

BUILDINGS

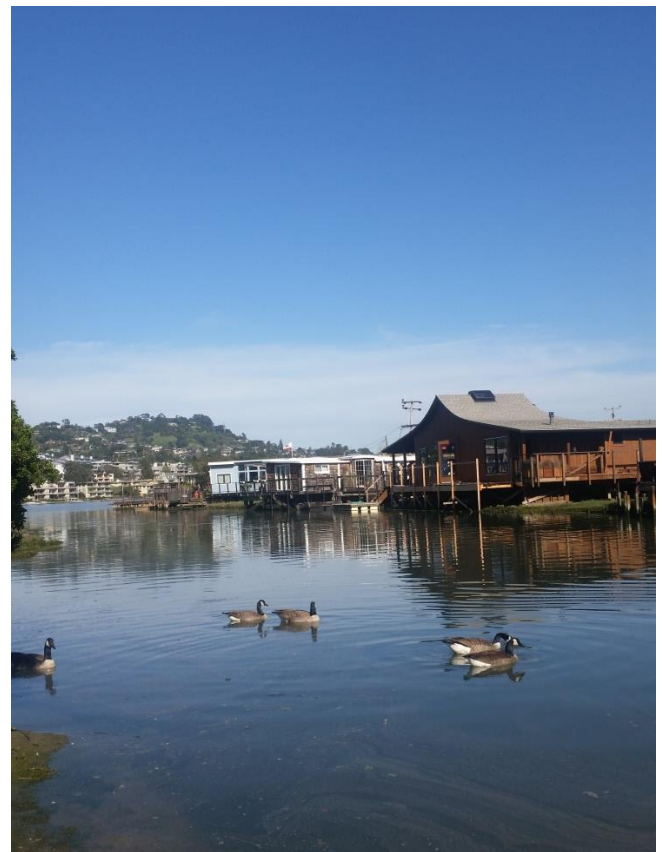
Asset Profile: Buildings

Buildings on the flooded parcels are significant assets along the Marin shoreline. Buildings house commercial activity, learning, worship, employment, home, and daily life. In addition, buildings provide a significant amount of wealth and equity for property owners. Moreover, everyone, despite age, income, or ethnicity uses and depends on the function of several buildings across the region. The following are key issues related to building vulnerability:

- Almost all buildings along Marin’s shoreline could be vulnerable to tidal and/or storm surge flooding.
- Many homes and their surroundings are built on filled bay mud and could sink, or subside, as the ground below saturates with water.
- According to utility managers, the earliest threats of flooding and subsidence may be to non-structural building components, such as utility and mechanical systems at or below grade. Malfunctions could make a building unusable even if the building is dry.⁴⁸
- Buildings untouched by rising tides may become isolated and cut off from essential services, such as wastewater service and roads.
- A large majority of existing armoring protecting buildings along the shoreline, except in Hamilton and the Redwood Landfill, could be overtopped daily after three feet of sea level rise.
- In San Rafael’s Canal neighborhood, one of the lowest income and most diverse areas of the shoreline, a large number of residents and businesses could be impacted in the near-term. By the end of the century the entire area could flood daily from the shoreline to I-580 and US-101.
- Several public facilities, including three schools, the Tiburon Fire Station, San Rafael Fire Station 54, Larkspur Ferry and emergency fuel tanks, and the Sewerage Agency of Southern Marin (SASM) wastewater treatment plant could be vulnerable in the near to medium-term.
- The Belvedere/Tiburon Post Office, San Rafael Main Post Office, San Rafael Transit Center, and seven schools could be vulnerable to sea level rise in the long-term.
- Several retirement and/or lower income communities are impacted in the long-term.
- The majority of impacted buildings are on residential parcels.

IMPACTS AT-A-GLANCE: SCENARIO 6

12,000+ homes, businesses, & institutions	100,000+ people
Billions of dollars in built assets vulnerable	Regional
Houseboats, mobile homes, multi-family housing, single-family housing	Property Owners County CDA Sausalito Mill Valley Belvedere Tiburon Corte Madera Larkspur Corte Madera San Rafael Novato



Lagoon homes on Boardwalk I, Corte Madera Creek, Larkspur. Credit: BVB Consulting LLC

⁴⁸ See Appendix A for a list of interviewed utility managers.

BUILDINGS

Structural Factors

Most of the vulnerable buildings in the study area, especially residential and office, are wooden single-story or two-story buildings, and are susceptible to water damage from flooding and storm surges. Buildings built prior to 1970 typically have T-footing foundations that extend 18 inches deep. Such buildings are prone to scouring from water hitting above their foundations, and their wooden floors are more likely to slide off the foundation. This foundation type is very common amongst the vulnerable buildings in the study area.

Homes built after 1970 are secured to drilled piles 20-30 feet deep with reinforced steel cages and concrete to connect the homes to the foundation. These buildings are engineered to resist settling and earthquake impacts, and could withstand lateral forces from water and wind during storms. However, much of the older housing along the shoreline was built beginning in the 1950's. Areas such as Almonte, Waldo Point Harbor, and Marin City in Southern Marin were built as work force housing under low budget conditions. In the Canal neighborhood, vulnerable buildings are a mix of apartment complexes, light industrial sites, and neighborhood commercial sites. One section, near Spinnaker Point, is a single family home subdivision that is not directly at risk until later in the century; however, vehicular access during high tides and storm surges may prove challenging before then.

In addition, Almonte, Belvedere, Santa Venetia, Paradise Cay, Bel Marin Keys, the Corte Madera shoreline, the Marinship neighborhood of Sausalito, and shoreline and downtown portions of San Rafael were built on bay fill and mud, and already experience subsidence. These areas could anticipate increased rates of subsidence as bay waters saturate the soil from the below. Tamalpais, Corte Madera, Santa Venetia, Bel Marin Keys, Belvedere, and Almonte are bordered by earthen berms, or levees, that provide protection under current sea levels; however, these structures could expect overtopping after three feet of sea level rise. Bel Marin Keys, Corte Madera, and Belvedere also manage lagoons that are relatively protected from tidal influences if properly managed and overtopping does not occur.

A few mobile home parks are at risk including the Los Robles Park in Novato, Marin Valley Country Club in Novato, Contempo Marin in San Rafael, Golden Gate Trailer Park in Larkspur, and Marin RV

Park in Greenbrae. All of these are relatively close to the shoreline marshes and are prone to flooding.

Floating homes are another major housing type in southern Marin and could be some of the most impacted. Many of these homes are tethered to pylons with u-locks that could float off the top of the pier if the tide is high enough. Others are tied with ropes that have their limits, and if the tides rise higher than the ropes, the boat could sink. The most vulnerable houseboat types, known as arks, are attached to the ground on a thick concrete foundation and do not fluctuate with the tides. About 20 arks are harbored in Richardson's Bay.

All 450 house boats in Richardson's Bay have the following vulnerabilities in common.

- They have utility lines tied to the docks and many of the docks are at a fixed elevation.
- Front entrances of many homes are on the lower level linked to the main dock with finger docks that go down or up with the tide. If the tide is too high, the finger docks may be dangerously slanted, or even flooded at one end or the other. These ramps are already relatively steep at king tides according to the Richardson Bay Floating Homes Association.
- In addition, the parking and access areas could be flooded and are already prone to continuous subsidence.

Area of Larkspur, Corte Madera, and Greenbrae could face similar impacts. Though unlike Waldo Point Harbor, metal utility pipes are fixed to the boardwalks.

Finally, though not buildings, unauthorized residential boats anchored in Richardson's Bay are highly vulnerable to storms and higher tides. According to the Richardson Bay Floating Homes Association, about 250 boats are in the Bay as residences, though some may be junk boats without residents.

Commercial structures, except for those on piers, and a few wooden structures, tend to be cinder block construction with stucco or paint sealing. Cinder block buildings built over twenty years ago are likely unreinforced and more vulnerable than newer reinforced buildings.

BUILDINGS



Greenbrae Boardwalk. April 2016. Credit: BYB Consulting LLC

Table 17. Vulnerable Buildings by Scenario

Scenario		Buildings	
		#	%
Near-term	1	717	1
	2	4,498	6
Medium-term	3	2,013	3
	4	5,608	7
Long-term	5	9,167	12
	6	12,138	16

Source: MarinMap, CoSMoS

Overall, Marin County shoreline properties, especially those on fill in the low-lying areas east of US Highway 101, are the most exposed and vulnerable to flooding, storm surges, and subsidence. The following sections present the available data for buildings in the near-, medium, and long-terms.

Near-term: Scenarios 1 & 2

In the near-term scenario 1, 10 inches of sea level rise, more than 700 buildings could be vulnerable to tidal flooding. The buildings are concentrated in:

1. San Rafael, 410 buildings,
2. Greenbrae, 72 buildings, and
3. Waldo Point Harbor, 61 buildings.

Table 18. Physical Vulnerabilities of Buildings

Factors	Influence
Building Elevation	<ul style="list-style-type: none"> At or below grade – If the lowest floor is as high as or below the flood level, it is susceptible to saltwater flooding. Mechanical or electrical equipment, pumps, utilities, heat, ventilation, power, openings (e.g. windows, entryways, or ventilation grates), etc. can be vulnerable if at or below grade.⁴⁹ Bluff top developments are highly vulnerable to erosion and scouring of the bluff toe.
Materials	<ul style="list-style-type: none"> Wooden buildings tend to be lighter and low-rise, and can incur structural damage.^{50, 51} Cinder block, brick, and reinforced concrete built buildings are heavier, taller, and less vulnerable to damage.⁵² Brick foundations are able to withstand up to 3 feet of flooding (highly unlikely unless building is very old).⁵³ Mobile and manufactured homes tend to be susceptible to flooding and may suffer in storm and high tide events.
Building Codes	<ul style="list-style-type: none"> Buildings built before modern building codes and FEMA requirements for flood prone areas will be more susceptible.⁵⁴
Surrounding environment	<ul style="list-style-type: none"> Buildings in areas without or failing shoreline armoring are more vulnerable.
Foundation	<ul style="list-style-type: none"> Older foundation types are more vulnerable to sea level rise. Buildings built on fill and/or bay muds could be vulnerable to worsening subsidence.

⁴⁹ The City of New York, *A Stronger, More Resilient New York* (2013), 75.

⁵⁰ Ibid.

⁵¹ Bay Conservation and Development Commission, *Housing Indicators Table*. Unpublished document.

⁵² The City of New York, *A Stronger, More Resilient New York* (2013), 75.

⁵³ Bay Conservation and Development Commission, *Housing Indicators Table*. Unpublished document.

⁵⁴ The City of New York, *A Stronger, More Resilient New York* (2013), 76.

BUILDINGS



Homes along San Pablo Bay, San Rafael. May, 2016. Credit: BVB Consulting LLC

Vulnerable buildings in San Rafael are concentrated in the Canal neighborhood, the lowest income and most diverse neighborhood in the region with many limited English proficient residents. Structures in Greenbrae and Waldo Point Harbor are houseboats that are highly vulnerable to higher high tides.

An additional storm surge, could impact more than 4,000 additional buildings, totaling six percent of the building stock in the study area. The top three communities with the highest number of vulnerable buildings under scenario 2 conditions are:

Table 19. Vulnerable Buildings in the Near-term

Location		Scenario 1		Scenario 2	
		#	%	#	%
Municipalities	San Rafael	410	2	1,846	10
	Larkspur	40	1	382	9
	Belvedere	32	2	84	5
	Tiburon	26	1	42	1
	Sausalito	21	1	113	4
	Novato	6	0	17	0
	Corte Madera	5	0	255	7
	Mill Valley	5	0	207	3
Unincorporated Jurisdictions	Greenbrae	72	59	112	91
	Waldo Point	61	16	89	23
	Bel Marin Keys	20	3	118	17
	Almonte	7	1	63	7
	Strawberry	7	0	58	3
	Paradise Cay	4	1	48	16
	Tiburon	1	0	18	6
	Santa Venetia			911	41
	Tamalpais			100	3
	Black Point			15	1
	North Novato			7	0
	Country Club			5	1
	Bayside Acres			3	1
	Pt. San Pedro			2	2
	China Camp			1	9
De Silva Island			1	6	
Total		717	1	4,498	6

Source: MarinMap, CoSMoS

1. San Rafael, 2,000 buildings
2. Santa Venetia, 900 buildings, and
3. Larkspur, 400 buildings.

Of note, 250 buildings in Corte Madera, and 207 in Mill Valley could also experience flooding under the conditions of scenario 2.

By percent of building stock impacted under scenario 1 conditions, the top three vulnerable communities would be:

1. Greenbrae, 59 percent,
2. Waldo Point Harbor, 16 percent, and
3. Bel Marin Keys, 3 percent of buildings in the community.

BUILDINGS

These figures are presented in [Table 19](#). During, a storm, significantly more buildings could be at risk, amounting to seven percent of buildings in the County. The top three communities by portion of building stock flooded are:

1. Greenbrae, 91 percent,
2. Santa Venetia, 42 percent, and
3. Waldo Point Harbor, 23 percent of buildings in the community.

These numbers are cause for concern in some of Marin’s most unique small communities. And while this flooding may only be temporary, nuisance storm flooding could be reoccurring and devastating.

Flood Depth

Each property could flood with a different amount of water depending on the property’s proximity to the Bay and its tributaries. While some buildings may be able to avoid some flooding because they are elevated above ground level, determining which of the 12,000 exposed buildings are elevated and by how much is beyond the scope of this report. Thus, the analysis in [Table 20](#) assumes all vulnerable buildings are situated at ground level. This table illustrates how many of the vulnerable buildings are flooded with one, two, or ten feet of water in scenarios scenario 1, 3, and 5. Storm surge flooding in scenarios 2, 4, and 6, would add an additional three feet of flooding to the figures. In scenario 1, a majority of the vulnerable buildings could expect up to 3 feet of tidal flooding at MHHW. Flooding could be deeper at the highest tides and shallower at low tides. A few buildings could expect up to 9 or 10 feet of tidal flooding in the near-term.

Medium-term: Scenarios 3 & 4

In the medium-term, several more buildings in the communities vulnerable in the near-term could be flooded, especially during a 100-year storm surge. At 20 inches of sea level rise, scenario 3, over 2,000 buildings across the study area could be vulnerable to tidal flooding, about twice as many as in the near-term. By community the communities with the most buildings vulnerable to tidal flooding are:

1. San Rafael, 1,088 buildings,
2. Larkspur, 165 buildings, and
3. Corte Madera, 138 buildings.

Table 20. Vulnerable Buildings by Flooding* at MHHW in Near-term Scenario 1

Average Flood Level (feet)	Number of Buildings
0.1-1	156
1.1-2	204
2.1-3	284
3.1-4	48
4.1-5	9
5.1-6	9
6.1-7	7
7.1- 8	8
8.1-9	3
9.1- 10	1

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

Source: MarinMap, CoSMoS

San Rafael’s Canal neighborhood continues to experience the most severe flooding. In Larkspur, the vulnerable buildings are on Boardwalk One and along the Corte Madera Creek. A stormy bay could surge waters into more properties in these communities and have some striking impacts in additional communities. The top three communities with the highest number of buildings vulnerable to storm surge flooding are:

1. San Rafael, 2,097 buildings,
2. Larkspur, 1,200 homes, and,
3. Santa Venetia, 945 buildings.

While San Rafael and Larkspur continue to expect worsening conditions, communities that are otherwise protected by some type of armoring to tidal flooding could flood during a 100-year storm surge combined with 20 inches of sea level rise. This includes Santa Venetia and Corte Madera. Sausalito could expect flooding in the Marinship and Old Town neighborhoods. Of note, Mill Valley’s Redwoods Community, and several hundred additional buildings near Richardson’s Bay, could experience storm surge flooding in this time period.

By percentage of buildings stock impacted, unincorporated water based communities could

BUILDINGS

expect the worst conditions, similar to the near-term. The top three communities that could expect the greatest portion of their building's flooded are:

1. Greenbrae, 66 percent,
2. Waldo Point Harbor, 23 percent, and
3. Paradise Cay, 17 percent of buildings in the community.

These small communities are surrounded by tidal water at high tides today. They incorporate boating and the water as a way of life, and are aware of the risks. Adding a storm surge at this level of sea level rise could even devastate some of these smaller bay oriented communities.

1. Greenbrae, 66 percent,
2. Santa Venetia, 42 percent, and
3. Paradise Cay, 26 percent of buildings in the community.

In addition, Bel Marin Keys and Corte Madera could expect about quarter to a fifth of their buildings stock compromised during a storm surge. Corte Madera could expect impacts in the San Clemente and Paradise Drive area. Note also that these communities were built on fill and thus, vulnerable to increased rates of subsidence.



East pier, Kappas Marina house boats, Waldo Point Harbor, March 10, 2016. Credit: BVB Consulting LLC

Table 21. Vulnerable Buildings in the Medium-term

Location	Scenario 3		Scenario 4		
	#	%	#	%	
Municipalities	San Rafael	1,088	6	2,097	11
	Larkspur	165	4	670	13
	Belvedere	65	4	90	5
	Tiburon	42	1	44	1
	Sausalito	67	2	133	4
	Novato	17	0	56	0
	Corte Madera	138	4	804	21
	Mill Valley	7	0	325	5
Unincorporated Jurisdictions	Greenbrae	81	66	115	98
	Waldo Point	87	23	90	23
	Bel Marin Keys	92	13	176	25
	Almonte	30	3	84	9
	Strawberry	33	2	117	7
	Paradise Cay	52	17	80	26
	Tiburon	13	4	18	6
	Santa Venetia	2	0	945	42
	Tamalpais	2	0	103	4
	Black Point	18	2	30	3
	North Novato	2	0	183	11
	Country Club	6	1	6	1
	Bayside Acres	2	1	5	2
	Pt. San Pedro	2	2	4	5
	China Camp	1	9	1	9
De Silva Island	1	6	1	6	
Kentfield			11	0	
Total	2,013	3	5,608	7	

Source: MarinMap, CoSMoS

BUILDINGS

Table 22. Vulnerable Buildings by Average Flooding* at MHHW in the Medium-term

Average Flood Level (feet)	Number of Buildings
0.1-1	342
1.1-2	469
2.1-3	366
3.1-4	281
4.1-5	118
5.1-6	30
6.1-7	47
7.1- 8	54
8.1-9	20
9.1- 10	2
10.1+	4

*Depth data is not available for every vulnerable asset.

Source: MarinMap, CoSMoS

Flood Depth

In the medium-term, the portion of buildings vulnerable to three feet or less greatly increases with several hundred more buildings subject to this level of flooding. Nearly 500 buildings are vulnerable to deeper flooding of four to eight feet deep. Additionally, over 20 buildings could experience up to nine feet of flood waters.

Long-term: Scenarios 5 & 6

In long-term scenario 5, more than 9,130 buildings, 12 percent of all buildings in the study area, could be directly affected by sea level rise. With the 100-year storm surge added, scenario 6, 12,138 buildings, making up 16 percent of buildings in the study area could flood.

By number, San Rafael, Corte Madera, Santa Venetia, and Bel Marin Keys have the highest number of vulnerable parcels across every scenario. Figures for the top three are:

1. San Rafael 2,495 buildings
2. Corte Madera, 1,283 buildings, and
3. Santa Venetia, 982 buildings.

Several hundred other buildings in Larkspur, Belvedere, Mill Valley, and Novato could be vulnerable as well. And more than 100 buildings

could be vulnerable to tidal flooding at 60 inches of sea level rise.

Table 23. Vulnerable Buildings in the Long-Term

Location	Scenario 5		Scenario 6			
	#	%	#	%		
Municipalities	San Rafael	2,495	13	3,247	18	
	Larkspur	802	19	1,160	28	
	Belvedere	423	24	470	27	
	Tiburon	153	4	261	7	
	Sausalito	154	5	299	10	
	Novato	672	4	871	5	
	Corte Madera	1,283	33	1,468	38	
	Mill Valley	329	5	536	8	
	Unincorporated Jurisdictions	Greenbrae	119	97	120	98
		Waldo Point	90	23	386	100
Bel Marin Keys		683	96	707	99	
Almonte		86	9	106	11	
Strawberry		185	11	264	15	
Paradise Cay		157	51	219	71	
Tiburon		17	6	23	7	
Santa Venetia		982	44	1,142	51	
Tamalpais		98	3	103	4	
Black Point		65	6	89	8	
North Novato		219	14	268	17	
Country Club		18	4	21	4	
Bayside Acres		5	2	6	3	
Pt. San Pedro		21	24	25	29	
China Camp		1	9	1	9	
De Silva Island		1	6	1	6	
Kentfield		79	3	247	8	
St. Vincent's	10	11	16	18		
San Quentin	10	3	32	9		
California Park	10	5	13	6		
Marin City	1	0	38	9		
Study Area	9,167	12	12,138	16		

Source: MarinMap, CoSMoS

BUILDINGS



Homes in Black Point on San Pablo Bay. Credit: Marin County CDA

Table 24. Number of Vulnerable Buildings by Average Flood* Level at MHHW in the Long-term

Average Flood Level (feet)	Number of Buildings
0.1-1	564
1.1-2	1,235
2.1-3	1,344
3.1-4	1,762
4.1-5	1,486
5.1-6	1,011
6.1-7	489
7.1- 8	290
8.1-9	289
9.1- 10	167
10.1+	298

*Flood depth data is not available for every vulnerable asset. Source: MarinMap, CoSMoS

Across the scenarios, San Rafael is one of the most vulnerable communities, especially in the Canal Area. According to San Rafael asset managers, vulnerable buildings, in addition to multi-family, and some single family housing, include thirty grocery stores, ten pharmacies, sixteen medical clinics, 48 doctor offices, 35 childcare facilities, five residential care facilities, seven convalescent facilities, 16 gas

stations, 29 building supply stores, and other critical facilities. These businesses either contain essential goods like medications and access to medical and buildings supplies after a major storm or flooding event or house some of the most vulnerable populations in the region.

By percentage of buildings stock impacted, unincorporated water based communities could still expect the greatest impacts, similar to previous observations. The top three communities with the largest portion of their building stock that could flood at mean higher high tide are:

1. Greenbrae, 97 percent,
2. Bel Marin Keys, 96 percent, and
3. Santa Venetia, 44 percent of buildings in the community.

The top two of these communities are tidally flooded in their near-entirety. A 100-year storm surge at this level of sea level rise would devastate some of these smaller bay oriented communities.

1. Waldo Point Harbor, 100 percent,
2. Bel Marin Keys, 99 percent, and
3. Greenbrae, 98 percent of buildings in the community.

Flood Depth

In the long-term, over 3,000 buildings could be vulnerable to at least three feet of flooding, with more than 4,000 additional buildings experiencing more than three feet to six feet of flooding. An additional 1,000 buildings could be vulnerable to depths greater than 6 feet, with several hundred flooded by nine to ten feet of saltwater.

Table 25 lists some of the vulnerable buildings along Marin's eastern shoreline. This list shows onset and tidal mean higher high water (MHHW) for neighborhoods, and in some cases, specific buildings were assessed.

BUILDINGS

Table 25. Example Vulnerable Buildings^a Assets Ranked By Onset and Flooding at MHHW

Location	Asset	Scenario 1	Scenario 2	Scenario 3
		Near-term	Medium-term	Long-term
Sausalito	GGF Sausalito Ferry facilities	No data ^b		
Tiburon	Tiburon Ferry facilities	No data ^b		
Tiburon	Tiburon Waterfront	9'2"	9'11"	12'9"
Belvedere	West Shore Road homes	0-5'10"	0-6'5"	3"-9'3"
San Rafael	Canal neighborhood/ Spinnaker Pt.	0-5'3"	6"-5'	1"-7'4"
Greenbrae	Boardwalk homes north of 101	0-5'	0-5'8"	3'-8'6"
Larkspur	Golden Gate Ferry Terminal buildings	0-5'	2'9"-5'4"	2'9"-6'9"
Greenbrae	Boardwalk homes south of 101	0-4'9"	0-5'5"	5'-8'5"
Corte Madera	Marina Village	0-3'5'	0-4'	11'-6'5"
Larkspur	Boardwalk One	2"-3'	5"-3'10"	3'2"-6'5"
Belvedere	Corinthian Hill homes	2'10'	3'2"	4'7"
Bel Marin Keys	Homes west of Bel Marin Keys Blvd.	0-2'7"	0-3'	3"-8'2"
Paradise Cay	Homes	0-2'4"	0-2'8"	5'3"
Larkspur	Industrial and commercial east of Hwy 101	0-1'9"	0-2'4"	2'2"-6'7"
San Rafael	GGBHTD headquarters & bus depot	0-1'6"	0-2'4"	4'2"-5'
Corte Madera	Mariner Cove neighborhood	0-1'3"	0-2'	1"-5'3"
Larkspur	Riviera Circle homes	0-10"	0-1'7"	1"-5'2"
San Rafael	Bahia Vista Elementary School	8"	2'3"	4'8"
Belvedere	Beach Road homes	6"	2'2"	4'
Waldo Point	Businesses		0"-7'7"	1'5"-10'10"
Strawberry	Greenwood Cove homes		0"-6'3"	6"-8'
Sausalito	Marinship neighborhood		0-6'	11"-9'
San Rafael	Peacock Gap Lagoon and golf course homes		0-6'	2"-8'9"
Santa Venetia	Santa Venetia homes		1"-3'6"	2"-6'7"
Corte Madera	Paradise Dr. auto dealerships and commercial		0-3'	2'-8'2"
Bel Marin Keys	Homes east of Bel Marin Keys Blvd.		1"-2'	3"-5'
Almonte	Shoreline development		0-2'	1'8"-5'
Tiburon	Tiburon Blvd. shopping		4"-2'	10"-4'2"
Greenbrae	Marin RV Park		0-1'10"	3'5"-6'8"
Tamalpais	Birdland Neighborhood		0-1'10"	2"-5'9"
Tamalpais	Tam Junction commercial		0-1'10"	2"-5'
Corte Madera	Aegis Senior Living		1'9"	4'7"
Tiburon	Cove Shopping Center		1'8"	3'11"
Mill Valley	Shelter Bay development		0-1'3"	5"-4'5"
Almonte	Caltrans Corporation Yard		1'	4'
San Rafael	Marin Community Clinic		10"	3'8"
Corte Madera	CA Highway Patrol Marin office		9"	6'
San Rafael	Marin County Health Innovation Campus		4"	3'4"
San Rafael	Montecito Plaza		1"	2'2"
Novato	Hamilton neighborhood			2"-12'4"
Novato	Vintage Oaks Shopping Center			5"-9'4"
Larkspur	Golden Gate Mobile Home Park			2'-8'4"
Belvedere	Belvedere Lagoon homes			5"-7'9"

BUILDINGS

Location	Asset	Scenario 1	Scenario 2	Scenario 3
		Near-term	Medium-term	Long-term
Corte Madera	Neil Cummins Elementary School			7'6"
Corte Madera	Madera Gardens			2'-7'4"
Larkspur	Heatherwood neighborhood			7'
San Rafael	Marin Lagoon			6"-7'
Corte Madera	Corte Madera Town Center Commercial			5'
North Novato	Binford Road Business Park			5'
San Rafael	Davidson Middle School			4'10"
Strawberry	Strawberry Circle homes			1'4"-4'8"
Mill Valley	Sycamore neighborhood			3"-4'5"
Larkspur	Multi-family on Larkspur Plaza Dr.			4'5"
Strawberry	Commercial along Seminary Marsh			5"-4'
Novato	NSD Wastewater treatment plant			4"-4'
Larkspur	San Andreas High School			4'
Mill Valley	Redwood Retirement Residential			7"-3'5"
Tiburon	Post Office			3'11"
Kentfield	Apartments/offices off Sir Francis Drake Blvd.			3'10"
Larkspur	Redwood High School			3'4"
Strawberry	Homes along Seminary Dr.			7"-3'2"
San Rafael	Downtown			1"-3'2"
Larkspur	Tamiscal High School			3'
San Rafael	PG&E office and yard			3'
San Rafael	Ritter Clinic			2'10"
Mill Valley	Mill Valley Shopping Center			6"-2'6"
Tiburon	Tiburon Fire Station			2'6"
Kentfield	Homes along McCallister Slough			6"-2'5"
San Rafael	San Rafael Transit Center			2'5"
Tiburon	Town Hall			2'4"
Tiburon	Library			2'4"
Mill Valley	SASM wastewater treatment plant			2'3"
Corte Madera	Cove Elementary School			2'3"
San Rafael	San Rafael High School			2'2"
San Rafael	Marin County Emergency Services			2'2"
Corte Madera	The Village at Corte Madera			5"-2'
Corte Madera	Aegis Senior Living			1'10"
Kentfield	Homes along Beren's Slough			10"-1'8"
Corte Madera	Marin Montessori			1'7"
Belvedere	Belvedere Corp Yard			1'5"
Bel Marin Keys	Bel Marin Keys CSD office			1'3"
Strawberry	Westminster Presbyterian Church & Preschool			1'2"
Larkspur	Tamalpais Adult School			1'2"
Mill Valley	Mill Valley Middle School temporary buildings			1'2"

^aFor groups of buildings, a maximum flood depth is provided. ^bNo data provided for facilities located in water beyond mean sea level. Source: CoSMoS, MarinMap. Credit: BVB Consulting LLC

BUILDINGS

All of these assets are also vulnerable to an additional 3 feet of storm surge flooding during a 100-year storm surge, not accounting for precipitation on the site. In addition, the following structures could be vulnerable to an additional storm surge at 60 inches of sea level rise:

- Marin Country Day School, Corte Madera (emergency shelter),
- Martin Luther King Jr Academy Marin City,
- Tamalpais High School Mill Valley,
- Glenwood Elementary School San Rafael,
- Anthony G Bacich Elementary School, Kentfield,
- Adaline E Kent Middle School, Kentfield,
- Strawberry Point Elementary School,
- Belvedere City Hall, Police Department, Community Center
- Sanitary District No. 5 Paradise Cove treatment plant, Unincorporated Tiburon,
- Strawberry Village Shopping Center,
- Alto Shopping Center,
- Marin County Expo Center and Amphitheater, Santa Venetia,
- Novato Corp Yard,
- Las Robles Mobile Home Park Novato,
- Novato Fire Association office,
- Holy Innocents Episcopal, Corte Madera (emergency shelter),
- Marin Lutheran Church, Corte Madera (emergency shelter), and
- College of Marin, Kentfield.



Tamalpais High School athletic fields along Richardson's Bay. Nov. 25, 2015. 10:40 a.m. Credit: Light Hawk Aerial

Public Facilities

Vulnerable government, or public, facilities include: 24 schools, five fire stations, Larkspur Landing ferry facilities, SASM wastewater treatment plant, Golden Gate Bridge, Highway and Transportation District bus depot and maintenance facilities in San Rafael, and the CA Highway Patrol Marin Office could be vulnerable in the near to medium-term.

The post offices in Tiburon and San Rafael's Bellam Boulevard location and the San Rafael Transit Center could be vulnerable nearing the end of the century. The Marin County Expo Center and Amphitheater is also vulnerable near the end of the century. To learn more about fire, police, and emergency shelter facilities see the Emergency Services Profile. For more information on transportation related facilities, see the Transportation Profile.

Several community centers including the Belvedere Community Center, Mill Valley Recreation Center, Corte Madera Community Center, and Belvedere CSD building could be vulnerable in the long-term. The Belvedere Community Center is housed in the same building as the police department and city hall. The Mill Valley Recreation Center also functions as an emergency shelter.

Also of concern are potentially vulnerable corporation yards in Belvedere and Novato. Corporation yards often contain heavy machinery and fuel tanks for refueling public fleets. These places often also contain tools that would be useful in emergencies and disaster recovery that could be threatened by flooding.

Though the buildings are not directly impacted, North Marin Water District headquarters and yard could experience access issues at high tide in the long-term, and could expect greater impacts in combination with stormwater flooding. The Central Marin Sanitation Agency treatment plant could also experience vehicular access issues nearing the end of the century. This could prevent employees from arriving at work to conduct the necessary operations and maintenance work that needs to be completed. For more details on buildings and facilities related to sanitary or water districts, see the Utilities profile. For parcels related to recreation, see the Recreation Profile.

BUILDINGS

Schools (Private and Public)

Schools vulnerable to sea level rise are listed in [Table 26](#). Marin Montessori, Corte Madera, and Bahia Vista, San Rafael, could be vulnerable to storms at scenario 2 and to sea level rise by scenario 3. Neil Cummins Elementary, Corte Madera, is vulnerable to storms at 20 inches of sea level rise and is vulnerable to sea level rise at 60 inches, scenario 5, along with Cove Elementary School, Corte Madera, Tamiscal High School, Larkspur, Anthony G Bacich Elementary School, Kentfield, and Westminster Presbyterian Church Preschool, Tiburon. The remainder, and majority, of schools in the table are not vulnerable to sea level rise alone and can be found under scenario 6, with 60 inches of sea level rise and a 100-year storm surge.

Additionally, several of these schools, including Neil Cummins Elementary, Adeline E. Kent Middle School, and Anthony G Bacich Elementary School already experience stormwater back up flooding during high tides, and as time continues this confluence of flooding could worsen.

Once high tide reaches the school grounds they could likely be lost to marshlands. In many cases the athletic fields are compromised first. At Tamalpais High School, the only portion impacted by sea level rise alone is the low lying athletic fields. Flooding can debilitate a school's ability to perform, especially if the buildings are compromised. In 2005, the Cove School experienced a 6.5 foot king tide and a 2.5 foot stormwater level that shut down half of the school for two weeks of reconstruction. During this time, students doubled in the useable space.

In addition to the school property being impacted directly, the schools are also impacted by the ability of students, teachers, and staff to access the location. This is the case at nearly every school on the list. And, aside from busing in the Novato School District, all other students arrive individually by vehicle or non-motorized means. If too few students are able to travel, schools that are funded with state equalization aid, and required to meet an average daily attendance threshold, could experience losses in funding and capacity, and more frequent closures.

These issues are also a concern for childcare facilities, where the child population is typically younger than school-aged. Children at thirty-five different childcare facilities could be vulnerable in

San Rafael alone. The Westminster Presbyterian Church's preschool also falls in this category.

Table 26. Schools Vulnerable to Sea Level Rise and the 100-year Storm Surge

	Scenario			
	2	4	5	6
Corte Madera		Neil Cummins Elem.	Schools in scenario 4 Marin Montessori Cove Elem.	Schools in scenarios 4 & 5 Marin Country Day School
Larkspur			Tamiscal High	Schools in scenario 5 Redwood High Henry Hall Middle School San Andreas High
Marin City			Martin Luther King Jr Academy (Middle)	Schools in scenario 5
Mill Valley			Mill Valley Middle School	Schools in scenario 5 Tamalpais High
San Rafael	Bahia Vista Elem. Trinity Preschool	See scenario 2	Schools in scenarios 2 & 4 Davidson Middle San Rafael High	Schools in scenarios 2, 4 & 5 Glenwood Elem.
Kentfield			Anthony G Bacich Elem. Adaline E Kent Middle	Schools in scenario 5
Strawberry			Strawberry Point Elem. Westminster Pres. Church Preschool	Schools in scenario 5

Source: MarinMap, CoSMoS

Medical Facilities

Several medical facilities, large and small could be vulnerable, and access to nearly all other in the study could be impeded from the east. Medical facilities in the tidally flooded area are:

BUILDINGS

- Marin Community Clinic, on Kerner Boulevard in San Rafael, is vulnerable to near-term storm surges, and medium-term sea level rise.
- Marin County Health, on Kerner Boulevard in San Rafael, is vulnerable to near-term storm surges, and medium-term sea level rise.
- Passport Health, on Eliseo Drive in Larkspur, is vulnerable to long-term tidal flooding, with worse conditions during a 100-year storm surge.
- Ritter Health Center, on Ritter Street in San Rafael, is vulnerable to long-term sea level rise flooding, with worse conditions during a 100-year storm surge.
- Marin County Emergency Medical Services, on Mitchell Boulevard in San Rafael, is vulnerable to long-term sea level rise flooding, with worse conditions during a 100-year storm surge.

The parking lots are also compromised on most of these sites. And while all emergency medical facilities are outside of the vulnerable area, access to them through the flooded area could be limited, leading to further injury, or worse, loss of life.

Retirement and Assisted Living

Several sites house people who are older in age and may have limited mobility or sensory abilities. These people may be especially vulnerable in floods, power outages, and other events that could isolate them. The locations that could be impacted are:

- The Redwood's, Mill Valley,
- South Eliseo Convalescent Home, Larkspur,
- Aegis, Corte Madera,
- Contempo Marin, San Rafael,
- Los Robles Park, Novato,
- Aegis, San Rafael,
- Golden Home Extended Care, San Rafael,
- Miracle Hands Homecare, San Rafael,
- Saint Michael's Extended Care, San Rafael,
- Schon Hyme Rest Home, San Rafael,
- All Saints Extended Care, Inc., San Rafael,
- Country Villa San Rafael,
- Harmony House, San Rafael,
- Kindred Transitional Care & Rehabilitation, San Rafael,
- Pine Ridge Care Center, San Rafael,
- San Rafael Care Center, Inc., and
- San Rafael Healthcare & Wellness Center, LP.

Potential Damages

Using the FEMA Hazus scale applied in post-disaster assessments for debris⁵⁵ Table 27 estimates the cost of damages to buildings and their contents depending on the severity of damage. This analysis uses scenario 6, the worst case scenario with a storm surge strong enough to cause significant damage. A smaller surge may cause minor damage, where as a large surge would cause moderate damage or even destroy buildings. This analysis assumes all buildings in scenario 6 are impacted either at a minor, moderate, or major level, and not a mix of minor, moderate, and major, which would likely reflect reality more closely.

According to the *Structure Debris Estimates: Hazus Level 1 Flood and Wind Losses*,⁵⁶ building damage costs⁵⁷ are assigned as:

- Yellow Tag
 - Affected: Loss is \$0 to \$5,000, or 2.05 tons of debris per 1,000 square feet.
 - Minor: Loss is \$5,001 to \$17,000, or 4.1 tons of debris per 1,000 square feet.
- Orange Tag: Loss is greater than \$17,000 or 8 tons of debris per 1,000 square feet.
- Red Tag: Destroyed as defined by the FEMA inspector.



Waldo Point Houseboats. Nov. 24, 2015. Credit: Marin County DPW

⁵⁵ ArcGIS. FEMA Modeling Task Force (MOTF)-Hurricane Sandy Impact Analysis. Last update June 22, 2015. <http://www.arcgis.com/home/item.html?id=307dd522499d4a44a33d7296a5da5ea0>

⁵⁶ Federal Emergency management Agency (FEMA) Website. Hazus. Last updated July 8, 2015. <http://www.fema.gov/hazus>

⁵⁷ 2016 dollars

BUILDINGS

By long-term scenario 6, if all vulnerable buildings experience minor injury, \$60 million (2016 dollars) in damages could occur. If all of the buildings are moderately damaged, more than 200 million in damages could be incurred. If all of the buildings were to be destroyed by a storm surge and/ or lost to tidal flooding the assessed value of that lost buildings could surpass \$6 billion (2016). If the land cannot be reclaimed for development, another \$9 billion in assessed land value would be lost, totaling, \$15 billion (2016 dollars) in assessed value. Reality would likely reflect a mix of these outcomes, costs would be incurred gradually in the previous decades,

and damaging storm surges could occur multiple times within the timeframe of this assessment.

Maps on the following pages show vulnerable buildings by onset and location. Buildings in the southern portion could be vulnerable sooner than those in the northern portion of the study area. 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. For even closer imagery, see the Community Profiles.

Table 27. Damage Cost^a Estimates Applied to Vulnerable Buildings in Long-term Scenario 6

Location		Yellow Tag-Minor	Orange Tag-Moderate	Red Tag-Destroyed
		\$5,000/building minimum	\$17,001/building minimum	Assessed structural value
Municipalities	San Rafael	\$16,235,000	\$55,202,247	\$1,496,065,489
	Corte Madera	\$7,340,000	\$24,957,468	\$726,321,314
	Larkspur	\$5,800,000	\$19,721,160	\$1,496,649,606
	Novato	\$4,355,000	\$14,807,871	\$629,369,009
	Mill Valley	\$2,680,000	\$9,112,536	\$300,215,511
	Belvedere	\$2,350,000	\$7,990,470	\$356,209,805
	Sausalito	\$1,495,000	\$5,083,299	\$228,617,482
	Tiburon	\$1,305,000	\$4,437,261	\$187,457,062
Unincorporated Jurisdictions	Santa Venetia	\$5,710,000	\$19,415,142	\$124,787,181
	Bel Marin Keys	\$3,535,000	\$12,019,707	\$188,722,172
	Waldo Point	\$1,930,000	\$6,562,386	\$21,056,654
	North Novato	\$1,340,000	\$4,556,268	\$7,911,796
	Strawberry	\$1,320,000	\$4,488,264	\$214,941,911
	Kentfield	\$1,235,000	\$4,199,247	\$99,778,853
	Paradise Cay	\$1,095,000	\$3,723,219	\$123,268,429
	Greenbrae Brdwlk	\$600,000	\$2,040,120	\$8,836,871
	Almonte	\$530,000	\$1,802,106	\$37,738,121
	Tamalpais	\$515,000	\$1,751,103	\$22,654,207
	Black Point	\$445,000	\$1,513,089	\$15,807,484
	Marin City	\$190,000	\$646,038	\$24,685,548
	San Quentin	\$160,000	\$544,032	\$689,013
	Pt. San Pedro	\$125,000	\$425,025	\$33,137
	Tiburon	\$115,000	\$391,023	\$36,868,808
	Country Club	\$105,000	\$357,021	\$6,311,404
	St. Vincent's	\$80,000	\$272,016	\$4,477,392
California Park	\$65,000	\$221,013	\$1,508,352	
Bayside Acres	\$30,000	\$102,006	\$5,340,362	
Total	\$60,690,000	\$206,358,138	\$6,366,322,973	

^a2016 dollars. Source: MarinMap, CoSMoS, FEMA

BUILDINGS

Map 12. Northern Study Area Vulnerable Buildings

Vulnerable Assets

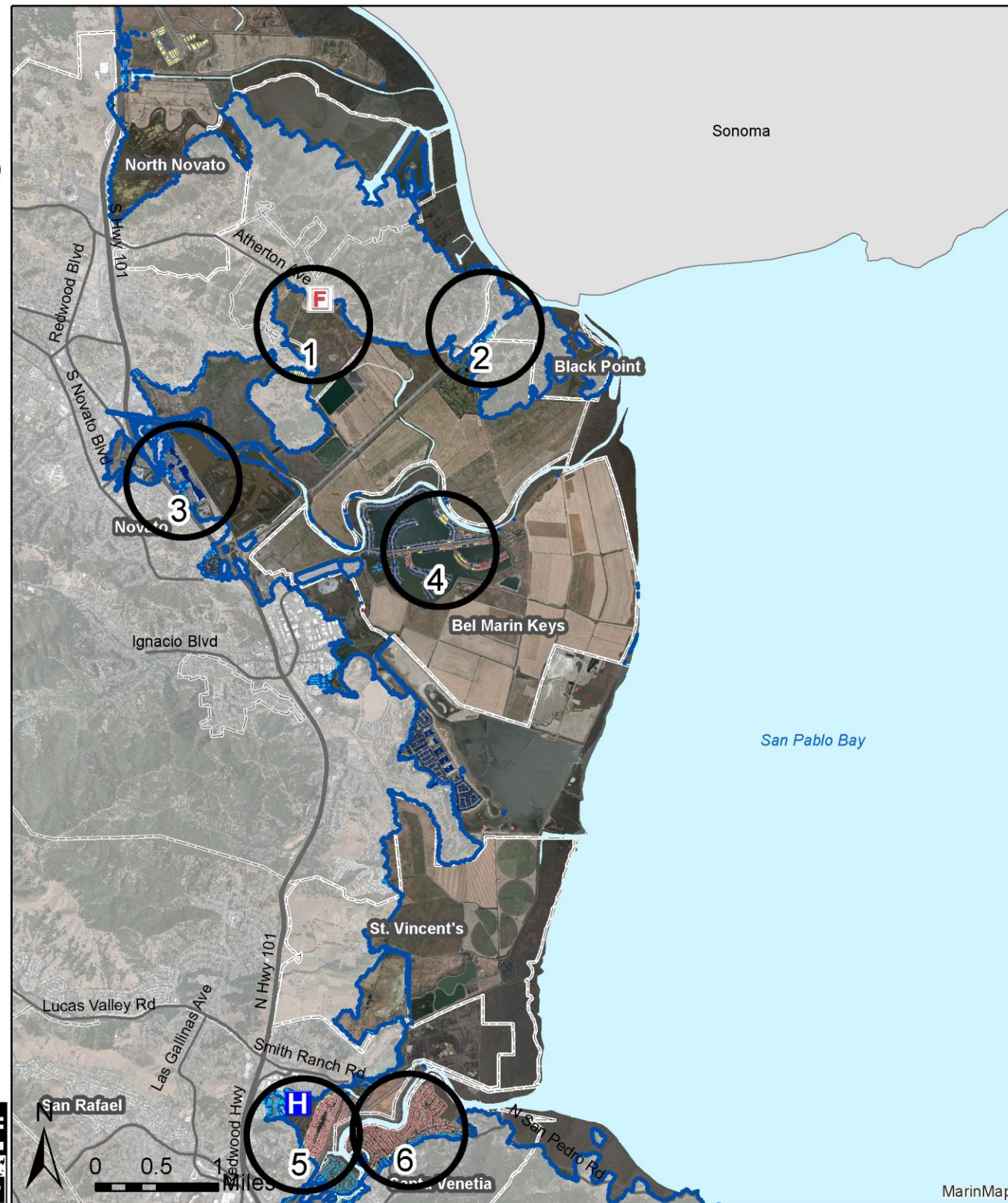
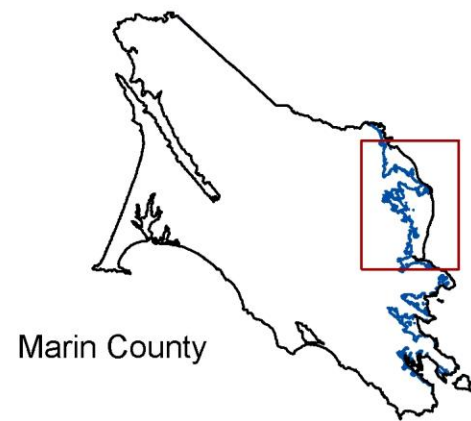
- F** Fire Station
- H** Medical Facility

Vulnerable Buildings

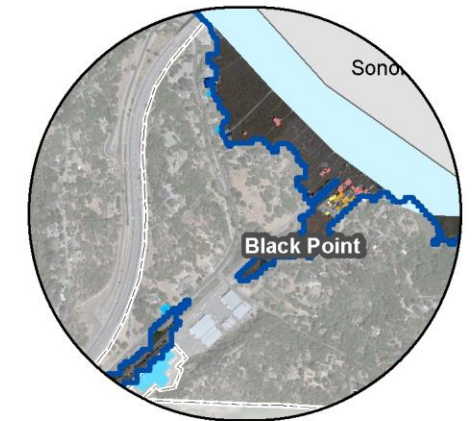
- Scen. 1: 10" Sea Level Rise (SLR)
- Scen. 2: 10" SLR+Storm Surge
- Scen. 3: 20" Sea Level Rise
- Scen. 4: 20"SLR+Storm Surge
- Scen 5: 60" Sea Level Rise
- Scen. 6: 60"SLR+Storm Surge

Location Indicators

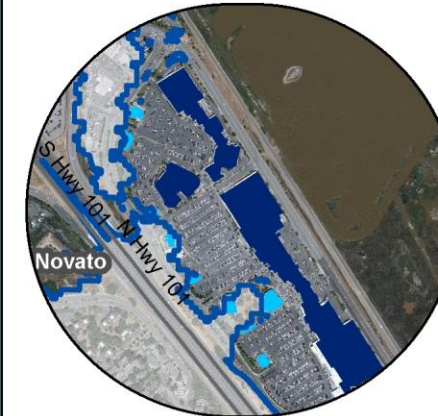
- Unincorporated
- Municipality
- Road
- Bay
- Inland Extent: Sea Level @ 60"+100-year Storm



1: Green Point



2: Black Point



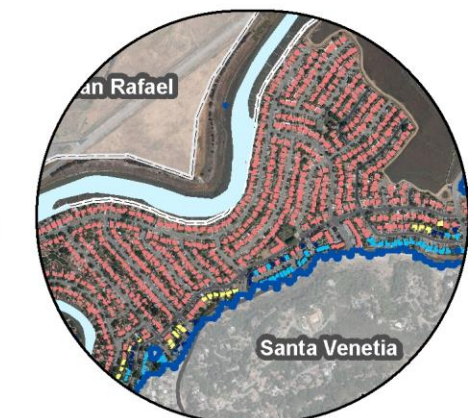
3: Vintage Oaks Shopping Center



4: Bel Marin Keys



5: Western Santa Venetia



6: Eastern Santa Venetia

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



Date: 3/30/2017



BUILDINGS

Map 13. Southern Study Area Vulnerable Buildings





Vulnerable Assets

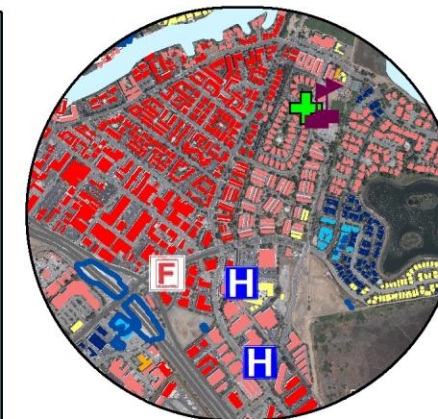
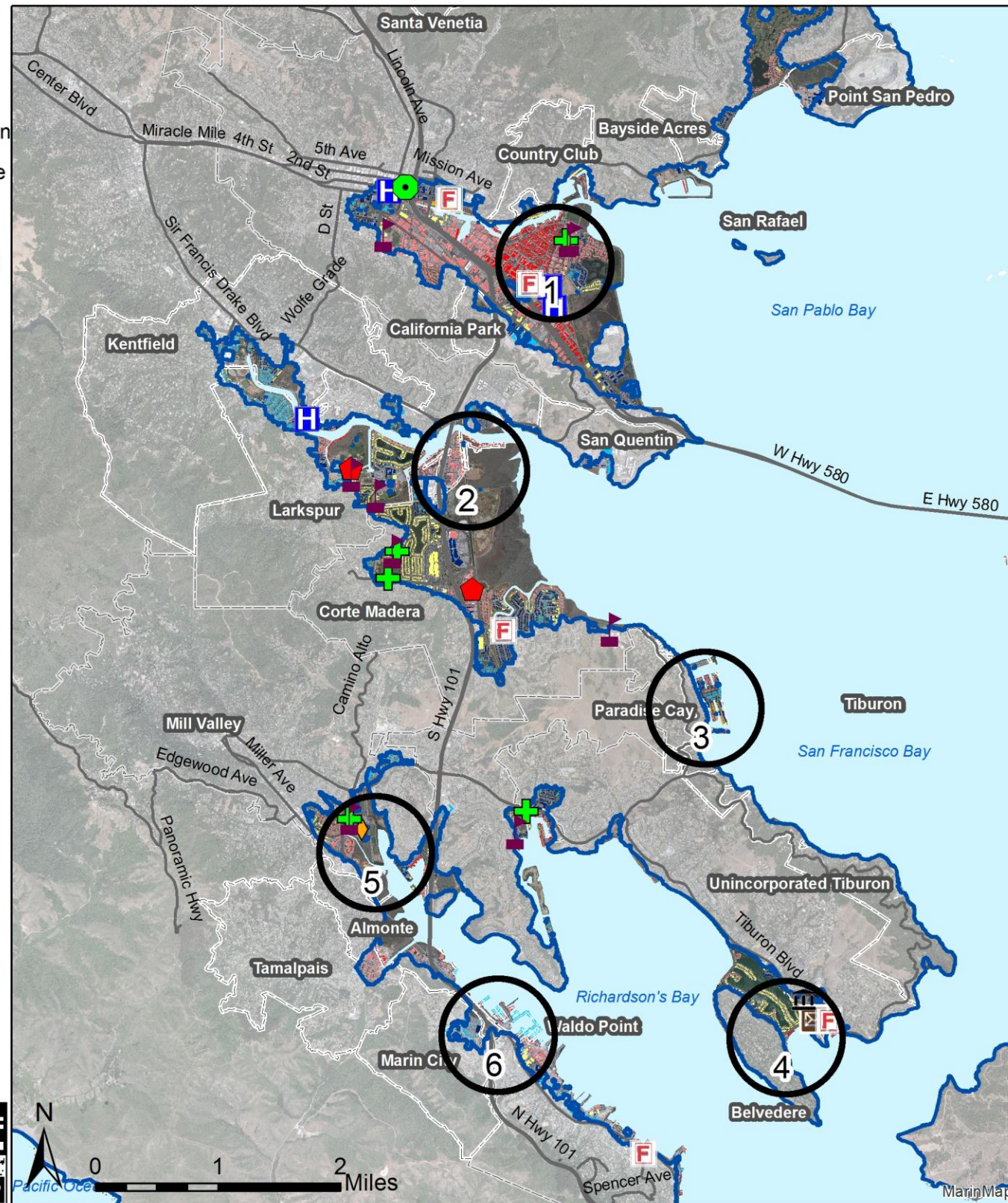
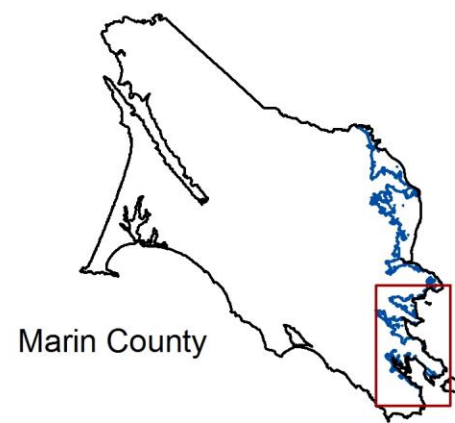
-  District Office
-  SMART Station
-  Medical Facility
-  Law Enforcement
-  Emergency Shelter
-  School
-  City Hall
-  Fire Station
-  Post Office

Vulnerable Buildings

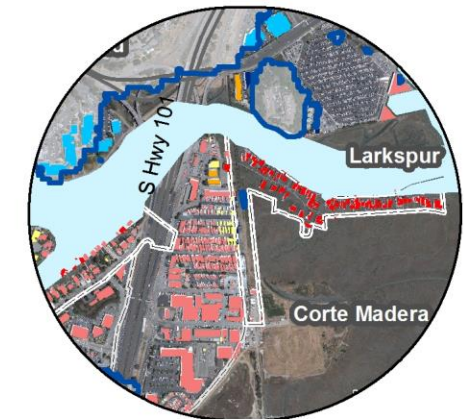
-  Scen. 1: 10" Sea Level Rise (SLR)
-  Scen. 2: 10" SLR+Storm Surge
-  Scen. 3: 20" Sea Level Rise
-  Scen. 4: 20" SLR+Storm Surge
-  Scen. 5: 60" Sea Level Rise
-  Scen. 6: 60" SLR+Storm Surge

Location Indicators

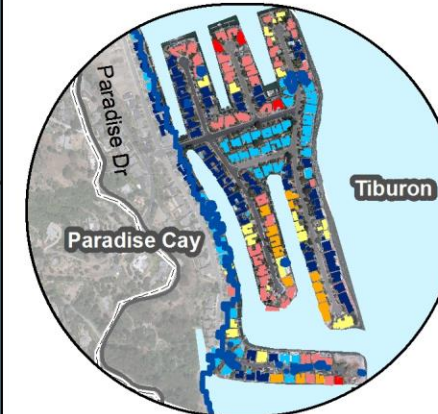
-  Unincorporated
-  Municipality
-  Road
-  Bay
-  Inland Extent: Sea Level @ 60"+100-year Storm



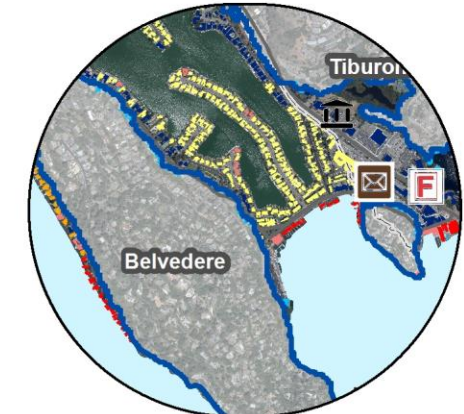
1: Canal Neighborhood



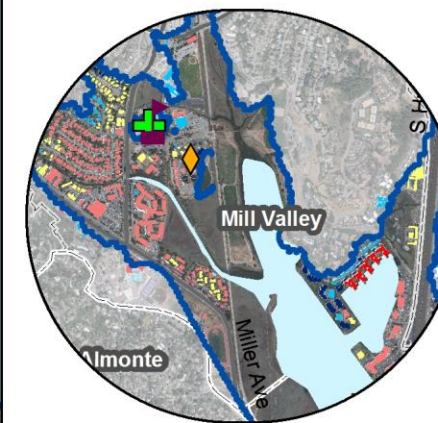
2: Greenbrae/Larkspur



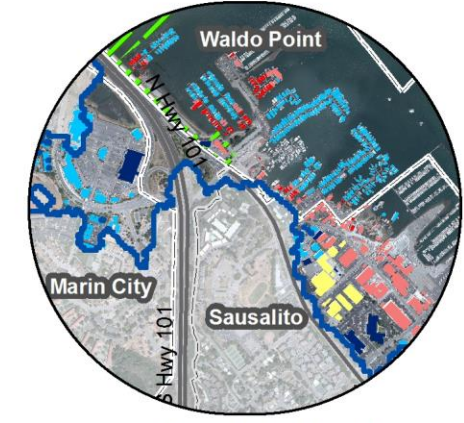
3: Paradise Cay



4: Belvedere/Tiburon



5: Mill Valley



6: Marin City/Waldo Pt. Harbor

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



Date: 6/15/2017



BUILDINGS

Other Considerations

Economic

The Marin shoreline accounts for hundreds of millions of dollars in economic activity. The more than 12,000 vulnerable buildings, account for more than \$6 billion in assessed improvement value as shown in Table 28. Unincorporated Marin properties that are expected to be vulnerable to sea level rise contributed \$101,205,044⁵⁸ in 2015 property taxes to roughly 55 taxing agencies. Table 29 breaks down the multi-million-dollars in contributions from vulnerable properties in unincorporated Marin by taxing jurisdiction. Municipal tax revenues would add several hundred million in revenues.

Sales tax would also decline if the vulnerable commercial areas in Sausalito, Marin City, Corte Madera, Mill Valley, Larkspur, San Rafael, and Novato flood. Tourism tax could also decline because more than ten hotels could be impacted in Sausalito, Almonte, Mill Valley, Tiburon, and San Rafael. Access issues could impact other guest accommodations outside of the vulnerable portions of the study area.

Employment opportunities at shopping, industrial, and office sites could be lost. Moreover, businesses require transportation access for their deliveries, employees, and customers that is compromised under the BayWAVE scenarios, typically before the business itself is vulnerable. Employees within or who have to pass through the vulnerable areas may not be able to get to work. Access issues would also impact additional shopping centers, including the Marin Country Mart in Larkspur.

In addition to tax generation impacts, on-site expenses could be incurred by property owners. According to the National Flood Insurance Program, a 1,000 square foot home built on slab that experiences 1 foot of flooding can experience an estimate of \$27,000⁵⁹ in damages to the structure and its contents.⁶⁰ A 2,000 square foot homes could anticipate an estimate of more than \$52,000⁶¹ in damages to structures and their contents.

Table 28. Economic Value of Vulnerable Buildings in Long-term Scenario 6

Location	Assessed Improvement Value ^a	Single Family Home Median Market Value ^b
Municipalities		
Larkspur	\$1,496,649,606	\$1,263,482,000
San Rafael	\$1,496,065,489	\$1,755,058,800
Corte Madera	\$726,321,314	\$1,475,834,400
Novato	\$629,369,009	\$684,226,000
Belvedere	\$356,209,805	\$1,397,145,700
Mill Valley	\$300,215,511	\$831,482,400
Sausalito	\$228,617,482	\$60,985,000
Tiburon	\$187,457,062	\$572,516,000
Unincorporated Jurisdictions		
Strawberry	\$214,941,911	\$1,665,727,200
Bel Marin Keys	\$188,722,172	\$569,754,900
Santa Venetia	\$124,787,181	\$1,243,810,000
Paradise Cay	\$123,268,429	\$581,863,200
Kentfield	\$99,778,853	\$3,080,781,000
Almonte	\$37,738,121	\$783,140,400
Tiburon	\$36,868,808	\$343,509,600
Marin City	\$24,685,548	0
Tamalpais	\$22,654,207	\$2,762,400,000
Waldo Point	\$21,056,654	0
Black Point	\$15,807,484	\$366,133,700
Greenbrae	\$8,836,871	\$76,532,500
North Novato	\$7,911,796	\$359,582,600
Country Club	\$6,311,404	\$252,193,200
Bayside Acres	\$5,340,362	\$109,798,400
California Park	\$1,508,352	\$103,793,800
San Quentin	\$689,013	\$27,449,600
Pt. San Pedro	\$33,137	0
Total	\$6,366,322,973	\$20,367,200,400

Source: ^aAssessor Tax Data 2015/2016, ^bZillow May 2015

⁵⁸ 2016 dollars

⁵⁹ 2016 dollars

⁶⁰ National Flood Insurance Program. The Cost of Flooding Estimator Tool https://www.floodsmart.gov/floodsmart/content/overlays/cost_of_flooding_nonajax.jsp. Accessed Dec. 13, 2016.

⁶¹ 2016 dollars

BUILDINGS

Table 29. Sample Tax Generation for Parcels Vulnerable in Long-term Scenario 6

Tax District	Tax Revenue
County General	\$22,835,222
Tamalpais High School District	\$10,781,271
Marin Community College	\$7,360,565
Education Revenue Augment	\$7,303,352
Mill Valley School District	\$6,991,178
Southern Marin Fire	\$5,750,363
Kentfield School District	\$5,225,279
Kentfield Fire	\$4,109,315
Novato Unified School District	\$3,765,050
County Library	\$2,954,595
County School Service Fund	\$2,528,240
San Rafael Elementary Schools	\$2,253,634
Community Service Area (CSA) #19 Fire Protection	\$1,950,984
Novato Fire	\$1,906,311
San Rafael High School	\$1,690,337
Ross Valley Sanitation No. 1	\$1,564,305
Reed Union School	\$1,446,789
Marin County Open Space	\$1,020,102
Tiburon Fire	\$795,261
Richardson Bay Sanitation	\$745,599
Tamalpais Community Service District (CSD)	\$649,472
Flood Control Zone (FCZ) 3 Richardson Bay	\$635,130
Marin County Highway Lt	\$615,373
Sausalito-Marin City School District	\$595,858
Marin County Transit	\$586,546
County Fire Department	\$512,272
Ross School	\$493,532
Strawberry Recreation	\$473,938
Bel Marin Keys CSD	\$443,596
CSA 17 Kentfield	\$401,931
FCZ 7 Santa Venetia	\$359,149
Mosquito Abatement	\$317,948
Corte Madera Sanitation No. 2	\$288,308
Marin City CSD	\$270,722
FCZ 1 Novato	\$215,209
Bay Area Air Quality	\$205,089
#6 Novato Sanitation	\$146,654
CSA 18 Gallinas	\$128,756
FCZ 4 Bel Aire	\$127,962

Tax District	Tax Revenue
Almonte Sanitation	\$108,938
Las Gallinas Valley Sanitary District	\$104,146
FCZ 9 Ross Valley	\$81,954
Larkspur-Corte Madera School District	\$80,287
San Rafael Sanitation	\$64,836
CSA 6 Santa Venetia	\$57,811
Sausalito-Marin City Sanitation	\$55,230
CSA 16 Greenbrae	\$46,234
Tiburon Sanitation No. 5	\$41,804
Murray Park Sanitation	\$41,684
San Quentin Sanitation	\$19,282
Alto Sanitation	\$19,182
CSA 9 Northbridge	\$12,074
North Marin Water	\$10,822
Petaluma Joint High	\$7,026
Dixie School District	\$6,543
Santa Rosa Junior College-Laguna Joint School	\$1,275
Lincoln School	\$723
Total	\$101,205,044

Source: S. Kucharos, County of Marin Department of Revenue, June 6, 2016

In addition, several existing buildings are protected with shoreline armoring, such as seawalls, revetments, levees, bulkheads, bluff walls, and other hard engineering structures, to impede flooding and erosion. With higher tides, these protective structures may become compromised and require increased maintenance or replacement, or relocation. Some may already be in need of repair to withstand existing conditions. These expenses can be significant and would require increasing upkeep and improvement as tides rise.

For properties that become part of the public trust lands, regulations could diminish an individuals' capacity to maintain and retain value in their properties in the most cost effective ways. The equity held in these properties could be lost; negatively impacting a major contributor to wealth. In addition, these homeowners may be required to pay leasing fees to the State of California.

BUILDINGS

Several low-income and affordable housing locations, the Canal neighborhood, Marin City, and other locations along the shoreline, could be compromised by higher sea levels, having significant economic and displacement impacts on the most vulnerable citizens in the county. Moreover, as developable land area diminishes and housing supply is lost, the cost of housing in the County could escalate more rapidly, making it difficult for low income resident to relocate nearby.

Environmental

Storm damage could result in building debris that could pollute the bays and ocean. Many buildings also contain potential water contaminants that could be swept out to sea. When homes are repaired or rebuilt, resource consumption will occur. As homes are demolished and relocated, additional consumption could occur, and degradation of the relocation site is likely. Additionally, using seawalls and other shoreline protective devices to protect buildings could result in the loss of beaches, wetlands, and other habitats and recreational areas by preventing these areas from migrating inland.

Social Equity

Equity concerns may arise regarding who should pay for adaptation or recovery related to sea level rise impacts, or what places should be protected and when. Temporarily or permanently relocating residents can sever neighborhood relationships, reducing neighborhood cohesion and breaking down emergency networks. Neighborhoods without these social networks are especially vulnerable to sea level rise and storm threats, and may have a harder time recovering from disasters.

People living with scarce financial resources are especially vulnerable to sea level rise. According to the Healthy Marin Partnership, 2013 Community Health Needs Assessment, between 50 and 70 percent of Marin’s shoreline residents in the BayWAVE study area pay more than 45 percent of their income on housing and transportation combined.⁶² The affordability standard is 30 percent of income on housing and 15 percent on transportation.⁶³ This indicates that a large portion of

residents are already burdened by these basic expenses. Consequently, these households have less income for other necessities such as emergency preparedness, medical care, healthy food, child care, and education.

In addition, those with health or mobility constraints, who do not own a home or car, or are not proficient in the English language, may be disproportionately burdened by sea level rise and storms. Notably, in the Canal neighborhood of San Rafael, hundreds of residents meet several of these criteria. If displaced, the loss would be significant to these residents, their neighborhood, and the regional economy. In addition, the cost of repairs may be passed on to the tenants and increase the cost of living, potentially pricing existing residents out of their neighborhood.

Table 30. Income Spent on Housing & Transportation, 2005-2009

Jurisdiction	% residents paying more than 45% on housing & mobility
SF-Oakland-Fremont Region	48
Marin County	56
Sausalito	52
San Rafael	50
Larkspur	54
Corte Madera	55
Mill Valley	61
Strawberry	61
Kentfield	67
Belvedere	58
Tiburon	70
Novato	54
Santa Venetia	53
Tamalpais-Homestead	67
Black Point-Green Point	64
Marin City*	No data

Source: Human Impact Partners, 2015, H+T Index, CNT
 * No data is available for Marin City, though Marin City figures may be incorporated with a nearby community.

62 Human Impact Partners. 2013. Healthy Marin Partnership. Community Health Needs Assessment Sub-county Health Indicators.

63 Human Impact Partners. Healthy Marin Partnership. Community Health Needs Assessment Sub-county Health Indicators. 2013.

BUILDINGS

In Marin City, also a low-income community, the commercial shopping center is already vulnerable to stormwater flooding in combination with existing storm and king tides. Sea level rise could push tides even closer to stormwater outlets preventing the release of stormwater, and causing it to back up into the community. By scenario 6, storm surge flooding could reach directly over US Highway 101 and into the commercial and multi-family affordable housing on the other side. The loss of the shopping center could reduce local employment opportunities, shopping options, and community character. The apartments across from the shopping center could also be impacted by storm surge flooding. Combined with existing stormwater issues, this could displace several vulnerable residents and trap many more.

At worst, with long-term sea level rise, displaced residents the Canal neighborhood of San Rafael may not have access to equivalent affordable housing near the jobs, schools, and facilities they rely on and may be forced to leave their neighborhood. Residents in Marin City may be temporarily displaced by the long-term, with the potential to return to restored housing. In both areas, the residents are not responsible for restoring the buildings, and dependent on the investment and action of property owners. This would also apply to the many businesses serving these communities that lease their facilities.

Management

The Bay Conservation Development Commission (BCDC) retains development permit authority over tidelands (below mean high tide), submerged lands, and public trust lands. Potential state boundary changes could occur as tide levels rise. This could significantly impact private property rights when flooded land becomes lands of the State and existing residents are forced to pay leasing fees.

Individual property owners may take individual measures to protect their property that could be damaging to neighboring properties, creating private property conflicts. And in some communities getting property owners to work together towards a shared goal may prove challenging.

In addition, as housing units are lost to the Bay, political representation based on population could shift to other areas, both with in and out of the County. Planning and implementing adaptation measures for higher water levels could span several election cycles across several levels of government.

Successful preparation would require continuous political support from mayor to mayor, council to council, state congress person to person, and so on for several decades. If government priorities shift away from supporting sea level rise preparation, communities could be less equipped to weather increased flooding.