style.[185] *Credit: Wikipedia*

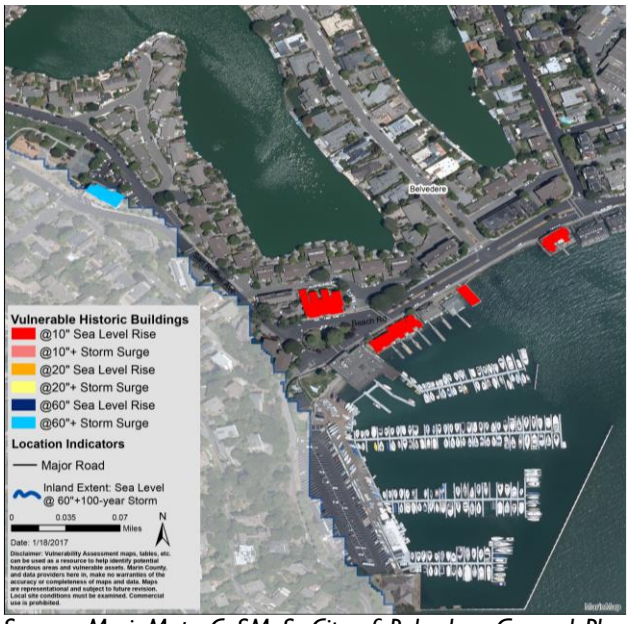
Emergency Services

The largest threat to emergency services is lost emergency vehicle access to the community. High tides and storms could flood the roads in front of the police department and, in the long-term, up to four feet of flooding could impact the property and the vehicles. In addition, though technically in Tiburon, the Tiburon Fire Department serves Belvedere and could be blocked from providing service if roads are severely flooded or if the station itself is flooded.

Select assets are presented in Table 74. A 100-year storm surge would add an additional one to three feet of water to these properties. Note also, above average high tides could impact more properties than accounted for in this analysis. The maps on the following pages illustrate vulnerable utility, natural resource, recreation, emergency and historic features. The areas in the call out circles enable the reader the see areas that are difficult to see on the large scale map. The circles do not indicate that these areas are more vulnerable than others along the shoreline.

[185] Albert L. Farr. Last updated October 10, 2016. <en.wikipedia.org/wiki/Albert_L._Farr>

Map 66. Belvedere Vulnerable Cultural Resource Assets



Source: MarinMap, CoSMoS, City of Belvedere General Plan Update. Credit: Marin County CDA

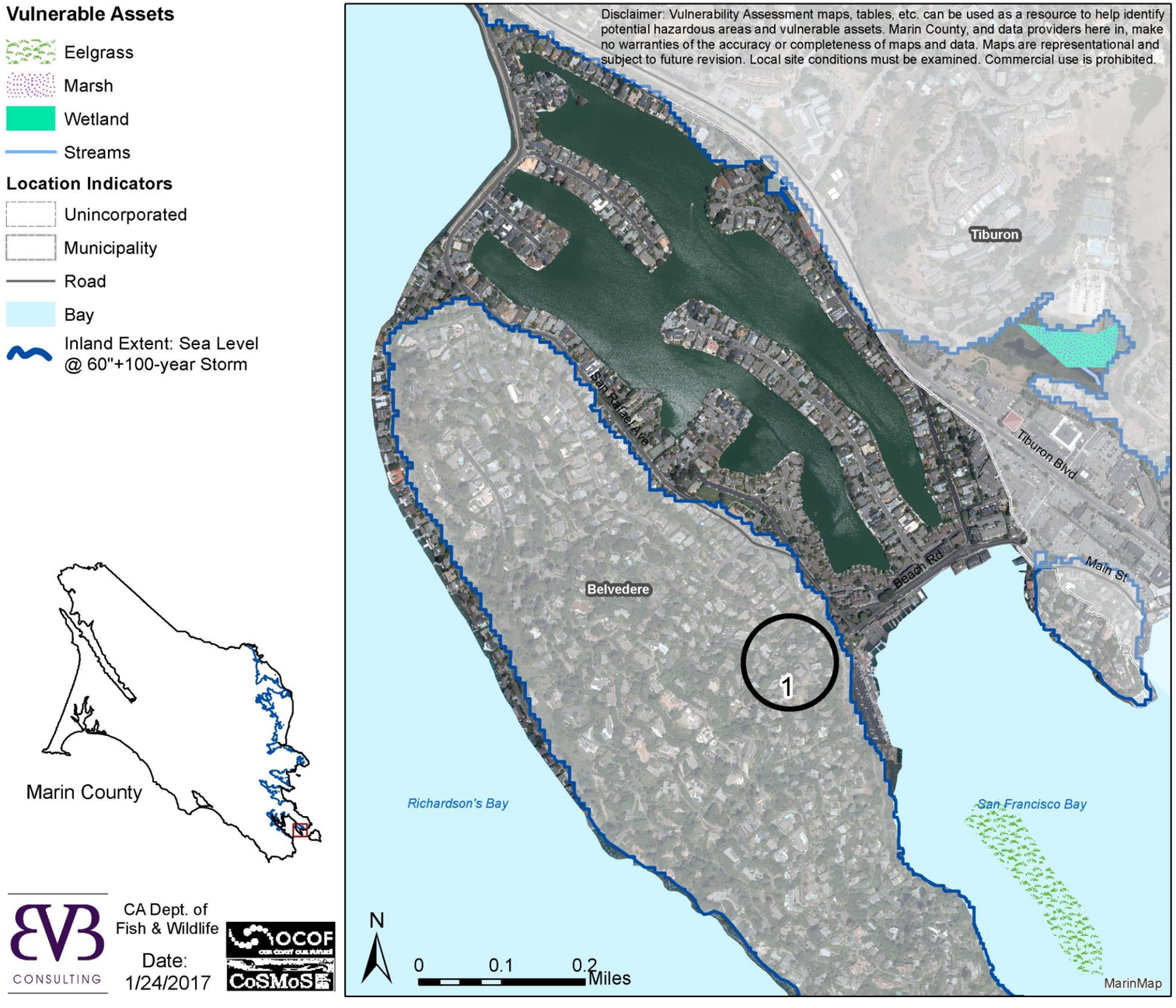
Table 74. Example Belvedere Vulnerable Assets by Sea Level Rise Onset and Flooding at MHHW

Asset	Scenarios		
	Near-term	Medium-term	Long-term
	1	3	5
Corinthian Hill homes	2'10'	3'2"	4'7"
West Shore Rd. homes	0-2'4"	2"-3'6"	5"-8'11"
SF Yacht Club	2'2"	3'6"	8'10"
Beach Rd. homes	6"	2'2"	4'
Lagoon homes		2"-3'	5"-7'9"
Corp Yard		4"	1'5"
San Rafael Ave.		0-3"	2"-4'3"
West Shore Rd.			2'3"-5'5"
Mini Park			5'3"
Beach Rd.			11"-5'
Community center city hall, & police			4'4"
Belvedere Lagoon	Saltwater resource		

Source: MarinMap, CoSMoS

BELVEDERE

Map 67. Belvedere Vulnerable Natural Resource Assets



BELVEDERE

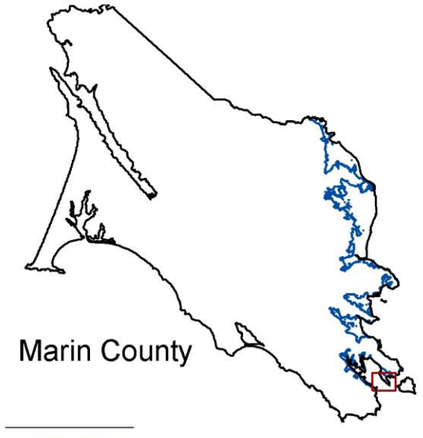
Map 68. Belvedere Vulnerable Recreation Assets

Vulnerable Assets

- Bay Trail
- Trail
- Bikeway
- Park
- Ferry
- Marina

Location Indicators

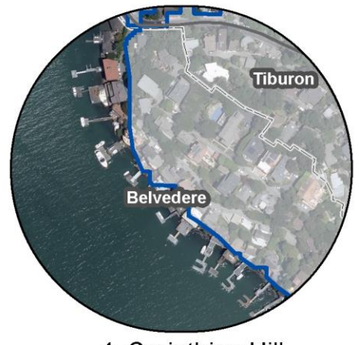
- Unincorporated
- Municipality
- Road
- Bay
- Inland Extent: Sea Level @ 60"+100-year Storm



1: West Shore Rd. Home Docks

2: Belvedere Community Park

3: San Francisco Yatch Club



4: Corinthian Hill Home Docks

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Date: 1/25/2017

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Map 69. Belvedere Cultural Resource Assets

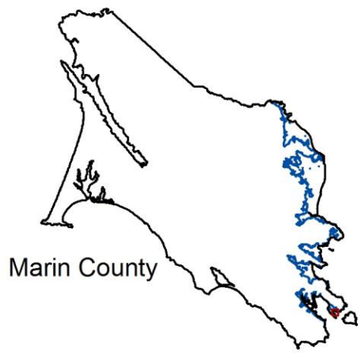
Vulnerable Historic Buildings

- @10" Sea Level Rise
- @10"+ Storm Surge
- @20" Sea Level Rise
- @20"+ Storm Surge
- @60" Sea Level Rise
- @60"+ Storm Surge

Location Indicators

- Municipality
- Major Road
- Inland Extent: Sea Level @ 60"+100-year Storm

Source: Marin Map, CoSMoS, Belvedere General Plan Update



Date: 2/17/2017

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TIBURON

Community Profile: Tiburon

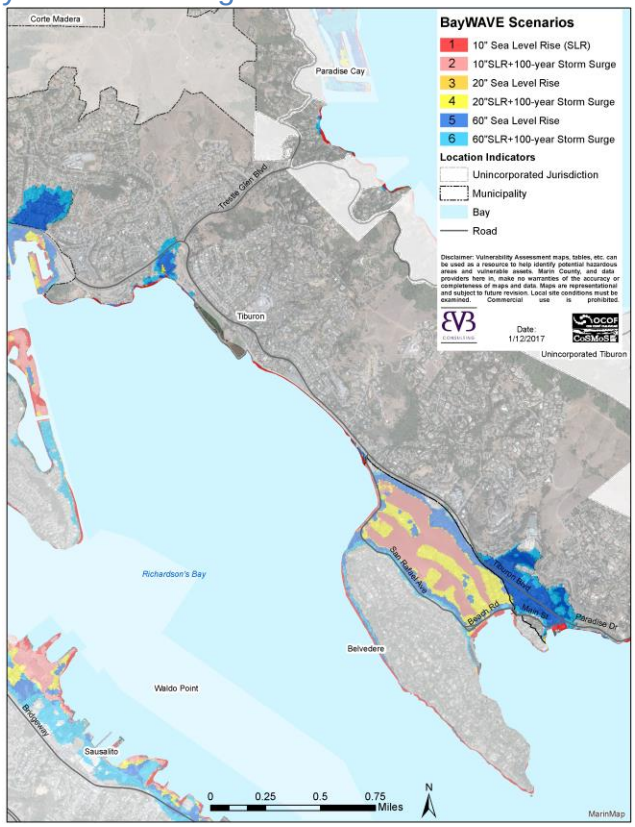
Tiburon is located along an extensive peninsula projecting into Richardson's and San Pablo Bays. The peninsula is generally steep with several areas of reinforced shoreline. However, the low-lying downtown Blackie's Pasture, and Cove areas could be vulnerable. Increased sea level rise and storm surges could significantly compromise this shoreline community in the following ways:

- Highly valued Main Street shoreline shops and restaurants could be vulnerable in the near-term.
- Homes along the interface of the bluffs and shoreline could be vulnerable to increased erosion and bluff collapse during storms.
- The Tiburon and Angel Island ferries may face complications with loading during extreme high tides, and may experience compromised American Disabilities Act (ADA) access.
- Vehicular access along Tiburon Blvd. could be compromised at the Cove Shopping Center and in downtown in the long-term.
- The Tiburon Fire Department, library, post office, and municipal facilities may be vulnerable to tidal flooding in the long-term.
- The Bay Trail and hotels downtown are compromised in the near-term.
- Corinthian Yacht Club facilities could be vulnerable to storm damage and flooding in the medium- to long-terms.
- The Cove Shopping Center is vulnerable in the long-term to sea level rise, though could suffer sooner from combinations of higher tides and stormwater.
- If US 101 is compromised, so is service and goods delivery to Tiburon businesses.
- Access to Tiburon from Corte Madera could also flood in the medium-term.
- Homes high in the hills could become isolated and cut off from necessities and the ability to leave the community, as alternative access routes are not available at this time.
- Several historic sites downtown and the old shipping terminal could flood with saltwater as early as the near-term.

IMPACTS AT-A-GLANCE

341 living units	8,500+ people
135 acres exposed	36 commercial parcels
2.4 miles of roads	
Storm and tidal impacts already occur	
Over $400 million in assessed value; nearly $600 million in single-family market family[186]	Town of Tiburon Property Owners Caltrans Marin DPW Ferry Services

Map 70. Tiburon Sea Level Rise and 100-year Storm Surge Scenarios



Source: MarinMap, CoSMoS. Credit: BVB Consulting LLC

[186] 2016 dollars

TIBURON

View of Corinthian Marina and Tiburon Ferry facilities from Shoreline Park. Credit: BVB Consulting LLC

Vulnerable Assets

Tiburon's most vulnerable assets are concentrated on the face of the peninsula, downtown, and the Cove. These areas feature housing and a number of business, civic, recreation, historic and visitor serving uses. These areas tend to draw millions of visitors a year and provide a significant amount of economic and cultural value to the community and Marin County.

Land

Low-lying land on Tiburon's steep peninsula are concentrated in small areas that ae highly developed and treasured. Bluff top parcels could expect negative impacts from storm surges that could cause the bluffs to collapse. Note that because significant amounts of development are in the uplands, the exposed land area is relatively small compared to the total area of Tiburon. Examining the exposed acreage and the vulnerable land uses on the exposed land provides a glimpse of what is at stake if actions to prepare for sea level rise are no taken.

Acres

In near- and medium-term scenarios 1, 2, 3, and 4, about fifty acres could be vulnerable. By the long-term, 106 acres could be vulnerable to sea level rise and 135 acres could be vulnerable with an additional 100-year storm surge. Despite the numeric jump, these figures account for less than one percent of Tiburon's land area.

Parcels

Table 76 shows how many parcels are in the exposed area of the community under the six BayWAVE scenarios. About 45 to 50 parcels could be vulnerable in the near- and medium-terms. IN the long-term, this number triples to 150 vulnerable parcels. An additional 100-year storm surge at five feet of sea level rise could triple this figure again, to and 450 flooded parcels.

Table 75. Tiburon Exposed Acreage

Scenarios		Acres	
		#	%
Near-term	1	48	0.3
	2	47	0.3
Medium-term	3	48	0.3
	4	49	0.3
Long-term	5	106	0.6
	6	135	0.8

Source: MarinMap, CoSMoS

Table 76. Tiburon Vulnerable Parcels at MHHW

Scenarios		Parcels	
		#	%
Near-term	1	46	1
	2	46	1
Medium-term	3	47	1
	4	49	1
Long-term	5	145	4
	6	442	12

Source: MarinMap, CoSMoS

Table 77. Tiburon Vulnerable Residential and Commercial Parcels

Land Use	Scenario					
	1		3		5	
	#	%	#	%	#	%
Residential	34	1	34	1	88	3
Commercial	4	7	5	9	36	64

Source: MarinMap, CoSMoS.

TIBURON

The Tiburon waterfront is vulnerable in the near-term. Source: Marin County CDA.

When taking a closer look at land use, a striking 65 percent of commercial properties could be vulnerable to long-term levels of sea level rise. In this scenario, tidal flooding could extend down Tiburon Boulevard. Additional stormwater from the hillsides would only exacerbate his flooding during storms. Reductions in service or loss due to building or inventory damage could have significant economic and employment repercussions for Tiburon. In earlier scenarios, roughly ten percent of commercial parcels could face tidal flooding at MHHW. While less than three percent of residential parcels in Tiburon could face tidal flooding, several downtown commercial buildings likely feature second story apartments.

Buildings

Many of Tiburon's Vulnerable parcels host buildings for commercial, residential, and public service activities. Compared to other communities in the study area, Tiburon has fewer buildings that could be vulnerable to sea level rise due to the bluff side development pattern. Nevertheless, these buildings provide much of Tiburon's historic and charming character.

Table 78. Tiburon Vulnerable Parcels by Land Use

Land Use	Scenarios					
	1		3		5	
	Near-term		Medium-term		Long-term	
	#	Ac.	#	Ac.	#	Ac.
Commercial Improved	4	1	5	1	32	18
Commercial Unimproved					4	1
Residential	34	10	42	10	87	19
Multi-Family Improved	12	3	12	3	12	3
Multi-Family Unimproved	2	0.5	2	0.5	4	0.5
Single Family Improved	13	6	13	6	62	15
Single Family Unimproved	7	0.5	7	0.6	7	0.6
Tax Exempt	8	18	8	18	20	36

Source: MarinMap, CoSMoS

Table 79. Tiburon Vulnerable Buildings

Scenarios		Buildings	
		#	%
Near-term	**1**	26	1
	2	42	1
Medium-term	**3**	42	1
	4	44	1
Long-term	**5**	153	4
	6	261	7

Source: MarinMap, CoSMoS

Table 79 shows how many buildings could be impacted under the six BayWAVE scenarios. The analysis shows that 20 to 50 buildings in the near- and medium-terms, and 150 buildings in the long-term are vulnerable to tidal flooding at MHHW. When a 100-year storm surge also occurs, 260 parcels would flood temporarily. The difference in scenario 6 parcel and building figures may be attributed to the nature of bluff side development, where the parcels could be impacted at the water's edge with the building safely elevated above and/or back from the edge.

In the downtown area, several of the buildings impacted first are restaurants that feed locals and

visitors, later the condos and other office facilities and housing just beyond the Tiburon Blvd. and Main Street intersection. Heading north along Tiburon Blvd. are several buildings, including CVS, Town Hall, Library, and other Tiburon offices that could expect tidal flooding in the long-term. Some of these buildings are newer construction and elevated with floating foundations designed to maintain stability of soggy soils. Because of this, these buildings may be able to withstand seasonal flooding; however, parking and access points could be compromised then and when tidal waters reach the area.

Housing is primarily impacted along the bluff edge around the peninsula. These properties may have docks and other structural components on the water that would be adjusted or lost first. Another batch of homes could suffer tidal impacts just east to the Cove Shopping Center in the long-term. The shopping center, which could expect over one foot of water in the medium-term and over 3 feet of water in the long-term, and the adjacent stretch of Tiburon Blvd. already face seasonal stormwater flooding. The site is equipped with a high capacity pump station to prevent flooding here. Additional tidal forces against the stormwater flow could burden the pump station and may result in more severe stormwater back-ups during high tides.

Table 80 divides the vulnerable buildings by how much water could fill the property, whether it is one, two, or ten feet of tidal waters at MHHW. In scenario 1, a few buildings downtown are flooded with seven to nine feet of water. In scenario 3, a few are flooded at low levels of flooding, and the buildings impacted in scenario 1 flood with deeper waters. In the long-term, scenario 5, nearly 100 buildings could be under three feet of flood waters, with a few buildings vulnerable to between three and six feet of flooding. The same buildings measured in scenario 1 remain under deep water at MHHW.

Table 81 outlines cost estimates for damage to buildings and their contents under scenario 6, the worst case storm surge scenario analyzed in this assessment. The analysis uses the FEMA damage tagging levels of yellow for minor damage of $5,000 and no more than $17,000 per building, orange for moderate damage of more than $17,000, and red for destroyed structures. Nearly $200 million of damage could occur if all vulnerable buildings in scenario 6 were to be destroyed in the long-term. This figure assumes all of the vulnerable buildings in scenario 6 experience one of the three damage levels, destroyed. Reality would likely reflect a mix of damage levels.

The maps on the following pages illustrate vulnerable buildings by scenario. The areas in the call out circles enable the reader the see areas that are difficult to see on the large scale map. The circles do not indicate that these areas are more vulnerable than others along the shoreline.

Table 80. Tiburon Vulnerable Buildings Average Flood Depth* Estimates at MHHW

Flood Depth (feet)		Scenario		
		1	3	5
0.1-1	#		1	22
1.1-2	#		0	34
2.1-3	#		1	37
3.1-4	#			18
4.1-5	#			4
5.1-6	#			1
6.1-7	#		1	1
7.1- 8	#	5	2	1
8.1-9	#		2	1
9.1- 10	#	1	2	2
10.1+	#			1

Source: MarinMap, CoSMoS
** Flood depth data is not available for all exposed areas and assets.*

Table 81. Tiburon Vulnerable Buildings FEMA Hazus Damage Estimates for Long-term Scenario 6

Buildings in Scenario 6	261
Yellow Tag-Minor Damage **$5,000 minimum**	$1,305,000
Orange Tag: Moderate Damage **$17,001 minimum**	$4,437,261
Red Tag-Destroyed **Assessed structural value**	$187,457,062

Source: MarinMap, CoSMoS

Map 71. Tiburon Vulnerable Buildings

Vulnerable Assets

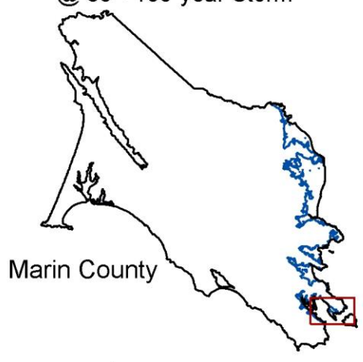
- Post Office
- City Hall
- Emergency Shelter
- Fire Station

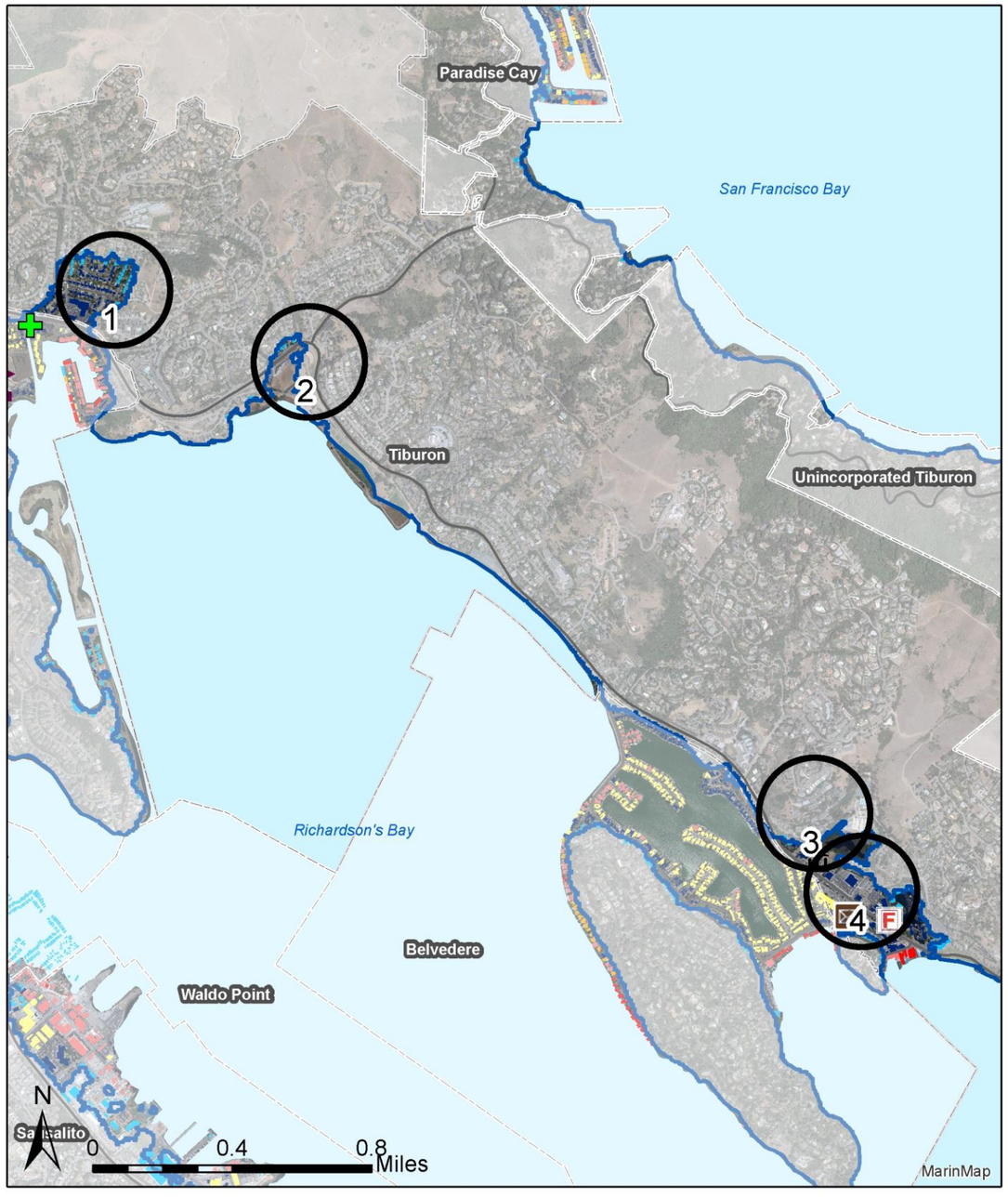
Vulnerable Buildings

- Scen. 1: 10" Sea Level Rise (SLR)
- Scen. 2: 10" SLR+Storm Surge
- Scen. 3: 20" Sea Level Rise
- Scen. 4: 20"SLR+Storm Surge
- Scen 5: 60" Sea Level Rise
- Scen. 6: 60"SLR+Storm Surge

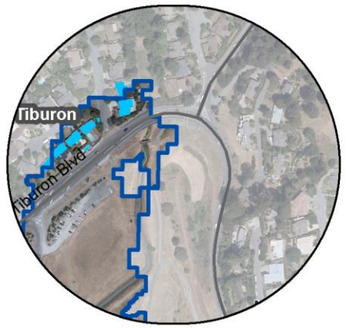
Location Indicators

- Unincorporated
- Municipality
- Road
- Bay
- Inland Extent: Sea Level @ 60"+100-year Storm

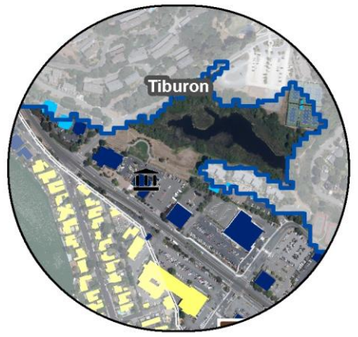




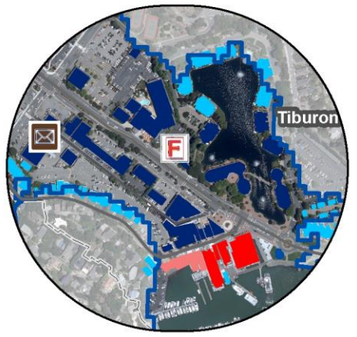
1: The Cove



2: Blackie's Pasture



3: Entry to Downtown



4: Downtown

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Transportation

The first road that could be impacted is Brunini Way in scenario 2. Additional roads downtown and west of Tiburon Boulevard may avoid impacts until after medium-term scenarios 3 and 4. Tiburon Boulevard could expect 100-year storm surge impacts in scenario 6 at Main Street, Paradise Drive, and the Cove. Tiburon Boulevard is the main access road to Tiburon. Paradise Drive offers a windy alternative; however, Paradise Drive faces its own flooding issues in Corte Madera. In addition to roads, the Bay Trail could expect flooding downtown and erosion along its course.

Roads could erode and deteriorate faster if they are repeatedly exposed to salt water. Vehicles can also be destroyed by salt water exposure. Temporary closures to the road and bicycle network could have significant impacts on commuting to and from the peninsula to US Highway 101, completing daily routines, recreational opportunities, and emergency vehicle access. Disruptions in the road network would disrupt Golden Gate Transit Route 8 service along Tiburon Boulevard and at the following stops:

- Tiburon Blvd. and Mar West St.,
- Tiburon Blvd. and Main St., and
- Tiburon Blvd. and Beach Rd.

If public transportation gets cut off because roads are inundated, people who travel through or to the area for work would be cut off. Similarly, people with mobility or health constraints will be affected.

Tiburon also features a robust boating center with the Corinthian Yacht Club, the Blue and Gold commuter ferry to San Francisco, and the Angel Island Ferry. These sites can typically adjust to higher tides, though they made need to be elevated. If the adjacent land severely floods, access to these water transportation features may not be available. This could significantly impact commuting to San Francisco via ferry, and travel to Angel Island. In addition, several private docks could be vulnerable in their current elevations. These facilities are anticipated to tolerate higher tides; however, storms are known to damage piers, docs, and other marina structures.

Table 82 lists Tiburon transportation routes by when they are exposed to salt water at MHHW. The maps on the following pages illustrate vulnerable transportation features. The areas in the call out circles enable the reader the see areas that are difficult to see on the large scale map. The circles do not indicate that these areas are more vulnerable than others along the shoreline.

Table 82. Tiburon Vulnerable Transportation Assets

Near-term		Medium-term		Long-term	
Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**	**Scenario 5**	**Scenario 6**
None	0.01 miles	None	0.02 miles	1.5 miles	2.5 miles
	Brunini Wy [L]		Road from scenario 2	Road from scenarios 2 & 4 Beach Rd [L] Blackfield Dr [L] Blackies' Pasture Rd [L] Cecilia Wy [L] Claire Wy [L] Harriet Way [L] Juanita Ln [L] Lagoon Vista [P] Leland Wy [L] Main St [L] Mar West St [L] Marsh Rd [P] Pamela Ct [L] Paradise Dr [L, M]	Roads in scenarios 2, 4, & 5 Tiburon Blvd [C] Jefferson Dr [L] Washington Ct [L]

M = Marin County; C = State of California; L = Local Municipality; P = Private. Source: MarinMap, CoSMoS

Map 72. Tiburon Vulnerable Transportation Assets

Vulnerable Assets

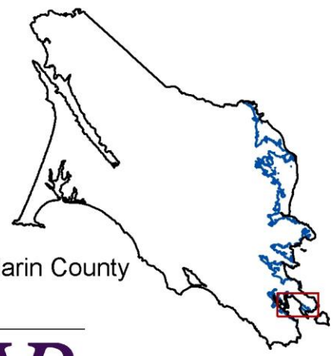
- Bike path
- Bay Trail
- Trail
- GGT Bus Stop
- Marina
- Ferry
- Public Boat Launch

Vulnerable Roads

- @10" Sea Level Rise (SLR)
- @10"SLR+ 100-year Storm Surge
- @20" Sea Level Rise
- @20"SLR+ 100-year Storm Surge
- @60" Sea Level Rise
- @60"SLR+ 100-year Storm Surge

Location Indicators

- Unincorporated
- Municipality
- Road
- Bay
- Inland Extent: Sea Level @ 60"+100-year Storm



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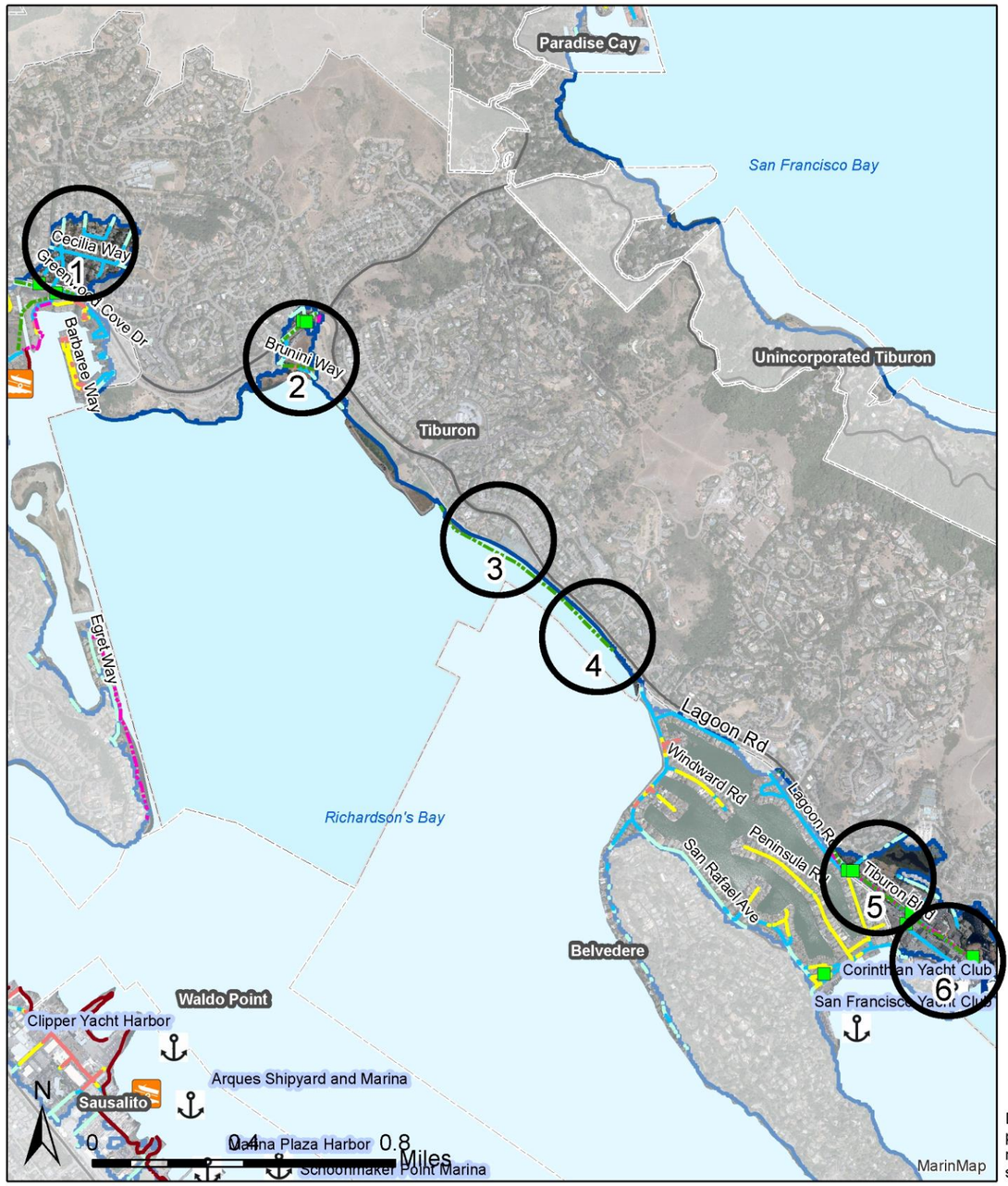
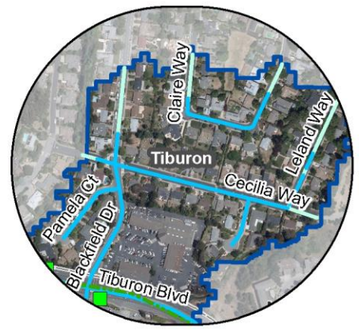
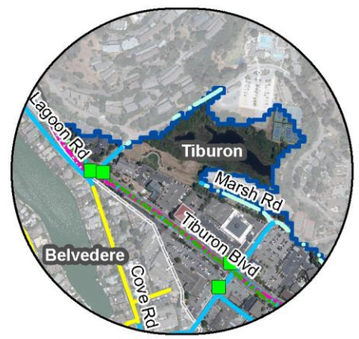


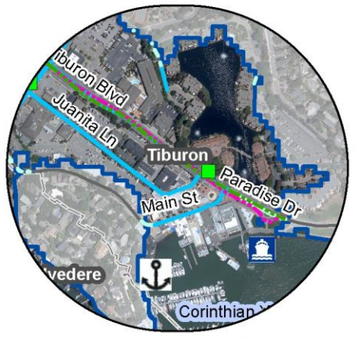


1: Northern Marinship

2: Southern Marinship



3: Bridgeway



4: Golden Gate Ferry.

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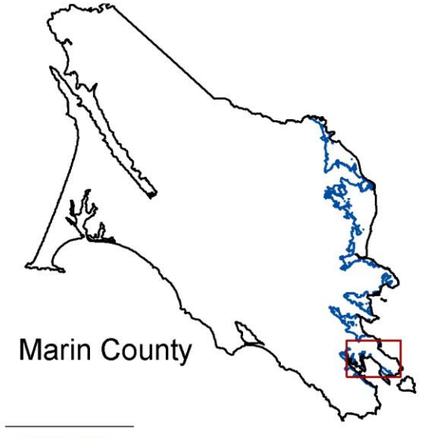
Map 73. Tiburon Vulnerable Stormwater Management Assets

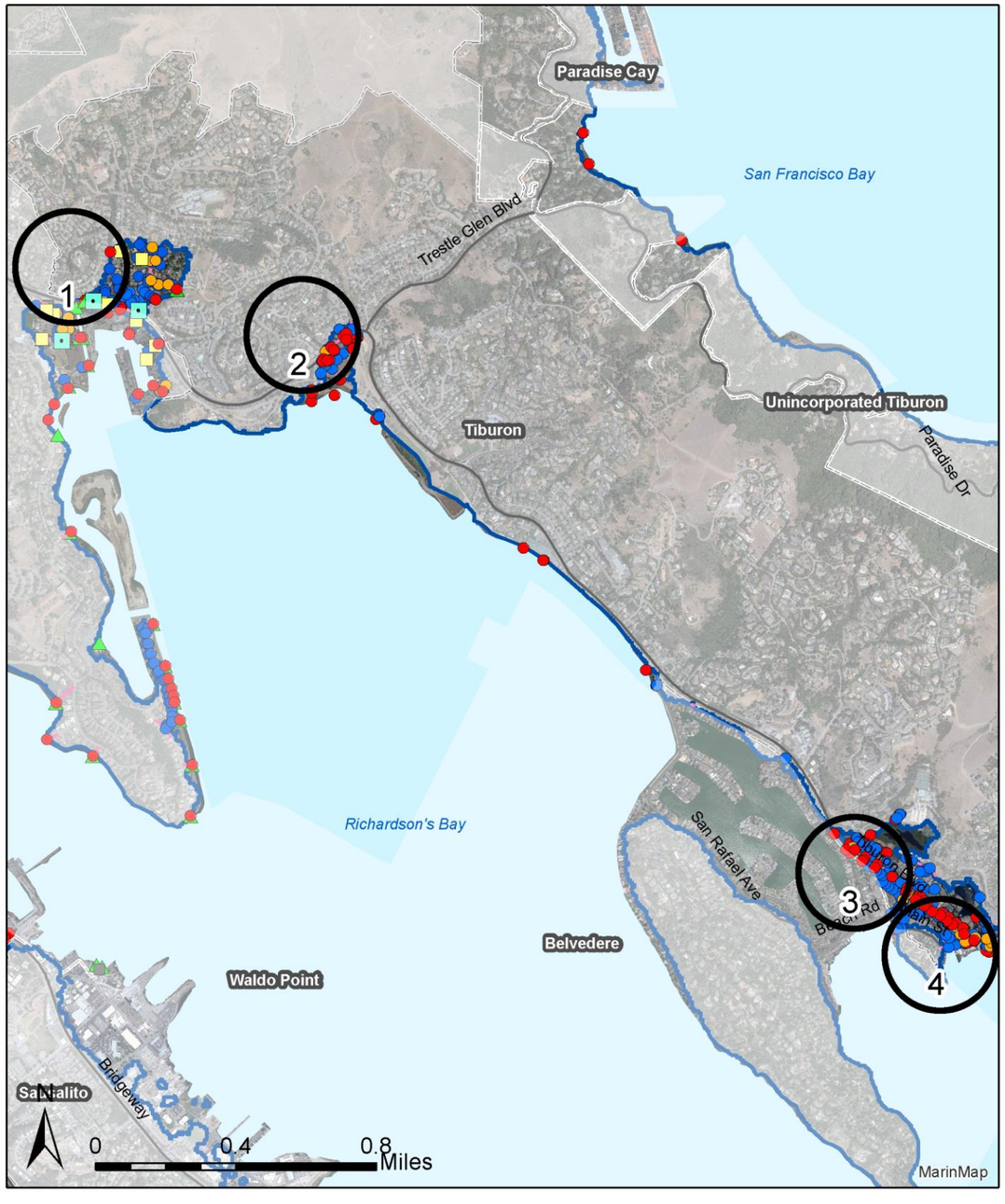
Vulnerable Assets

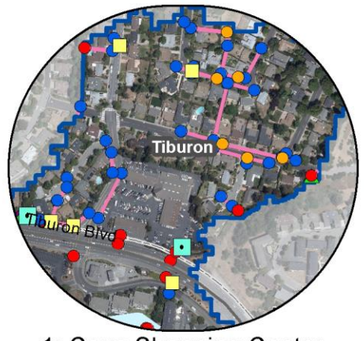
- Catch Basin
- Manhole
- Structures
- Pipe Inlet/Outlet
- Pump Station
- Channel
- Stormwater Pipe

Location Indicators

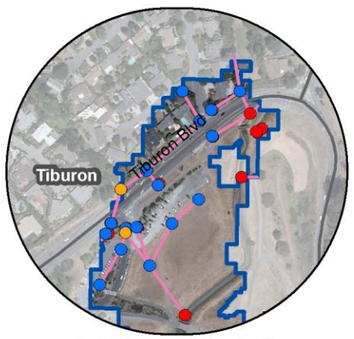
- Unincorporated
- Municipality
- Road
- Bay
- Inland Extent: Sea Level @ 60"+100-year Storm



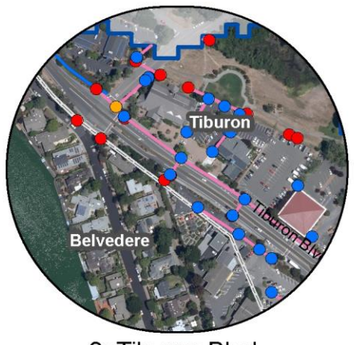




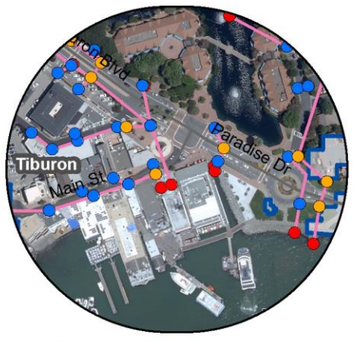
1: Cove Shopping Center



2: Tiburon Blvd. @ Blackie's Pasture



3: Tiburon Blvd.



4: Tiburon Blvd. Downtown

Date: 2/15/2017

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.

Pump station and overflow pond at the Cove Shopping Center. Credit: Marin County DPW

Utilities

Tiburon will likely face utility issues common in other shoreline communities in the study area, including:

- Underground pipes face compounding pressure forces from water and the road,
- Road erosion and collapse with underlain pipes,
- Saltwater inflow and infiltration causing inefficiencies in wastewater treatment,
- Continuously subsiding soils or fill, and
- Escalating activity, capacity demands, energy consumption, and wear and tear on pump stations in stormwater and wastewater systems,
- Aging individual site connections for water, sewer, and electrical, and
- Flood waters interrupting access for employees to reach work sites.

The smaller of two treatment plants in Sanitary District No. 5, the Paradise Cove Plant, would be impacted at scenario 6, 5 feet of sea level rise, plus 100-year storm surge. The main issues are worsening erosion and flooding at this site, saltwater intrusion for sewer lines along Tiburon Boulevard that run along the beach, a manhole at Beach Road and Tiburon Boulevard that already floods, and pump station electrical panels.

The primary treatment facility off Tiburon Boulevard could anticipate some flooding during storm surges in the parking lot. This flooding may also create access issues for employees and cause wear and tear on facility vehicles and equipment.

A majority of the pipes are original, and are planned for replacement, including the force main for Belvedere. All sewage is pumped from smaller pump stations to one main pump station and the 50-year old connecting pipe needs repair.[187]

The maps on the previous pages illustrate vulnerable utility features. The areas in the call out circles enable the reader the see areas that are difficult to see on the large scale map. The circles do not indicate that these areas are more vulnerable than others along the shoreline.

Natural Resources

The Tiburon Peninsula provides ample bird habitat, fishing, and other open water habitats. Small marshes also support wetland species. These habitats are very narrow and may already be drowned out at existing high tides. As sea level rises, these habitats could become dominated by standing water. Eelgrass is also a critical tidal habitat, typically in slightly deeper, saltier waters, associated with rocky ground. Eelgrass was observed off Tiburon Point off the high bluff extending into the San Francisco Bay. Eelgrass beds are recognized by both federal and state agencies as sensitive and highly valuable habitat for a suite of species. They are managed under the Magnuson-Stevens Fishery Conservation and Management Act. Eelgrass beds are listed as a Habitat Area of Particular Concern because they are susceptible to degradation, especially ecologically important, and/or located in an environmentally stressed area. As mean low tide rises closer to the bluff edge, these essential plants would be stressed by inadequate sunlight.

The longfin smelt is the only listed species recorded in this area. The smelt is list as threated on the California species list and a candidate for the federal list. The San Pablo Song sparrow is unique to the area and lives in potentially vulnerable habitat. In addition, the Tiburon Mariposa Lily at Ring Mountain could also be vulnerable to increased salinity.

Recreation

Tiburon is a destination for visitors via ferry, boat, bike, and car. The shoreline view of San Francisco, water bordering restaurants, and a walkable downtown, draw tourists from around the world to this small community. The main concern is reduced functionality of vulnerable transportation assets,

[187] Sea Level Rise Interview. Jan. 20, 2016. Sanitary District No. 5. Tony Rubio. Interviewed by C. Choo, Marin County Public Works.

including the Bay Trail and ferry service to San Francisco and Angel Island State Park. In addition, restaurants, hotels, and other visitor serving facilities on the shoreline could be vulnerable in the near-term. Potentially vulnerable hotels are the Water's Edge Hotel and the Lodge at Tiburon.

The maps on the following pages illustrate vulnerable natural resource, recreation, emergency and historic features. The areas in the call out circles enable the reader the see areas that are difficult to see on the large scale map. The circles do not indicate that these areas are more vulnerable than others along the shoreline.

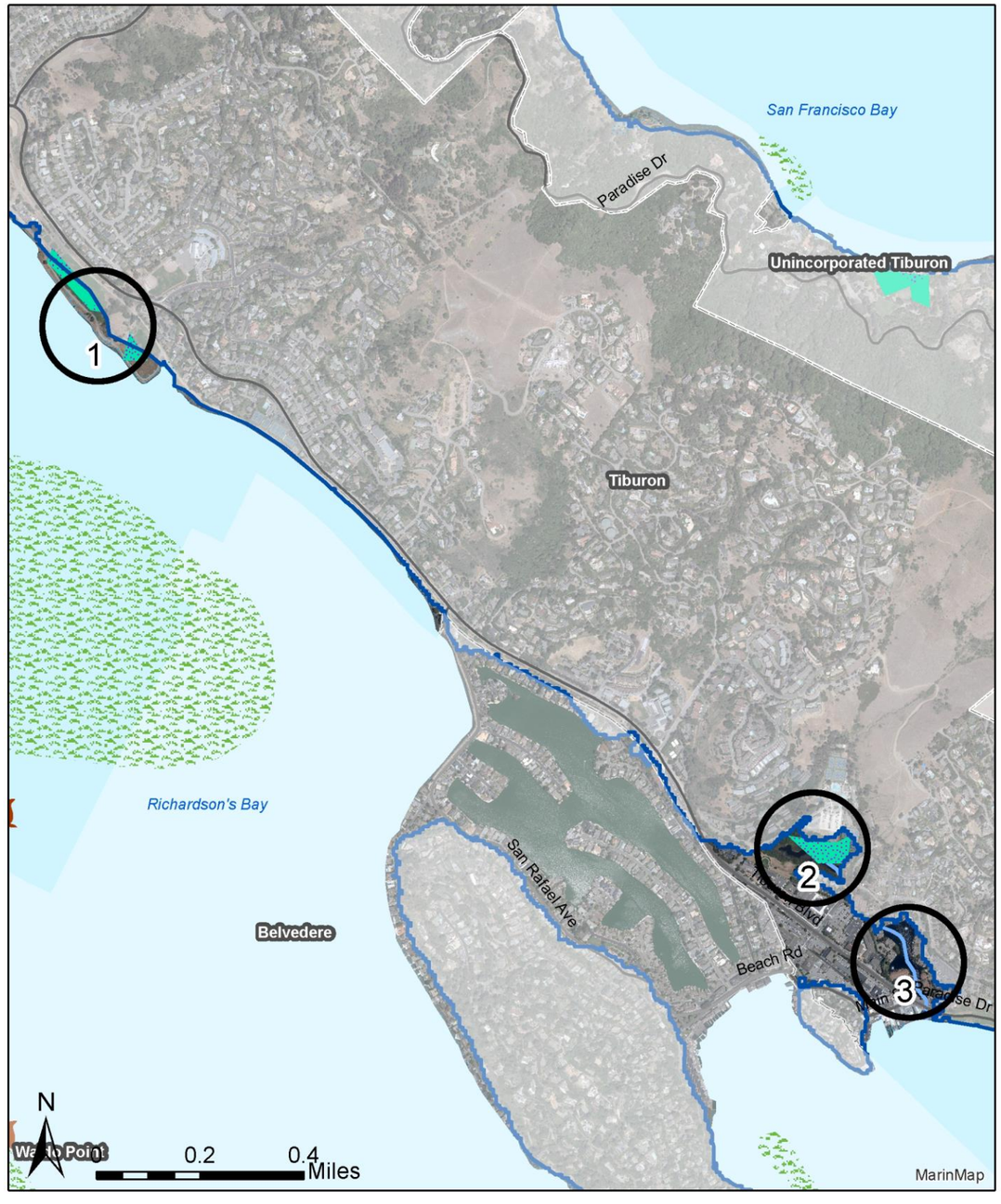
Map 74. Tiburon Vulnerable Natural Resource Assets

Vulnerable Assets

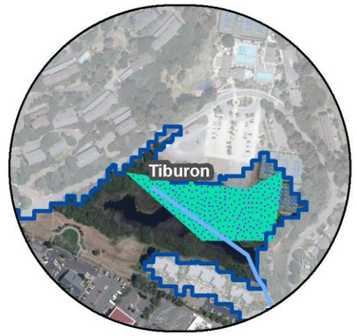
- Streams
- Eelgrass
- Marsh
- Wetland

Location Indicators

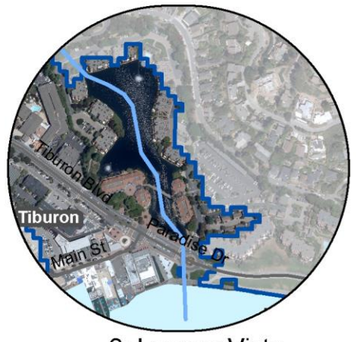
- Unincorporated
- Municipality
- Road
- Bay
- Inland Extent: Sea Level @ 60"+100-year Storm



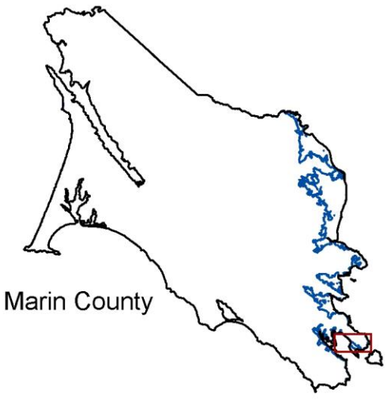
1: McKegney Field



2: Pt. Tiburon Marsh



3: Lagoon Vista

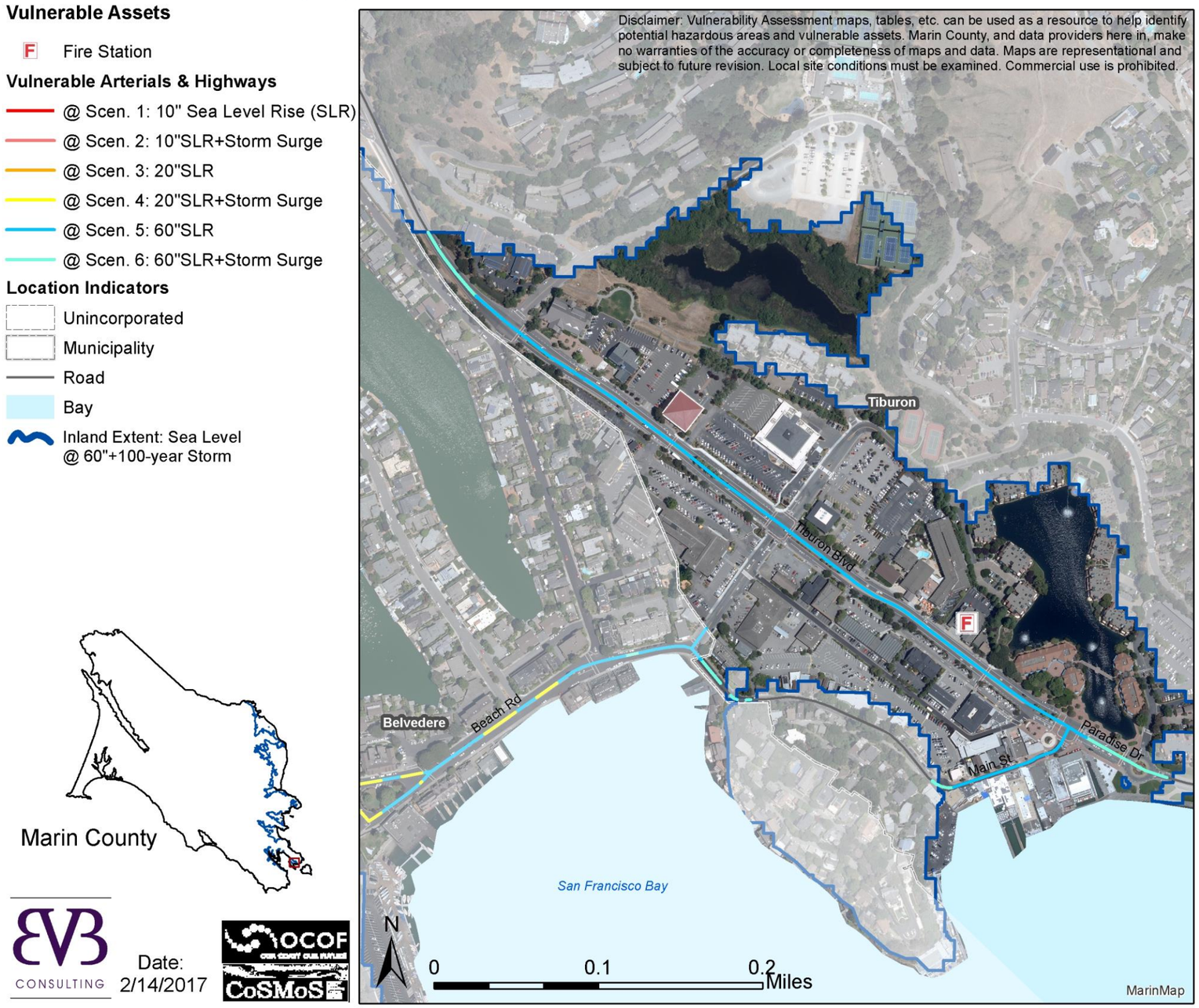


CA Dept. of Fish & Wildlife

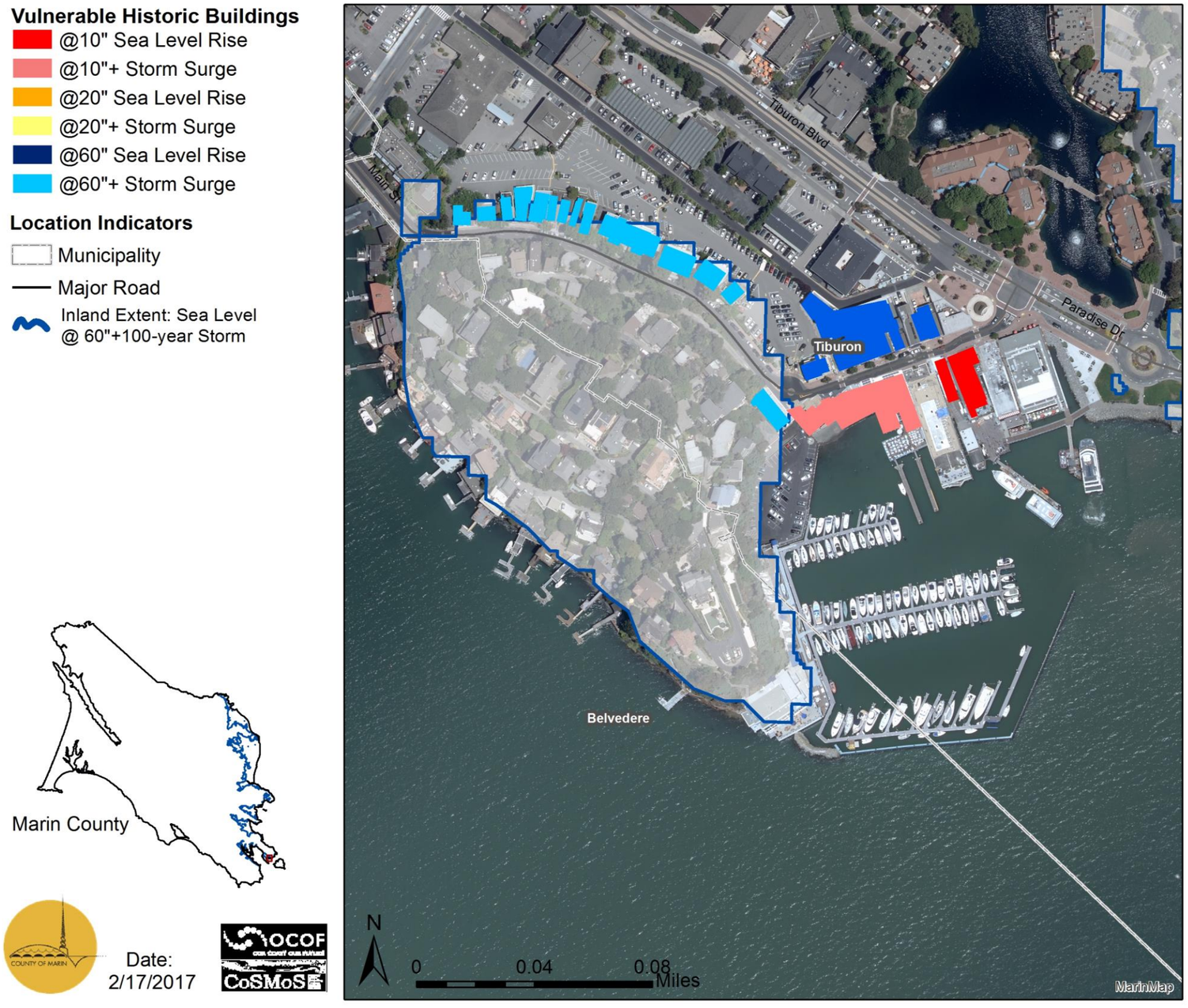
Date: 1/24/2017

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.

Map 75. Tiburon Vulnerable Emergency Assets



Map 76. Tiburon Vulnerable Cultural Resource Assets



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Tiburon's Main Street buildings date back to the early 1900s. Credit: Marin County CDA

Southern terminus of the Northwestern Pacific Railroad, Tiburon. Credit: San Francisco and North Pacific Railroad Station House-Depot National Register of Historic Places

Emergency Services

The Tiburon Fire Department could tidally flood in the long-term and experience restricted access throughout and out of downtown Tiburon. If Tiburon Boulevard is compromised, service up to the bluff may take longer. Service to the Cove area could be hindered by flooding on Tiburon Boulevard and within the Cove neighborhood itself.

Cultural Resources

Vulnerable historic buildings in Tiburon are the Peter Donahue Building on the National Register of Historic Places[188] and several others on the Local Historic Inventory for Downtown Tiburon. Vulnerable historic sites include over 20 buildings built in the 1920s along upper and lower Main Street. Then and now, commercial uses provide commuters and visitors using the Tiburon Ferry Terminal. Several lower Main Street sites could be subject to tidal inundation in the near-term. Upper Main Street sites are subject to storm surge flooding in the long-term. Just beyond the downtown, the San Francisco and North Pacific Railroad Station House-Depot, or the Peter Donahue Building, could be vulnerable to the 100-year storm surge in long-term scenario 6. Overall, these buildings could be vulnerable to over eight feet of tidal and storm surge flooding.

Table 83 lists example vulnerable assets in Tiburon by onset and flood depth. A 100-year storm surge would add an additional 1 to 3 feet of water to these properties. Note also, above average high tides, such as king tides, could impact more properties than accounted for in this analysis.

Table 83. Example Tiburon Vulnerable Assets by Onset and Flooding at MHHW

Asset	Scenarios		
	Near-term	Medium-term	Long-term
	1	3	5
Waterfront	9'2"	9'11"	12'9"
Pt. Tiburon Shoreline Park	8'	8'8"	11'6"
Ferry facilities	4'	5'	12'9"
Corinthian Yacht Club	4'	4'3"	11'
Richardson Bay Lineal Park	0-3'	1"-3'7"	1"-15'
Blackie's Pasture	0-9"	5'4"	12'9"
Cypress Garden Park	7"	1'4"	4'4"
Tiburon Blvd. shopping		4"-2'	1'-5'4"
Cove Shopping Center		1'8"	3'11"
Post office		1'6"	3'11"
Tiburon Fire Department		1'	2'6"
Town Hall		1'	2'2"
Town Library		1'	2'2"
Tiburon Blvd.			9"-5'
Zelinsky Park			4'10"
Pt. Tiburon Marsh			4'4"
Bay Trail			6"-3'
Main Street			4"-2'5"
Bel Aire Park			2'4"

Source: MarinMap, CoSMoS

[188] Arnett, V.M. 1994. National Register of Historic Places Form-San Francisco and North Pacific Railroad Station House & Depot.