

# SAN RAFAEL

## Community Profile: San Rafael

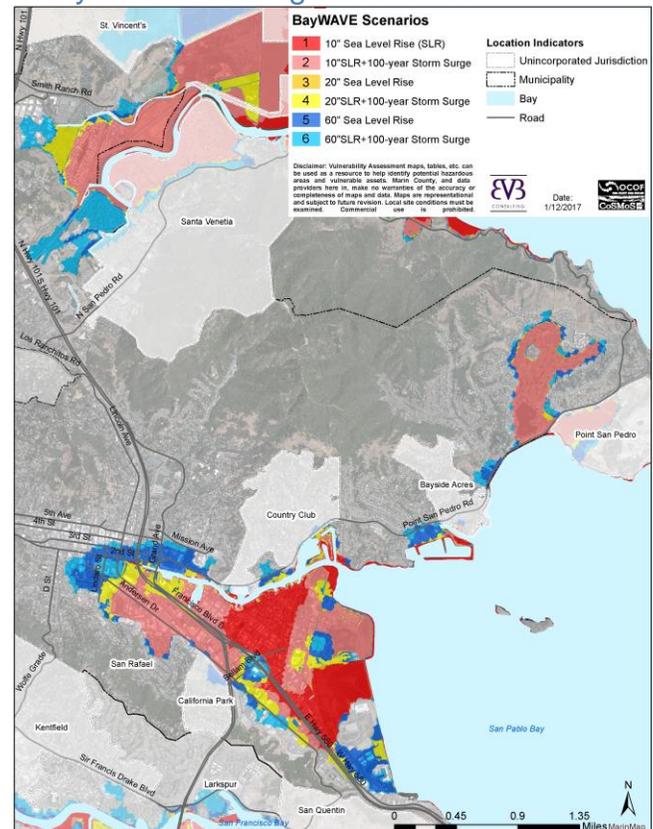
San Rafael is the Marin County seat and largest city. The city features an active boating sector, the largest downtown in the county, a university, and the county's largest employers. San Rafael is home to the largest population in general, and of low-income and limited English proficiency households. These households can be found throughout the city; however a large community exists in the low lying Canal District, the most densely populated area in the county. Compared to the other communities in the study area and the County, San Rafael could experience the most significant impacts, including:

- Flooding in the Canal area and Kerner Business District could compromise extensive multi-family housing, commercial, industrial, and recreational uses.
- US Highway 101 on and off-ramps could anticipate 100-year storm surge flooding in near-term and tidal flooding in the medium-term.
- The San Rafael Transit Center could be vulnerable in the long-term. This could compromise local and regional bus lines, and the new SMART train.
- A significant portion of downtown could face storm surges in the near- and medium-terms and sea level rise in the long-term.
- GGBHTD facilities on Andersen Drive could be vulnerable in the medium-term.
- Several schools including Bahia Vista and Glenwood Elementary, Davidson Middle, and San Rafael High schools could be vulnerable across the BayWAVE scenarios.
- Five historic landfills along the shoreline and one closed brownfield site further inland could be subject to inundation.
- Miles of electrical transmission and natural gas pipelines are in the near-term.
- Marinas and other boating facilities could be vulnerable to sea level rise in the medium- to long-term.
- Peacock Gap homes and golf course could be vulnerable to storms in the near-term and sea level rise in the long-term.
- Marin Lagoon and streets in the Las Gallinas area could begin to see peripheral tidal flooding and storm surge flooding in the near-term, and neighborhood scale flooding by the long-term.
- Fire Station 54 is vulnerable in scenario 1 and two others could have access issues.

### IMPACTS AT-A-GLANCE: SCENARIO 6

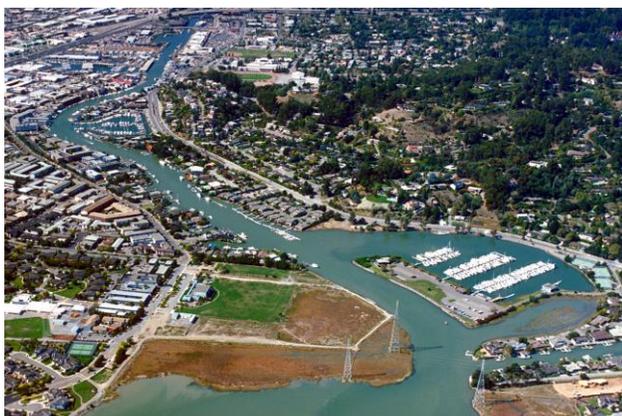
2,121 acres	58,000 people
4,700+ living units	475 commercial parcels
7.5 road miles	
Storm and tidal impacts already occur	
\$2.6 billion in assessed property value; \$1.7 billion in single-family home market value <sup>200</sup>	
City of San Rafael San Rafael Sanitation District Property Owners HOAs Caltrans	

Map 96. San Rafael Sea Level Rise and 100-year Storm Surge Scenarios



<sup>200</sup> 2016 dollars

# SAN RAFAEL



San Rafael Canal with the Canal District and Pickleweed Park to the left and several homes and private marinas on the right banks of the canal. Credit: Wikimedia Commons.

Table 102. San Rafael Exposed Acres

Scenarios		Acres	
		#	%
Near-term	1	449	3
	2	1,360	10
Medium-term	3	869	6
	4	1,590	11
Long-term	5	1,856	13
	6	2,121	15

Source: MarinMap, CoSMoS

## Vulnerable Assets

San Rafael's vulnerable assets include the entire Canal neighborhood and Kerner Business District, and shoreline development and boating facilities off Point San Pedro Road. In time, the impacts move into downtown San Rafael, Peacock Gap, and Marin Lagoon. Note that recent construction at the Loch Lomond Marina and surrounding properties recently completed projects to elevate the shoreline that are not accounted for in the CoSMoS models 2010 baseline imagery. Thus, flooding and onset predictions here may not be as severe as estimated in this assessment. In addition to sea level rise, subsidence is already a significant issue south of Interstate 580 and US Highway 101, and in Marin Lagoon, where development is built largely on fill atop bay mud. With sea level rise, subsidence rates could increase.

## Land

Most of the vulnerable land in San Rafael was built on filled land that used to be tidal marsh or mud. Sea level rise would likely return this area to tidal habitat again without measures to protect existing land uses. With a 100-year storm surge, downtown and further inland areas within the basin of the valley as far back as Gerstle Park.

## Acres

In the near-term, 449 acres, or three percent of San Rafael, could be exposed to tidal flooding at MHHW. A 100-year storm surge on top of ten inches of sea level rise, scenario 2, could flood three times as many acres. Outside of the Canal Neighborhood, much of the flooded acreage is marshland. In medium scenario 3, nearly 900 acres could flood tidally at MHHW. In scenario 4, 200 more homes could be impacted by storm surges than in scenario 2, the previous storm surge scenario. By the long-term, 1,856 acres, or roughly 15 percent of San Rafael's area could be exposed to sea level rise, and 2,121 acres could be exposed during an additional 100-year storm surge.

## Parcels

San Rafael's acreage is divided in several thousand parcels, any independently owned and developed. Several publically owned parcels could also flood, especially in the near-term. Examining parcels and their uses can provide a look into the human activities that could be flooded out by bay waters.

In the near-term, as seen in [Table 105](#), two percent of parcels could be vulnerable to tidal flooding. With a 100-year storm surge, an additional 136 parcels and 1,438 buildings could experience temporary flooding. These are mostly buildings lining the San Rafael canals and in the low-lying areas west of the canal. The area is characterized by a variety of apartment complexes, light industrial sites, and commercial strip areas that serve the predominantly residents from Central American countries. One single family home subdivision, near Spinnaker Point, not directly at risk until later in the century, however, year round vehicular access may prove challenging before then. Bahia Vista Elementary School, Albert J. Boro Community Center and Pickleweed Park, San Rafael Fire Station 54, and the Marin County Health Innovation campus are some of the potentially impacted public facilities.

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Table 103. San Rafael Vulnerable Residential and Commercial Parcels

Land Use	Scenarios					
	Near-term		Medium-term		Long-term	
	1		3		5	
	#	%	#	%	#	%
<b>Residential</b>	492	3	883	6	1,798	12
<b>Commercial</b>	132	11	234	19	475	40
<b>Industrial</b>	48	17	104	37	170	61

Source: MarinMap, CoSMoS.

Table 104. San Rafael Vulnerable Parcels by Land Uses

Land Use	Scenarios					
	1		3		5	
	Near-term		Medium-term		Long-term	
	#	Ac.	#	Ac.	#	Ac.
Commercial Improved	116	98	213	267	419	527
<b>Commercial Unimproved</b>	16	89	21	108	54	149
<b>Common Area</b>	2	2	3	5	20	26
<b>Industrial Improved</b>	45	21	97	50	153	83
<b>Industrial Unimproved</b>	3	0.6	7	1	17	5
<b>Residential</b>	492	46	883	88	1,798	196
<b>Mobile Home</b>					154	1
<b>Multi-Family Improved</b>	78	34	104	44	136	54
Multi-Family Unimproved	2	0.2	3	0.6	4	1
Single Family Attached	382	5	634	10	1,084	38
Single Family Improved	20	4	127	31	390	76
Single Family Unimproved	8	3	12	3	27	26
Tax Exempt	22	53	57	193	159	530
Exemption Improved	13	6	18	10	22	12
Exemption Unimproved					1	0.5

Source: MarinMap, CoSMoS

And as shown in [Table 103](#), within the vulnerable parcels, three percent of all residential, 11 percent of all commercial, and 17 percent of industrial parcels could face tidal MHHW flooding in the near-term. In medium-term scenario 3, double these figures could anticipate tidal flooding with 883, residential parcels, 234 commercial parcels, and 104 industrial parcels. A significant 20 percent of commercial parcels and almost 40 percent of industrial parcels in San Rafael could be vulnerable to tidal flooding.

In the long-term conditions would worsen, with 40 percent of commercial and 60 percent of industrial parcels could experience tidal flooding. With a 100-year storm surge 75 percent of San Rafael's industrial parcels could flood, and 15 percent of them would only experience storm surge flooding, the remaining could suffer the fates of both tidal and storm flooding combined. Many of these parcels are in the Canal area and Kerner Business District, this area is already highly dependent on storm water pump station to remove stormwater entering the area from the uplands. This force combined with sea level rise would require the pumps to work even harder and become overworked, or worse fail.

While not as large of a portion, 15 percent of residential parcels in San Rafael is nearly 2,000 parcels, many more than other communities in the study area. Moreover, these residential parcels are in the more affordable areas in the city and contain large numbers of low-income renter households. In fact, 34 acres amongst 78 parcels provide multi-family and could be vulnerable to tidal flooding in the near-term. By the end of the century, this figure climbs to 54 acres and 136 parcels. This is especially alarming because many of these parcels contain multiple buildings with multiple living units, thus impacting several hundred, if not thousands of households

A large number of acres are dedicated to tax exempt land. This land is typically public land, though some parcels belong to non-profit organizations. Parcels that are not dedicated to civic uses are generally parks or open space. Significant portions of open space and marshes make up the San Rafael shoreline that account for the 500 acre figure.

These losses in developable land area are significant to San Rafael, its residents, business owners, and the County as a whole. Continued use of this land would require extensive protection and reinvention.

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## Buildings

A majority of privately held parcels contain buildings used for housing, work, entertainment, worship, and commerce. Many public parcels can also contain buildings, especially schools, community centers, and emergency services. Without shelter, many, if not most, of the existing activities on the land would not be feasible. Damages to and destruction of buildings especially several hundred to thousands of buildings at once, would be devastating to the local, regional, and state economy for years afterwards.

In the near-term, as seen in [Table 105](#), two percent of buildings, 410 buildings, in San Rafael could be vulnerable to higher high tides. And With a 100-year storm surge, an additional 1,438 buildings could experience temporary flooding. These are mostly buildings lining the San Rafael canals and in the low-lying areas west of the canal. The area is characterized by a variety of apartment complexes, light industrial sites, and commercial strip areas that serve the predominantly Latino residents. One section, near Spinnaker Point, is a single family home subdivision that is not directly at risk until later in the century, however, year round vehicular access may prove challenging before then. Bahia Vista Elementary School, Albert J. Boro Community Center and Pickleweed Park, San Rafael Fire Station 54, and the Marin County Health Innovation campus are some of the potentially impacted public facilities.

The Kerner business district is vulnerable in the near and medium-terms. Though some portions of the district are protected until after the medium –term because of shoreline armoring, after three feet of sea level rise this area could be saturated at high tides. Note that storm surges could cause temporary impacts as early as scenario 2.

Development is also compromised in the near-term on Irwin, 2<sup>nd</sup>, and 3rd Streets. This area, known as Montecito, includes gas stations, grocery stores, small offices, and several daily needs businesses. San Rafael High School is located here and could anticipate long-term impacts. In the medium-term, more than 1,000 buildings could be vulnerable to tidal flooding and nearly twice that could be vulnerable under a 100-year storm surge. By the long-term, nearly 2,500 buildings, or 13 percent of all buildings in San Rafael, could face some level of tidal flooding. Under storm surge conditions, 18 percent of buildings in San Rafael, or more than 3,000 buildings could experience storm damage, only 1,200 of which would only suffer storm surge

flooding. Between the medium- and long-terms, ocean waters move further into the valley, crossing the freeway interchanges, flooding out the on and off ramps, reaching the Andersen and Francisco West industrial and commercial areas, downtown, and eventually the Gerstle Park neighborhood.

**Table 105. San Rafael Vulnerable Buildings by Scenario**

Scenarios	Buildings		
	#	%	
Near-term	1	410	2
	2	1,846	10
Medium-term	3	1,088	6
	4	2,097	11
Long-term	5	2,495	13
	6	3,247	18

Source: *MarinMap, CoSMoS*

***The Canal Neighborhood population is about 70 percent Central and South American origin and Spanish or native languages are typically spoken at home. Compared to other communities in the study area, Canal residents are younger, families are larger, incomes are lower, and residents are primarily renters.<sup>201</sup> Almost one-half of residents are housing cost burdened, paying more than 30 percent or more of their income for housing.<sup>202</sup> Canal Neighborhood residents own fewer cars and ride transit.<sup>203</sup> These residents are disproportionately vulnerable to sea level rise and some of the first people impacted by sea level rise at their front doors.***

<sup>201</sup>Census 2010

<sup>202</sup> Human Impact Partners. 2013. Healthy Marin Partnership. Community Health Needs Assessment Sub-county Health Indicators.

<sup>203</sup>Census 2010

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Table 106. San Rafael Vulnerable Buildings Tidal Flooding\* Estimates at MHHW

Flood Depth (feet)		Scenario		
		Near-term	Medium-term	Long-term
		1	3	5
0.1-1	#	94	143	108
1.1-2	#	143	212	228
2.1-3	#	187	251	346
3.1-4	#	26	206	548
4.1-5	#	3	102	401
5.1-6	#	1	9	360
6.1-7	#		1	215
7.1- 8	#			190
8.1-9	#			26

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

Source: MarinMap, CoSMoS

The analysis presented in [Table 106](#) breaks down the vulnerable buildings by how much saltwater could enter the property at MHHW. Storm surges would have one to three feet of additional water and would impact significantly more buildings. In the near and medium-terms most vulnerable buildings in San Rafael experience 6 feet or shallower waters, with the majority experiencing three feet or lower. In the long-term, more than 600 buildings could flood with up to three feet, more than 1,000 buildings could flood with between three and six feet, and more than 400 buildings could be flooded with up to nine feet of saltwater at mean higher high water. Buildings that flood to these extreme on a regular basis are not useable. Even if the building itself is flood proofed, the surrounding land, roads, and utilities would likely be compromised as well, rendering the buildings uninhabitable.

[Table 107](#) shows FEMA Hazus post-disaster estimates for damage to buildings and their contents. If all the buildings vulnerable in scenario 6, the worst case storms urge scenario analyzed in this assessment, experience minor damage a minimum of 16 million in damages could occur. If all for these buildings were to be destroyed, the worst possible outcome, up to \$1.5 billion in assessed structural value vulnerable in scenario 6. Reality would likely reflect a mix of damage levels amounting to monetary values between the high and low figures calculated here.

Table 107. San Rafael Vulnerable Buildings' FEMA Hazus Storm Damage Cost\* Estimates in Long-term Scenario 6

<b>Buildings in Scenario 6</b>	3,247
<b>Yellow Tag: Minor Damage</b> \$5,000 minimum	\$16,235,000
<b>Orange Tag: Moderate Damage</b> \$17,001 minimum	\$55,202,247
<b>Red Tag: Destroyed</b> Assessed structural value	\$1,496,065,489

Source: MarinMap, CoSMoS

\* 2016 dollars

Buildings in San Rafael are older, and many, especially downtown are unreinforced and could be weakened by flooding. These buildings are primarily mixed-use or commercial. Newer commercial buildings are typically concrete slab tilt-ups or smaller cinder block and stucco buildings. According to a BCDC profile for San Rafael for the Stronger Housing Safer Communities on seismic and flooding safety, most single-family homes in the low-lying areas of San Rafael are one- and two story homes, built in the Victorian era, the earlier part of the 20th century, post-WWII, and newer modern homes. There are also 2-4 unit dwellings, and medium- and large-sized apartment complexes typically of wood construction.<sup>204</sup>

According to San Rafael asset managers, several critical businesses could be vulnerable to sea level rise. These include: 30 grocery stores from 7-11 to Whole Foods Market, 10 pharmacies, 16 medical clinics, 48 doctor offices, and 29 building supply stores. These businesses either contain critical 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.

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 other areas along the shoreline.

<sup>204</sup> BCDC. March 2015 Stronger Housing Safer Communities. Strategies for Seismic and Flood Risk. Summary Report. San Rafael Profile: [http://resilience.abag.ca.gov/wp-content/documents/housing/San%20Rafael%20Community%20Profile\\_final\\_v2.pdf](http://resilience.abag.ca.gov/wp-content/documents/housing/San%20Rafael%20Community%20Profile_final_v2.pdf)

# SAN RAFAEL

Map 97. Southern San Rafael Vulnerable Buildings

## Vulnerable Assets

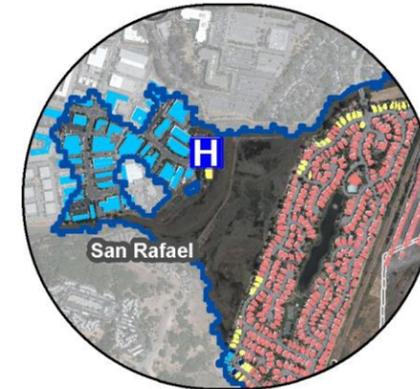
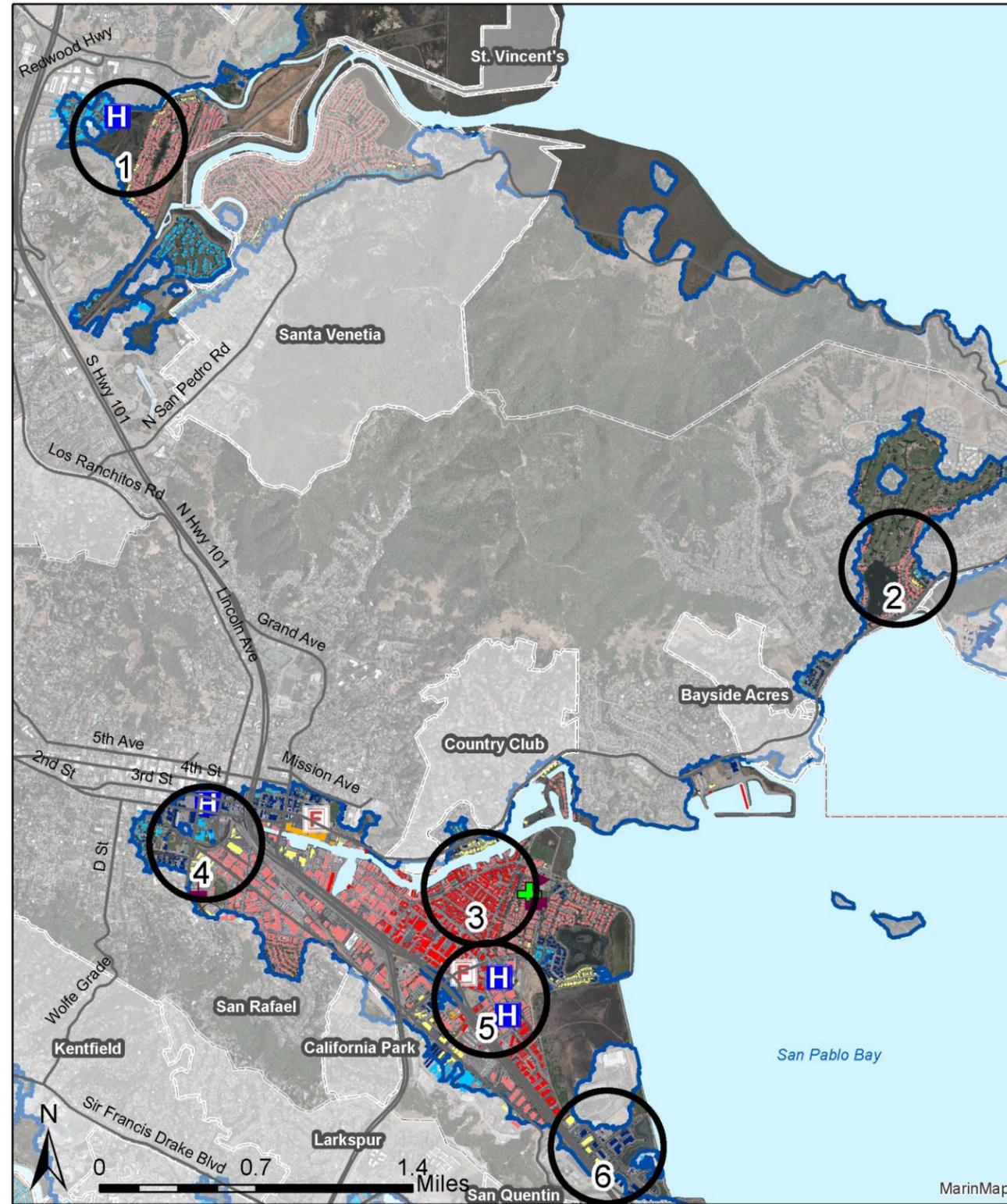
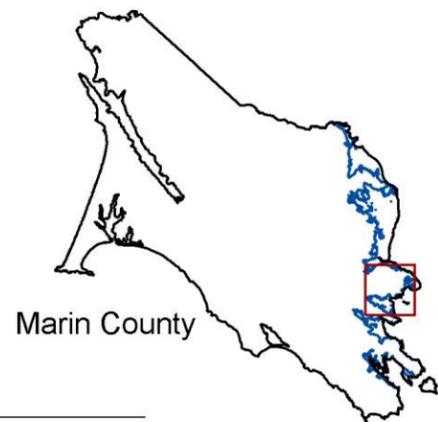
-  School
-  Medical Facility
-  Emergency Shelter
-  Fire Station

## Vulnerable Buildings

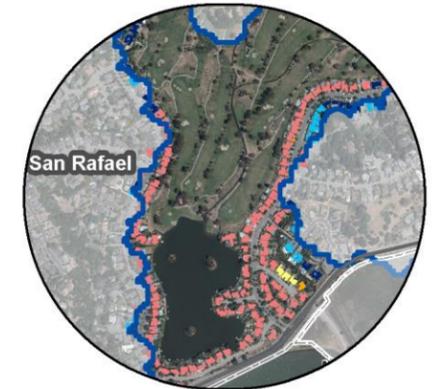
-  Scen. 1: 10" Sea Level Rise (SLR)
-  Scen. 2: 10" SLR+Storm Surge
-  Scen. 3: 20" Sea Level Rise
-  Scen. 4: 20"SLR+Storm Surge
-  Scen. 5: 60" Sea Level Rise
-  Scen. 6: 60"SLR+Storm Surge

## Location Indicators

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



1: Las Gallinas



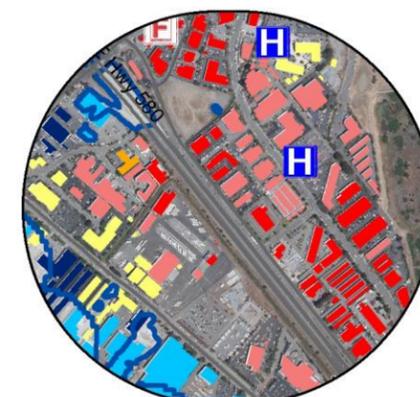
2: Peacock Gap



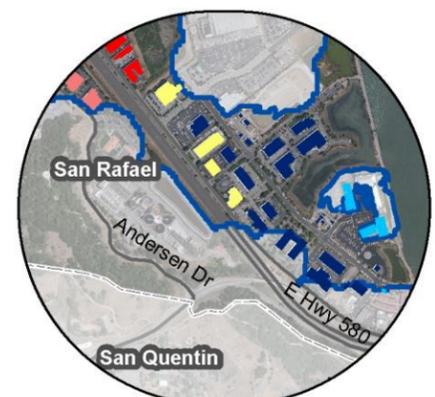
3: Canal Neighborhood



4: Downtown



5: Interstate 580



6: End of Kerner Blvd.

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



Date: 4/13/2017



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A closer examination of places where young children or disabled or older people spend much of their time reveals that nearly 50 vulnerable sites are in the vulnerable area of San Rafael. Thirty-five buildings support childcare facilities. Five buildings house residential care facilities, including:

- Aegis of San Rafael,
- Golden Home Extended Care,
- Miracle Hands Homecare,
- Saint Michael's Extended Care, and
- Schon Hyme Rest Home.

Seven convalescent facilities also house uniquely vulnerable residents. These are:

- All Saints Extended Care, Inc.,
- Country Villa San Rafael,
- Harmony House,
- Kindred Transitional Care and Rehabilitation,
- Pine Ridge Care Center,
- San Rafael Care Center, Inc., and
- San Rafael Healthcare & Wellness Center.

While these facilities may be able to withstand low levels of infrequent flooding, higher levels of water and/or more frequent flooding could be burdensome on these facilities and require relocation. Moreover, these facilities are especially vulnerable to power outages or disruptions to emergency services.

## Transportation

Transportation is a major concern for San Rafael and for the entire region. San Rafael serves as a regional transit center, and nearly all routes stop here, including the newly unveiled SMART line. In the near-term, other major roads impacted are Bellam Blvd, Francisco Blvd., East, Kerner Blvd, Grand Ave. and Irwin Street.

Much like with buildings, many of the roads to be flooded first are in, or are major access ways to, the Canal District and north of Interstate 580. Residents in this area tend to live with scarce financial resources and can be especially burdened by disruptions in the transportation system or damages to their vehicles. 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 also be disproportionately burdened by sea level rise and storms. If these residents are displaced, the upheaval and loss would be significant to the

community and the regional economy that depends on their contributions.

Further, this area hosts the majority of light industrial and a major portion commercial uses that depend on the transportation network to reach clients, receive and deliver materials, and receive customers. Moreover, already constrained street parking could be flooded with tidal waters. And repeated exposure to saltwater would damage personal and commercial vehicles. Finally, emergency access for fire, ambulance, and police could be limited at a time residents are most vulnerable. In fact, Fire Station 54 could be directly flooded, damaging equipment and vehicles in the station.

In the medium-term, tidewaters extend under the freeways further into the street grid of downtown and the industrial and commercial Andersen Drive area. While US Highway 101 is generally elevated, on and off ramps at grade could be flooded out along most of its course through the city. Unlike 101; however, Interstate 580 could anticipate surface flooding between the medium- and long-terms. In the long-term, streets and homes in the Gerstle Park neighborhood west of downtown and US Highway 101 could flood when Mahon Creek overflows its banks. While previously impacted by storm surges. Pt. San Pedro Rd. could expect impacts at tidal MHHW by the long-term as well. Roads bayside of Pt. San Pedro Road, such as Mooring Road, could be vulnerable in the near-term.

Preliminary conversations with Caltrans indicate that Caltrans is well aware of the existing and arising concerns in San Rafael.<sup>205</sup> According to Caltrans and the CoSMoS model, flooding occurs at low spots of US Highway 101 where it connects with Interstate 580 to the south of San Rafael Harbor. These low spots typically benefit from levees and pumps others operate to protect the larger area from flooding.

Table 108 lists transportation routes that could be vulnerable by scenario and annotates the agency responsible for a road. San Rafael has jurisdiction over the majority of the exposed portion of Pt. San Pedro Road, and the County has jurisdiction bordering the small unincorporated Country Club portions.

<sup>205</sup> Sea Level Rise Vulnerability Assessment Interview. Caltrans. April 30, 2015. J. Peterson. D. Fahey. Marin County Development Agency. BVB Consulting LLC.

# SAN RAFAEL

Table 108. San Rafael Vulnerable Transportation Assets

Near-term		Medium-term		Long-term	
Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
8 miles	22 miles	15 miles	27 miles	35 miles	41 miles
Hwy 101 <sup>C</sup> Hwy 580 <sup>C</sup> Bellam Blvd <sup>L</sup> Francisco Blvd <sup>E</sup> Kerner Blvd <sup>L</sup> Grand Ave <sup>L</sup> Irwin St <sup>L</sup> Canal St <sup>L</sup> Alto St <sup>L</sup> Amalfi Pl <sup>L</sup> Bahia Pl <sup>L</sup> Bahia Wy <sup>L</sup> Bahia Cir <sup>L</sup> Bay Harbor Wy <sup>P</sup>  Belvedere St <sup>L</sup> Capri Ct <sup>L</sup> Castro Ave <sup>L</sup> Charlotte Dr <sup>L</sup> Elaine Wy <sup>L</sup> Fairfax St <sup>L</sup> Front St <sup>L</sup> Golden Gate Dr <sup>L</sup>  Irene St <sup>L,P</sup> Larkspur St <sup>L</sup> Lido Ln <sup>L</sup> Lisbon St <sup>L</sup> Louise St <sup>L</sup> Madera St <sup>P</sup> Marian Ct <sup>L</sup> Market St <sup>L</sup> Medway Rd <sup>L</sup> Mill St <sup>L</sup> Mooring Rd <sup>L</sup> Novato St <sup>L</sup> Portofino Rd <sup>L</sup> Sea Wy <sup>L</sup> Shoreline Path Smith Ranch Airport <sup>L</sup> Sonoma St <sup>L</sup> Sorrento Wy <sup>L</sup> Summit Ave <sup>L</sup> Tiburon St <sup>L</sup> Verdi St <sup>L</sup> Vivian St <sup>L</sup> Yosemite Rd <sup>L</sup>	Roads in scenario 1 Pt. San Pedro Rd <sup>L,C</sup> Acadia Ln <sup>L</sup> Bahia Ln <sup>L</sup> Baxters Ct <sup>P</sup> Bedford Cv <sup>L</sup> Billou St <sup>L</sup> Bret Ave <sup>L</sup> Bryce Canyon Rd <sup>L</sup>  Carlsbad Ct <sup>L</sup> Catalina Blvd <sup>L</sup> Crater Lake Wy <sup>L</sup> De Luca Pl <sup>L</sup> Dolores St <sup>L</sup> Du Bois St <sup>L</sup> Duffy Pl <sup>L</sup> Duxbury Cv <sup>L</sup> Falmouth Cv <sup>L</sup> Gary Pl <sup>L</sup> Glacier Way <sup>L</sup> Gloucester Cv <sup>L</sup> Hingham Cv <sup>L</sup> Hoag St <sup>L</sup> Hyannis Cv <sup>L</sup> Isla Vista Ln <sup>L</sup> Isle Royale Ct <sup>L</sup> Jordan St <sup>L</sup> Lagoon Pl <sup>L</sup> Lagoon Rd <sup>L</sup> Lincoln Ave <sup>L</sup> Loma Vista Pl <sup>L</sup> Lovell Ave <sup>L</sup> Marina Way <sup>L</sup> McNear Dr <sup>L</sup> Mesa Verde Wy <sup>L</sup> Nantucket Cv <sup>L</sup> Narragansett Cv <sup>L</sup> Newport Wy <sup>L</sup> Olympic Wy <sup>L</sup> Peacock Dr <sup>L</sup> Playa Del Rey <sup>L</sup> Plymouth Cv <sup>L</sup> Porto Bello Dr <sup>L</sup> Rice Dr <sup>L</sup> Riviera Dr <sup>L</sup> Rockport Cv <sup>L</sup> Salem Cv <sup>L</sup> San Marcos Pl <sup>L</sup> Shenandoah Pl <sup>L</sup> Shoreline Pkwy <sup>L</sup> Spinnaker Point Dr <sup>L</sup> Tahoe Pl <sup>L</sup> Teton Ct <sup>L</sup> Vista Del Mar <sup>L</sup> Windward Wy <sup>L</sup> Woodland Ave <sup>L</sup> Yellowstone Ct <sup>L</sup> Zion Ct <sup>L</sup>	Roads in scenario 1 Francisco Blvd W <sup>L</sup>	Roads in scenarios 1-3 2nd St <sup>L</sup> 3rd St <sup>L</sup> Lindaro St <sup>L</sup> Aqua Vista Dr <sup>L</sup> Baypoint Dr <sup>L</sup> Baypoint Village Dr <sup>L</sup> Biscayne Dr <sup>L</sup> Dodie St <sup>L</sup> Egret View <sup>L</sup> Loch Lomond Dr <sup>L</sup>  Novato St <sup>L</sup> Pelican Wy <sup>L</sup> Royal Ct <sup>L</sup> Simms St <sup>L</sup> Yacht Club Dr <sup>P</sup>	Roads in scenarios 1-4 4th St <sup>L</sup> A St <sup>L</sup> B St <sup>L</sup> Hetherton St <sup>L</sup> Albert Park Ln <sup>L</sup> Avocet Ct <sup>P</sup> Brooks St <sup>L</sup> Chapel Cove Dr <sup>L</sup> Cijos St <sup>L</sup> Dowitcher Wy <sup>P</sup> Embarcadero Wy <sup>L</sup>  Glacier Pt <sup>L</sup> Grange Ave <sup>L</sup> Jacoby St <sup>L</sup> Knight Dr <sup>L</sup> Leith Ln <sup>L</sup> Lido Ln <sup>L</sup> Lochinvar Rd <sup>L</sup> Lootens Pl <sup>L</sup> Mariposa Rd <sup>L</sup> Mary St <sup>L</sup> Mission Ave <sup>L</sup> Morphew St <sup>L</sup> Park St <sup>L</sup> Peacock Ln <sup>L</sup> Piombo Pl <sup>L</sup> Portsmouth Cv <sup>L</sup> Ritter St <sup>L</sup> Riviera Pl <sup>L</sup> Silk Oak Cir <sup>L</sup> Summit Ave <sup>L</sup> Surfwood Cir <sup>L</sup> Tern Ct <sup>P</sup> Turnstone Dr <sup>P</sup> Union St <sup>L</sup> Warner Ct <sup>L</sup>	Roads in scenarios 1-5 C St <sup>L</sup> Bayview St <sup>L</sup> Bridgewater Dr <sup>L</sup> Commercial Pl <sup>L</sup> Loma Linda Rd <sup>L</sup> Main Dr <sup>L</sup> Mariners Cir <sup>L</sup> Mark Dr <sup>L</sup> McInnis Pkwy <sup>L</sup> Milano Pl <sup>L</sup> Mitchell Blvd <sup>L</sup> Newport Wy <sup>L</sup> Octavia St <sup>L</sup> Paul Dr <sup>L</sup> Pelican Wy <sup>L</sup> Riviera Manor <sup>L</sup> Rockport Cv <sup>L</sup> San Pedro Cv <sup>P</sup> Sandpiper Ct <sup>L</sup> Shores Ct <sup>L</sup> Smith Ranch Rd <sup>L</sup>  Taylor St <sup>L</sup> Waterside Cir <sup>L</sup> Willow St <sup>L</sup> Woodland Pl <sup>L</sup>

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

# SAN RAFAEL



Loch Lomond Marina Club House. Credit: BYB Consulting LLC

Compromises in the road network impact transit services. Nearly every transit service provider travels through the exposed areas in San Rafael. Not only could service be interrupted, the Golden Gate Transit and Marin Airpporter facilities could be compromised as early as scenario 2. Moreover, the San Rafael Transit Center could be vulnerable to tidal flooding in the long-term. Golden Gate Transit routes 17, 22, 23, 27, 28, 29, 35, 36, 40, 42, 44, 49, 70, 71, 80, 99, 101, 117, SR7, 126, and DH could be vulnerable if they roads they travel are flooded. The following bus stops could also be flooded:

- San Rafael Transit Center
- Canal St. and Medway Rd.,
- Canal St. and Novato St.,
- Canal St. and Sonoma St.,
- Second St. and Grand Ave.,
- Third St. and Grand Ave.,
- 445 Francisco Blvd. E,
- 1525 Francisco Blvd. E,
- Irene St. and Francisco Blvd.,
- 3140 Kerner Blvd.,
- Kerner Blvd. and Bahia Way,
- Kerner Blvd. and Canal St.,
- Kerner Blvd. and Fairfax St.,
- Kerner Blvd. and Larkspur St.,
- Medway Rd. and Francisco Blvd., E
- Medway Rd. and Mill St.,
- Andersen Dr. and Jacoby St.,
- 1261, 1011, and 1022 Andersen Dr.,
- Andersen Dr. and Simms St.,
- Andersen Dr. and PG&E,
- Andersen Dr. and Francisco Blvd. W,
- Andersen Dr. and Dubois St.,
- Andersen Dr. and Irwin St., and
- Bellam Blvd. and Lisbon St.,
- Bellam Blvd. and Francisco Blvd. E,

- Bellam Blvd. and I-580 EB On-Ramp
- Francisco Blvd. E and Pelican Way,
- Kerner Blvd. and Shoreline Pkwy.,
- Lindaro St. and Andersen Dr.,
- Lindaro St. and Second St.

Marin Transit routes that could be vulnerable to hazardous road conditions are 23, 29, 35, 36, 228, 233, and 257, with stops at:

- Third St. and Grand Ave.
- San Rafael Transit Center,
- Second St. and Grand Ave.,
- 887 Andersen Dr.,
- 1011 Andersen Dr.,
- Andersen Dr. and Jacoby St.,
- Andersen Dr. and Simms St.,
- Andersen Dr. P and R Lot,
- Andersen Dr. at Office 1261,
- Andersen Dr. GGBHTD facility
- Andersen Dr. and PG&E Office,
- Medway Rd. and E Francisco Blvd.,
- Medway Rd. and Mill St.,
- E Francisco Blvd. and Bay St.,
- Canal St. and Medway Rd.,
- Canal St. and Novato St.,
- Canal St. and Sonoma St.,
- Kerner Blvd. and Canal St.,
- Kerner Blvd. and Fairfax St.,
- Kerner Blvd. and Bahia Way,
- Kerner Blvd. and Larkspur St.,
- Bellam Blvd. and E. Francisco Blvd., and
- Union St. and Fourth St.

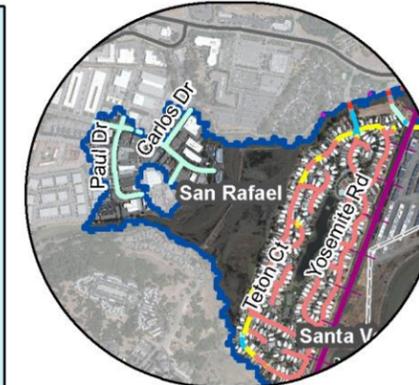
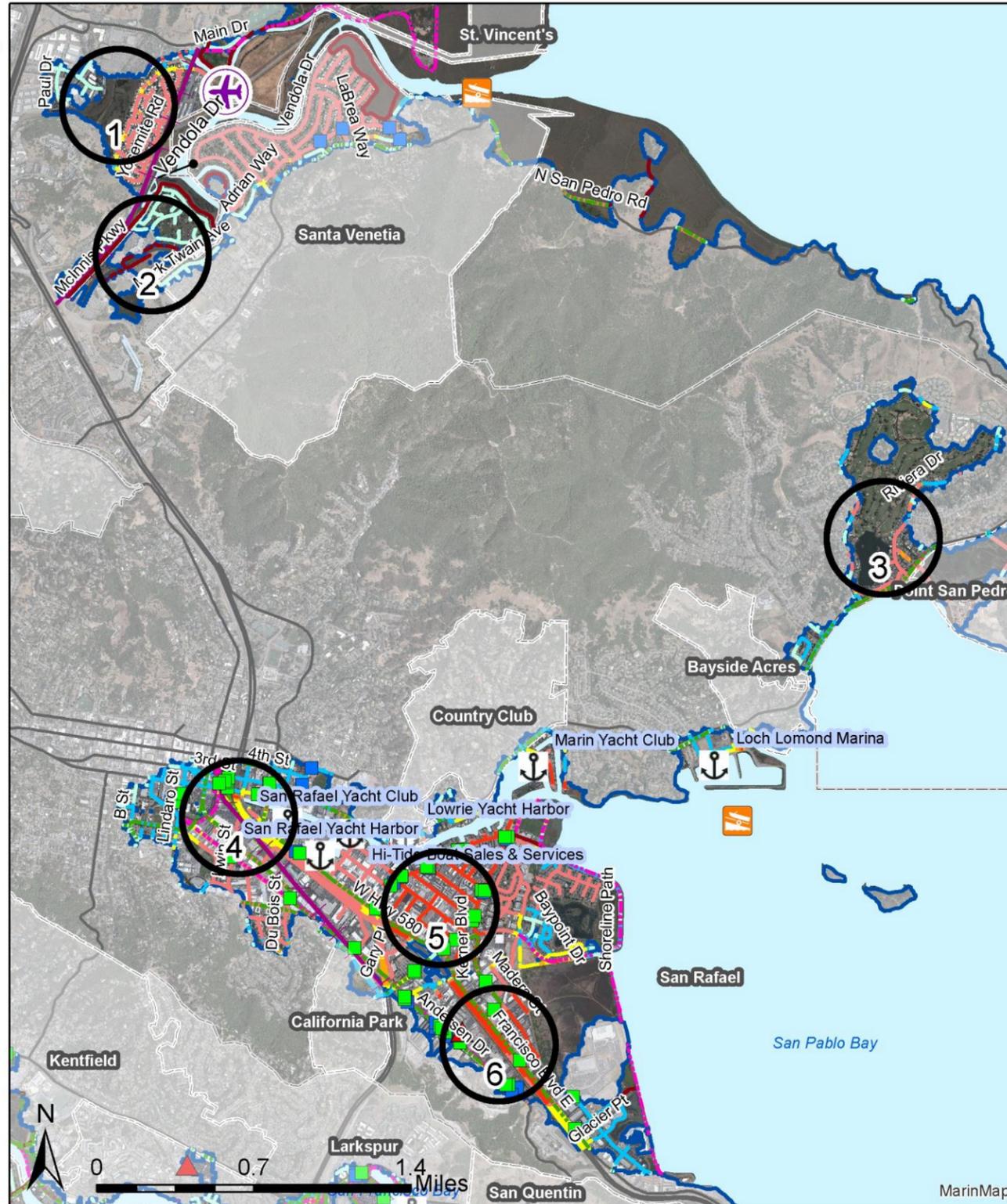
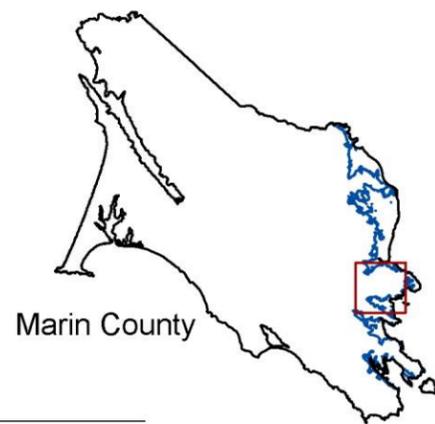
Water transportation is a major contributor the San Rafael's sense of place, commercial activity, and recreation. One of Marin's two ports is located here along with several private marinas that could experience damage from storms and their facilities flooded out if barriers walls are not adequately elevated or pier and dock pilings are not tall enough for the highest high tides. Finally, several miles of trails could be vulnerable to sea level rise including the Bay Trail and Shoreline Path.

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.

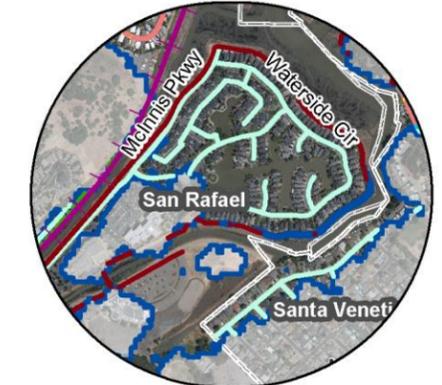
# SAN RAFAEL

Map 98. San Rafael Vulnerable Transportation Assets

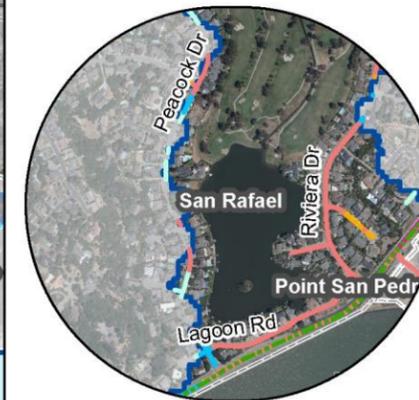
- Vulnerable Assets**
- Park & Ride
  - GGT Bus Stop
  - SMART Track
  - MT Bus Stop
  - SMART Station
  - Bike path
  - Marina
  - Bay Trail
  - Airport
  - Trail
  - Public Boat Launch
- Vulnerable Roads**
- @10" Sea Level Rise (SLR)
  - @10"SLR+ 100-year Storm Surge
  - @20" Sea Level Rise
  - @20"SLR+ 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



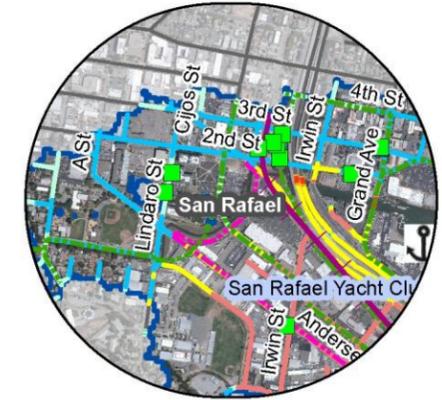
1: Las Gallinas



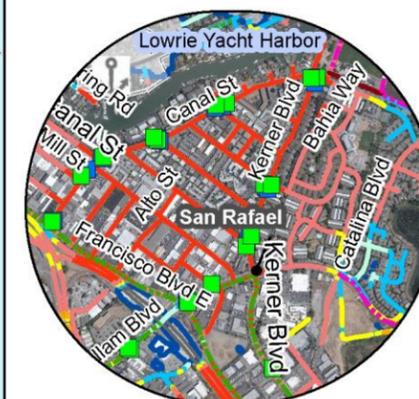
2: N. San Pedro Rd. @ U.S. Hwy. 101



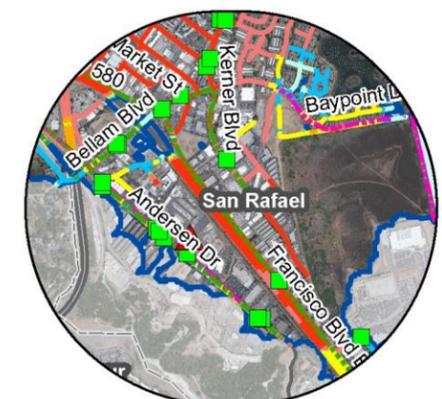
3: Peacock Gap



4: Central San Rafael



5: Canal Neighborhood



6: Interstate 580 corridor

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: 3/29/2017



# SAN RAFAEL

Map 99. San Rafael Vulnerable Wastewater Management Assets

## Vulnerable Assets

- Force Main
- Node
- ▲ Valve
- Wet Well
- Cap
- Lateral
- Manhole
- Pump Station
- Residential Lateral

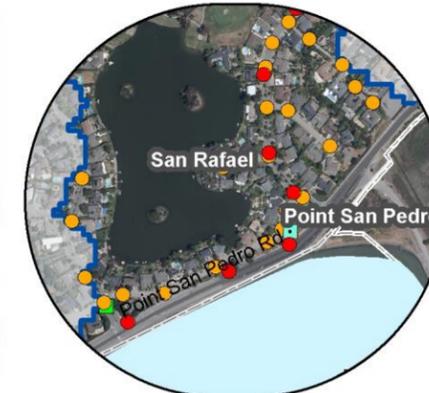
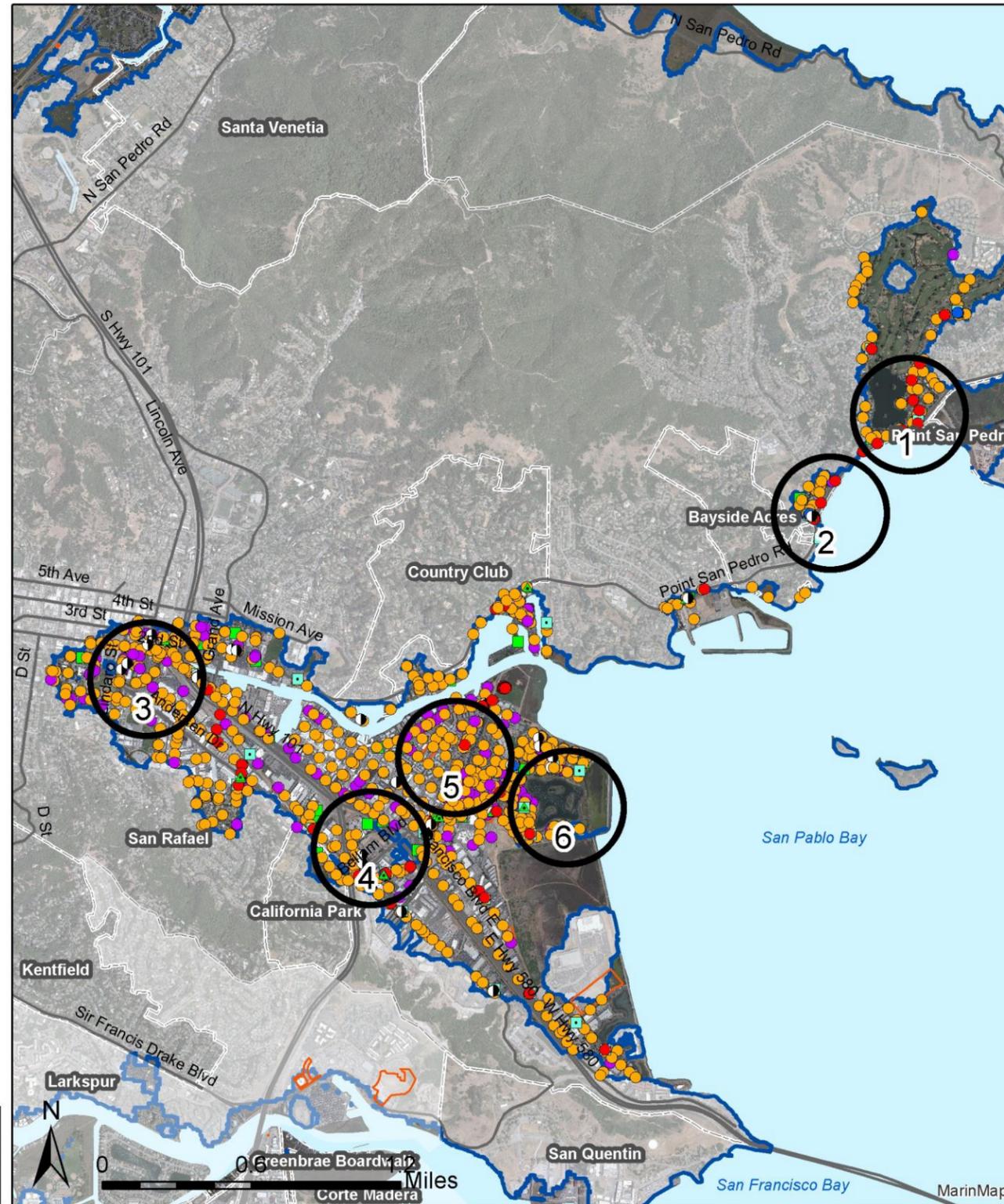
Service District Parcels

## Location Indicators

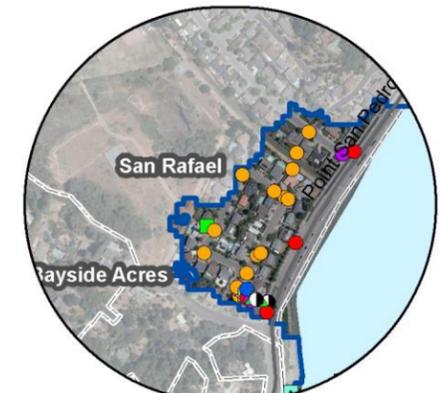
- Unincorporated
- Municipality
- Road
- Bay
- Inland Extent: Sea Level @ 60"+100-year Storm



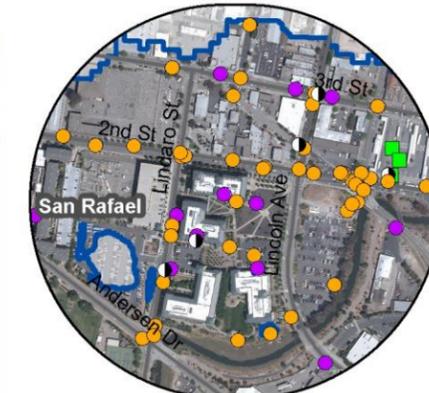
Marin County



1: Peacock Gap



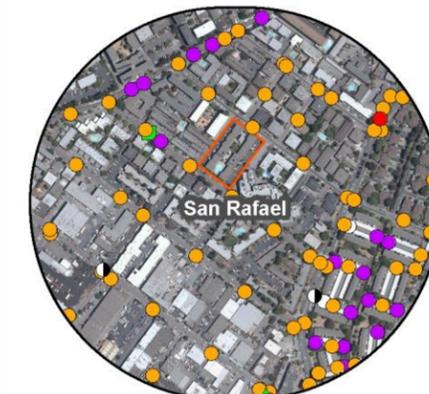
2: Pt. San Pedro Blvd.



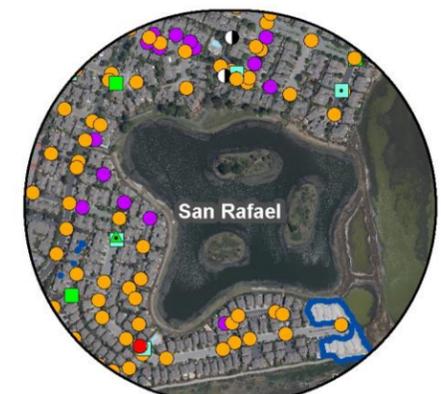
3: Central San Rafael



4: Woodland Ave.



5: Canal Neighborhood



6: Spinnaker Point

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: 1/31/2017



# SAN RAFAEL

Map 100. San Rafael Vulnerable Gas and Electric Assets

## Vulnerable Assets

⊕ Solar Installation

## PG&E Assets

— Electric Transmission Lines

— Natural Gas Pipeline

◆ Substation

▲ Transmission Tower

▭ PG&E Property

▭ PG&E Buildings

## Location Indicators

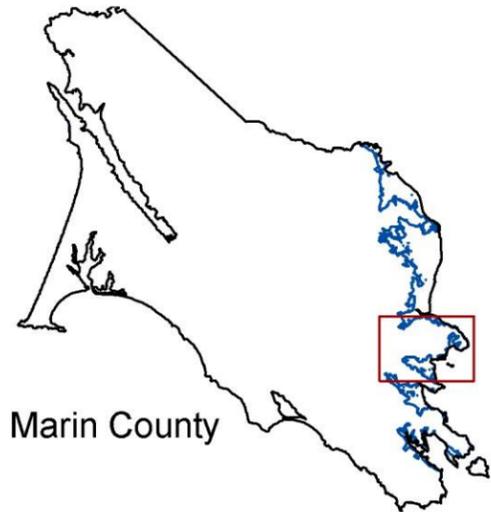
▭ Unincorporated

▭ Municipality

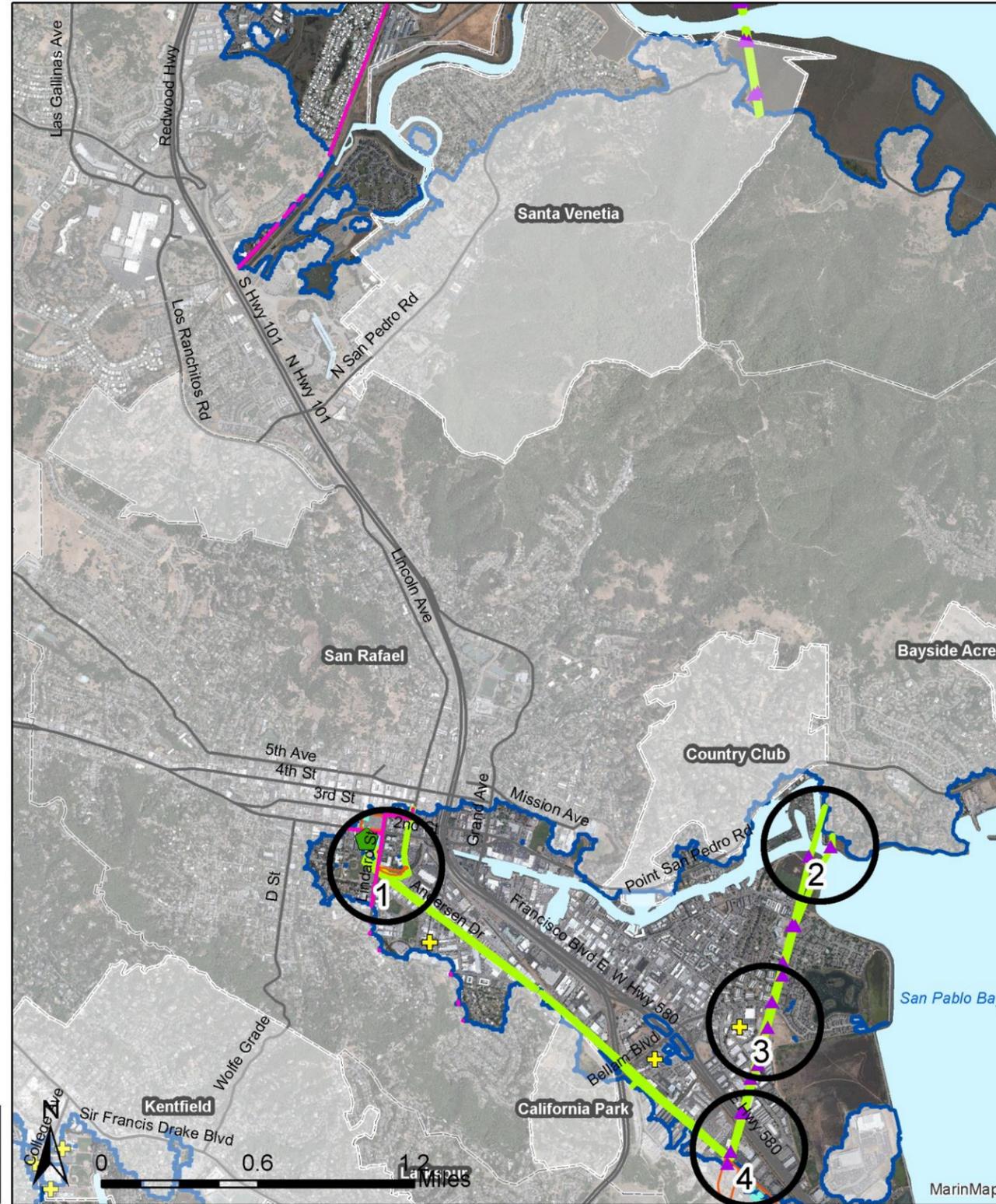
— Road

— Bay

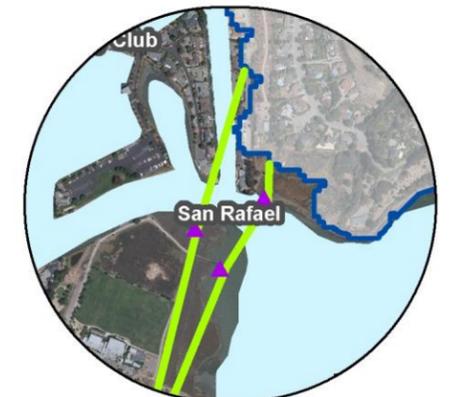
— Inland Extent: Sea Level @ 60"+100-year Storm



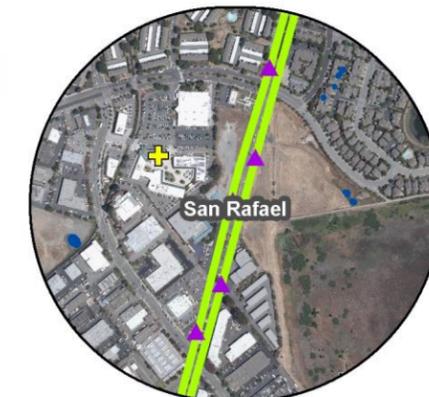
Date: 1/29/2017



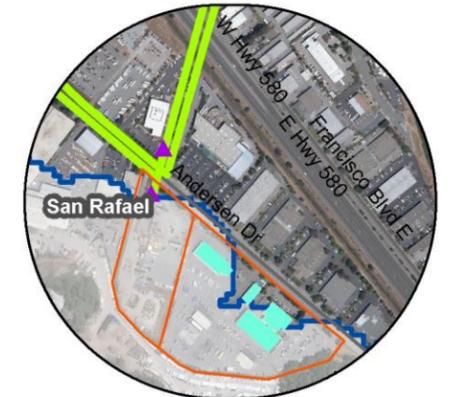
1: Central San Rafael



2: San Rafael Canal



3: Canal Area



4: PG&E Yard & Offices on Andersen Dr.

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.

# SAN RAFAEL

## Map 101. San Rafael Vulnerable Stormwater Management Assets

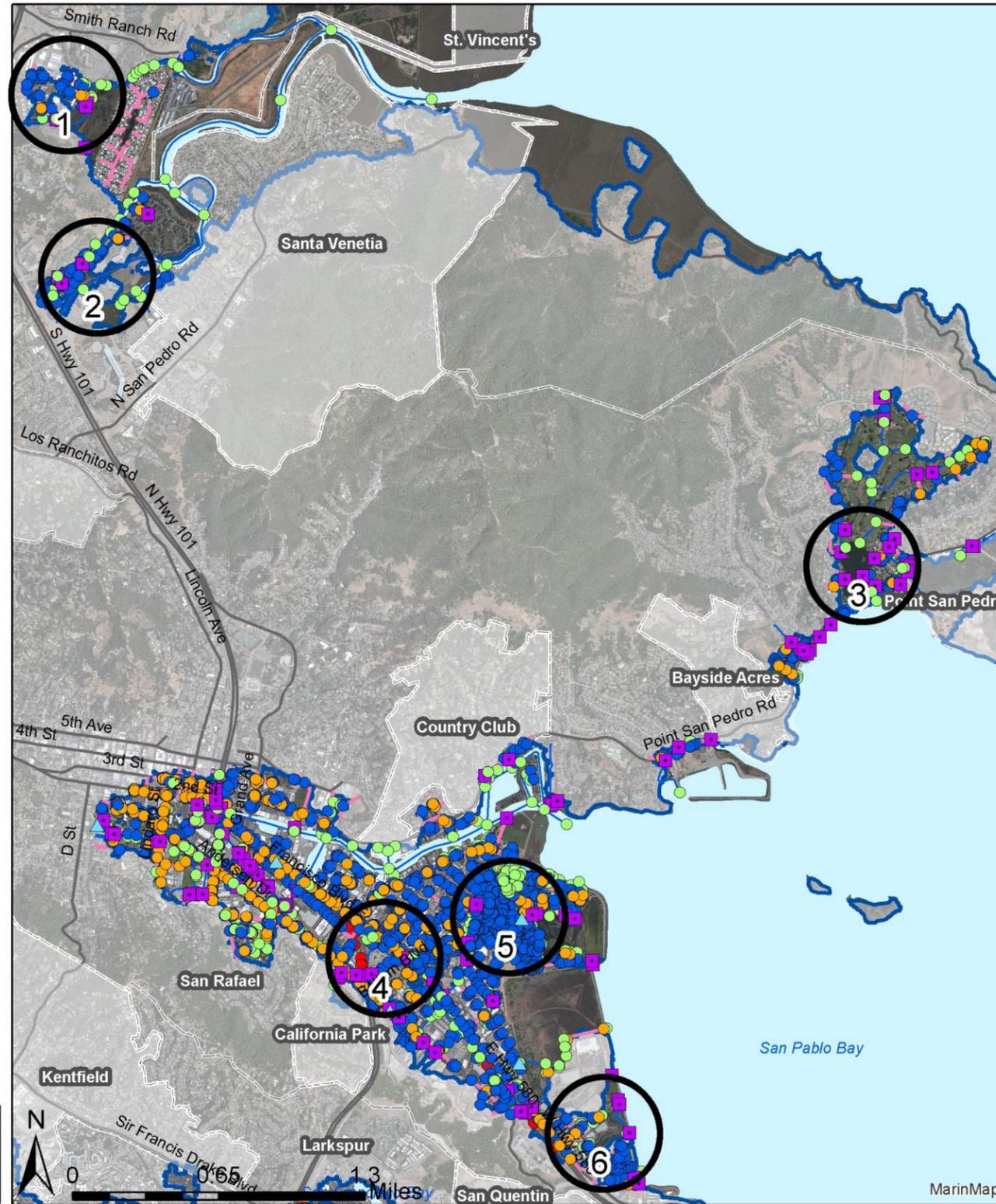
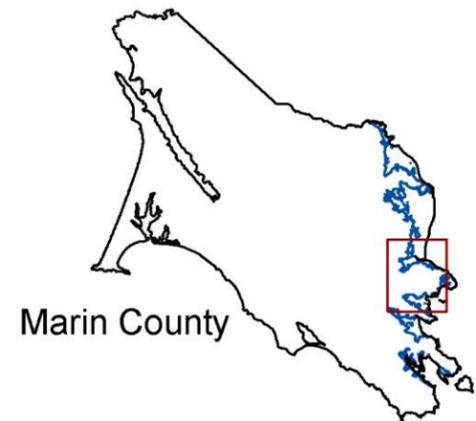
### Vulnerable Assets

- ▲ Curb Outlet
- Catch Basin
- Headwall
- Manhole
- Node
- Pipe Inlet/Outlet

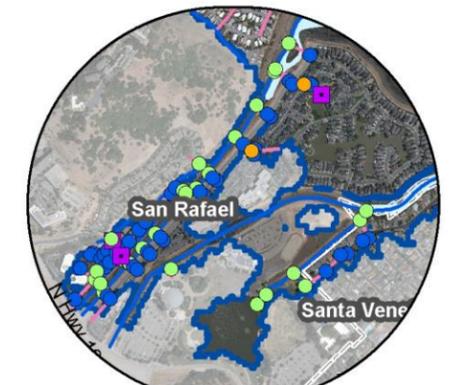
- Channel
- Pipe

### Location Indicators

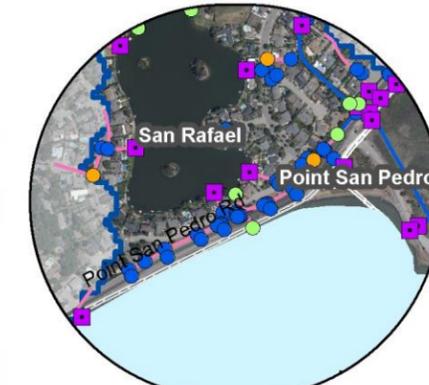
- Unincorporated
- Municipality
- Road
- Bay
- ⋈ Inland Extent: Sea Level @ 60"+100-year Storm



1: Las Gallinas



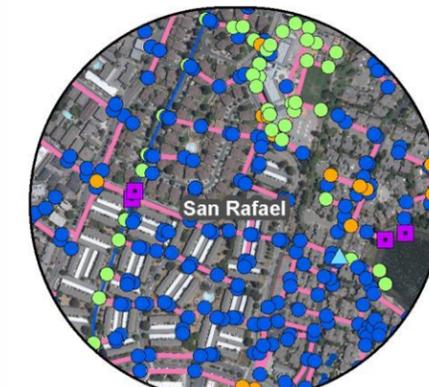
2: Las Gallinas Creek



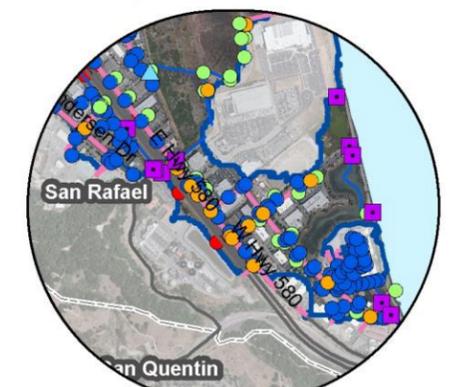
3: Peacock Gap



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



5: Canal Neighborhood



6: Interstate 580 & Kerner Blvd.

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: 3/29/2017



# SAN RAFAEL

## Utilities

PG&E has significant assets in San Rafael that could be exposed and vulnerable to sea level rise and storm surge impacts. Underground gas pipes could face buoyancy pressures as the water table beneath them rises and pushes them to the surface. The pressure can place bending forces on the pipes, especially where they are held down by roads. Moreover, if a road sheltering a natural gas pipe is damaged enough to rupture the pipes the consequences could be severe. The transmission lines are above ground and could be vulnerable to falling trees and high winds. In addition, posts could become damaged over time, from floating debris, and subsidence. Lastly, the PG&E offices and yard on Andersen Drive could anticipate storm surge impacts in the long-term.

The San Rafael public works building and corporate yard may not experience direct impacts until the long-term with a storm surge, and primarily in the parking lots. However, access to and from the site could be compromised in the long-term due to sea level rise alone. With respect to other utilities, San Rafael is vulnerable to similar issues as other shoreline 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,
- Escalating activity, capacity demands, energy consumption, and wear and tear on San Rafael's stormwater pump stations 50-61, and others in the wastewater collection system,
- 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 to 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 shoreline stemming away from the San Rafael Canal hosts significant riparian and tidal marsh

habitats. The diked baylands further south, serve as a storm buffer between urban and tidal areas and contribute to improved water quality trapping and/or removing pollutants from runoff and wastewater. They also act as storage basins for rain runoff and saltwater during high tides.

The dike lands, wetlands, and marshes provide habitat areas for threatened and endangered species; and can serve as possible mitigation areas. Their partial or complete flooding in the winter rainy season provides needed shallow wetland habitat for many species and flocks of migratory ducks and shorebirds.<sup>206</sup>

Based on the National Inventory of Habitats, several endangered species are known to inhabit these tidal areas including the California Black Rail, Ridgway's Rail, the California Brown Pelican, and the tidewater goby. Other than Brick Yard Beach, San Rafael incorporated has a few beaches that are used for recreation and are not necessarily of habitat value. The Marin Rod and Gun Club beach is also narrow.

## Recreation

The San Rafael shoreline and canal are highly active recreation areas. Boating, fishing, biking, and walking the pathways are the most common activities. The marinas are used for boating and could face challenges in the onset of sea level rise. Biking and walking on the streets and trails could be limited to low tides and inaccessible depending on the path's proximity to the existing shoreline.

In the near-term, McNear's Beach, Gallinas Creek, Pickleweed, and Starkweather Shoreline parks could anticipate impacts at the shoreline edges, and in the medium-term, see significant tidal flooding. In the long-term, Albert, Peacock Gap, and Schoen parks could also see tidal flooding. A few hotels, including the Extended Stay America, North Bay Inn, and Motel 6 could also be vulnerable to tidal flooding.

## Emergency Services

The San Rafael Fire Department could be directly impacted at the Castro Street Station 54 in the near-term and face access issues at Station 52 and 55 in the medium- and long-terms. In addition, Bahia Vista Elementary and the Albert J. Boro Community

<sup>206</sup> San Rafael Community Development Department. Amended and reprinted 2013. San Rafael, CA General Plan 2020: Our Natural Resources.

# SAN RAFAEL

Center serve as emergency shelters that could each face up to two feet of flooding by scenario 3. Finally, access on flooded roads would be severely compromised during MHHW and storms.

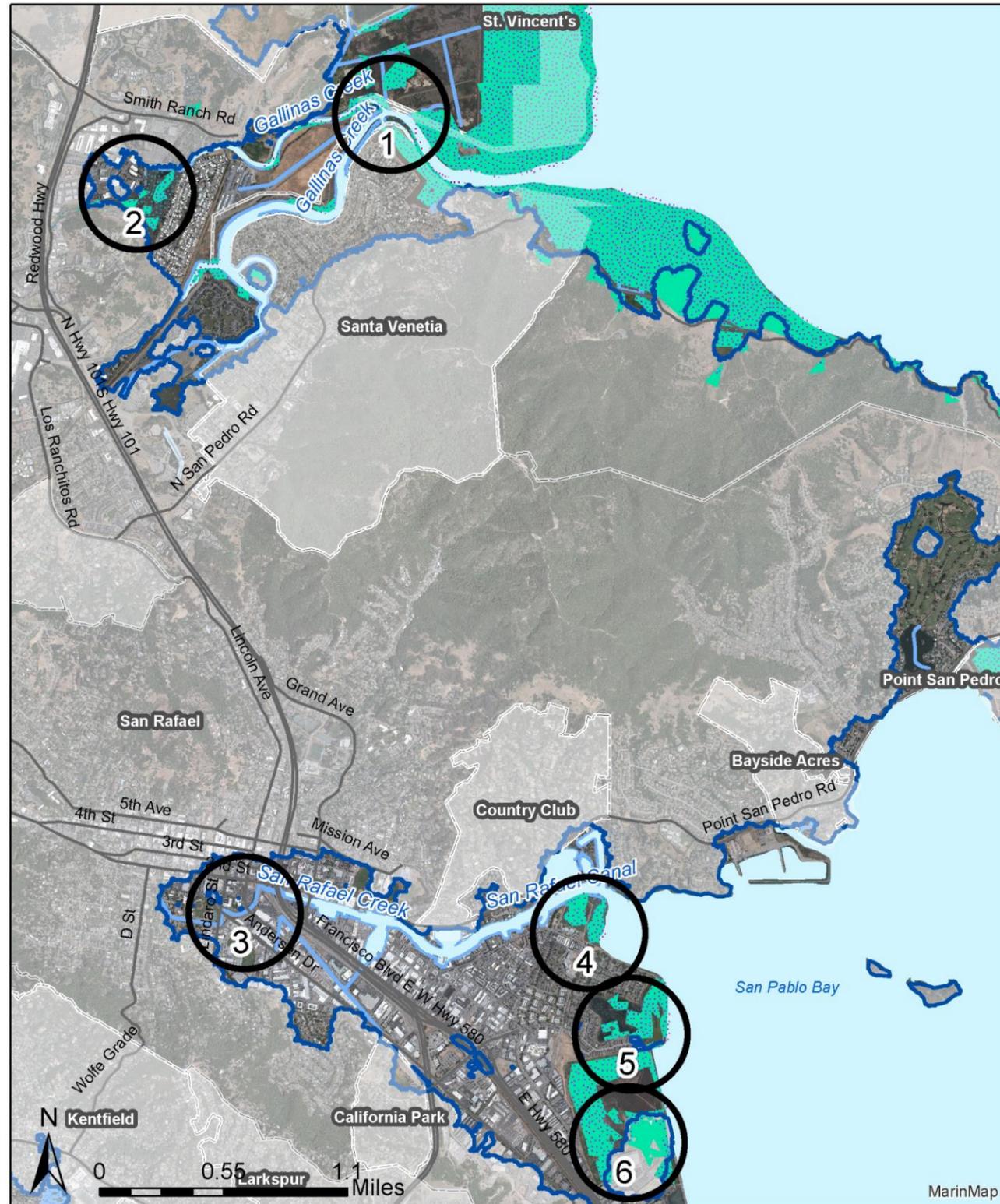
The maps on the following pages illustrate vulnerable natural resource, recreation, emergency and historic features. The areas in the call out circles enable the reader the see areas that are difficult to see on the large scale map. The circles do not indicate that these areas are more vulnerable than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

# SAN RAFAEL

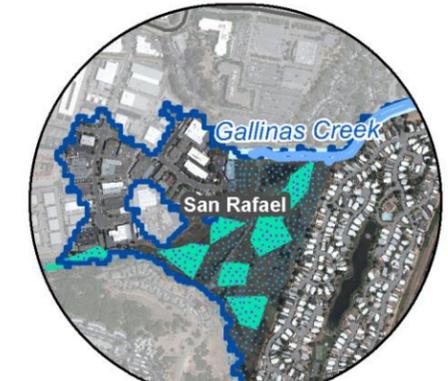
Map 102. San Rafael Vulnerable Natural Resource Assets

## Vulnerable Assets

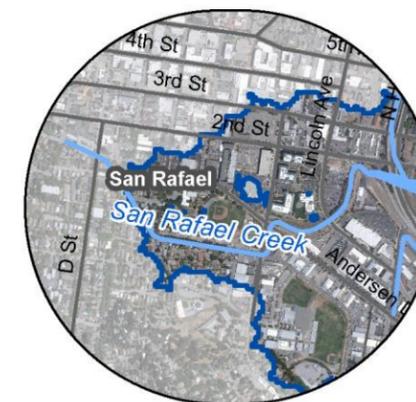
-  Streams
  -  Marsh
  -  Estuary
  -  Wetland
- ## Location Indicators
-  Unincorporated
  -  Municipality
  -  Road
  -  Bay
  -  Inland Extent: Sea Level @ 60"+100-year Storm



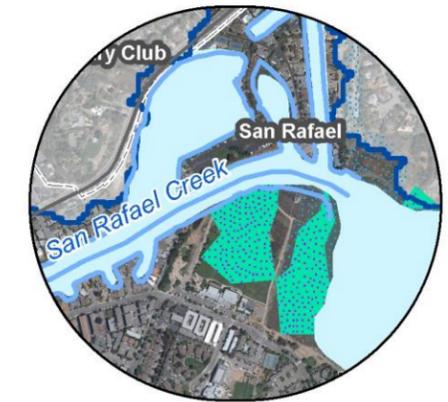
1: Santa Venetia Marsh



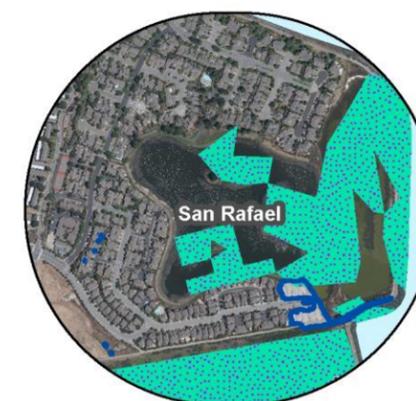
2: Las Gallinas



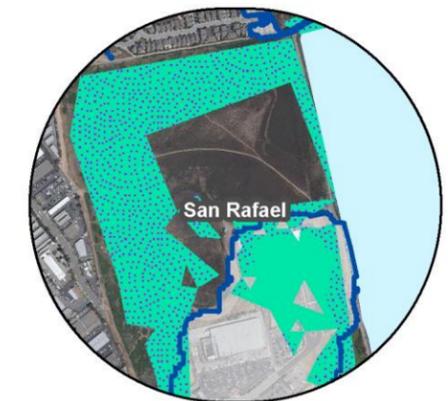
3: San Rafael Creek



4: San Rafael Canal

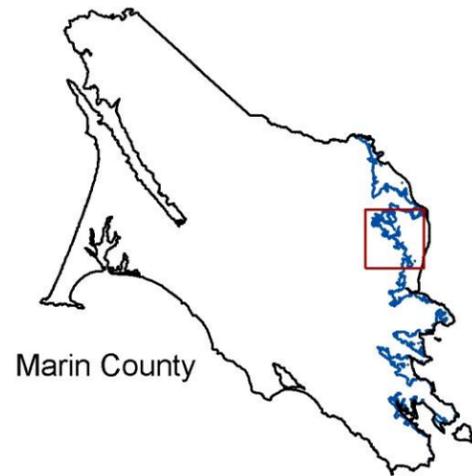


5: MMWD & Bayview Marshes



6: Shoreline Park

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Marin County



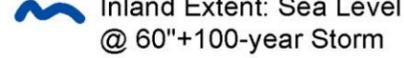
CA Dept. of Fish & Wildlife  
Date: 3/29/2017

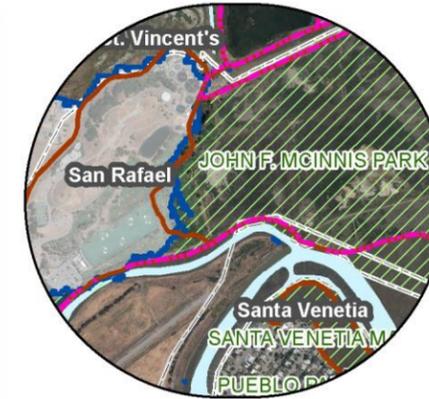
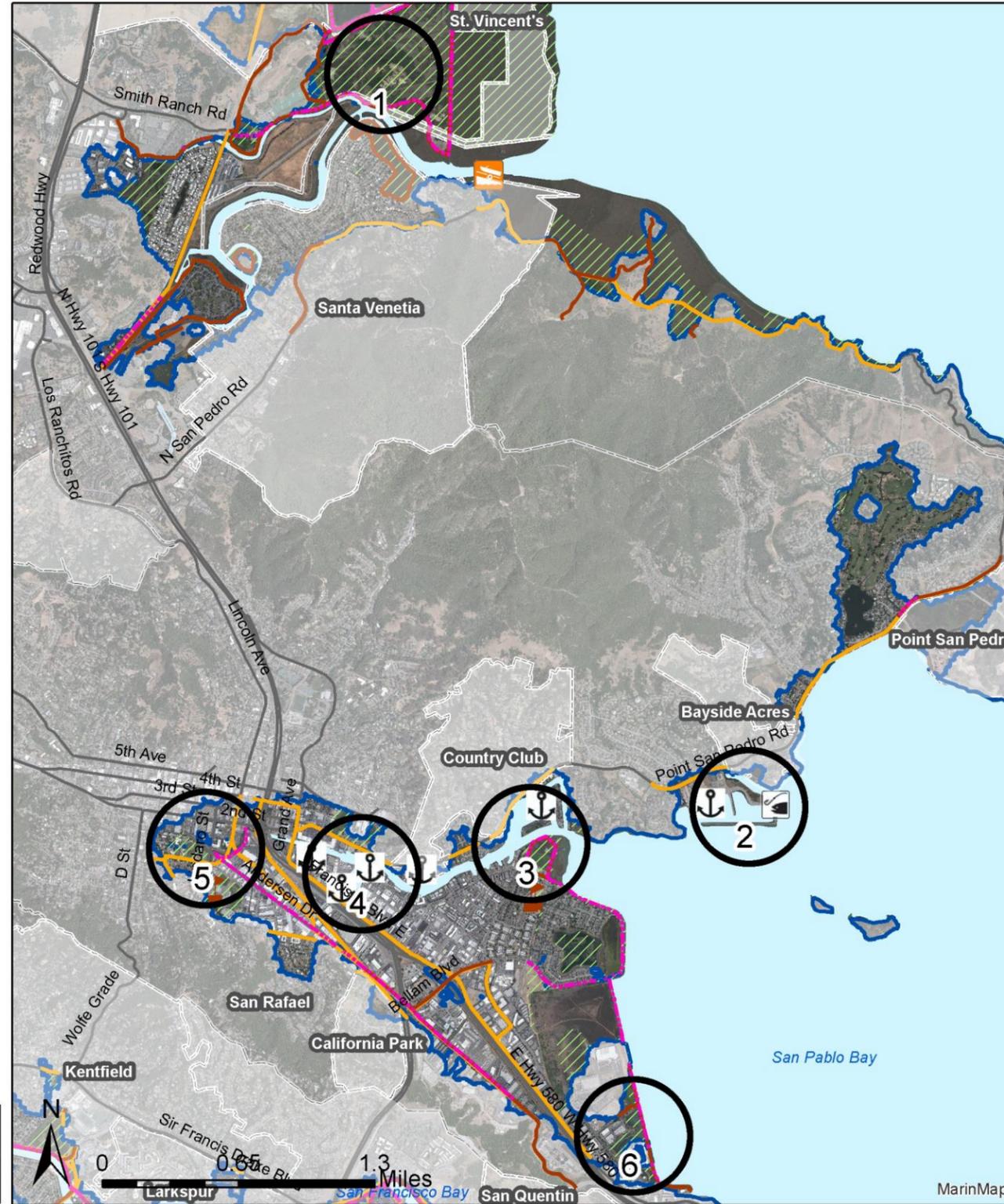
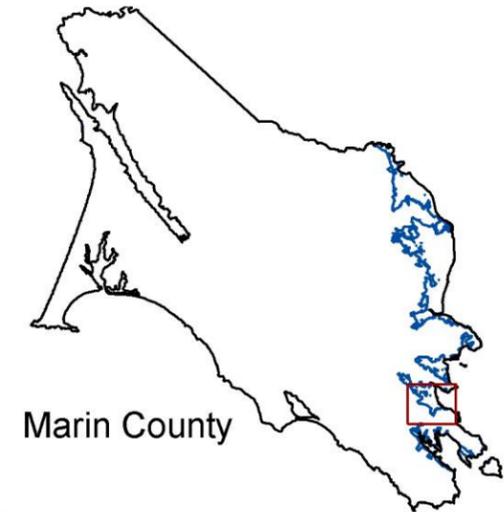


# SAN RAFAEL

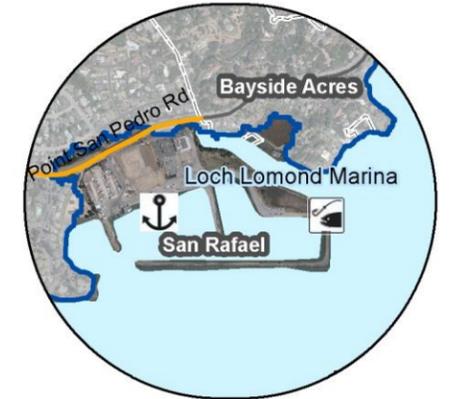
Map 103. San Rafael Vulnerable Recreation Assets

## Vulnerable Assets

-  School
  -  Public Boat Launch
  -  Public Fishing Pier
  -  Marina
  -  Bay Trail
  -  Trail
  -  Bikeway
  -  Park
- ## Location Indicators
-  Unincorporated
  -  Municipality
  -  Road
  -  Bay
  - 



1: McInnis Park



2: Loch Lomond Marina



3: Canal Neighborhood



4: San Rafael Canal



5: Gerstle Park Neighborhood



6: Spinnaker Marsh

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: 3/29/2017



# SAN RAFAEL

Map 104. San Rafael Vulnerable Emergency Service Assets

## Vulnerable Assets

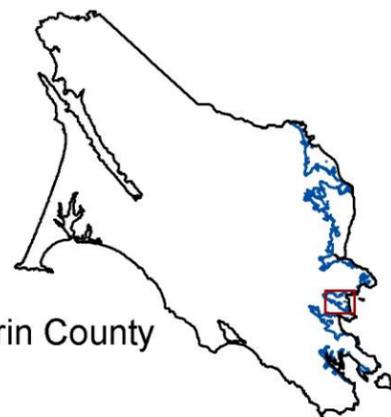
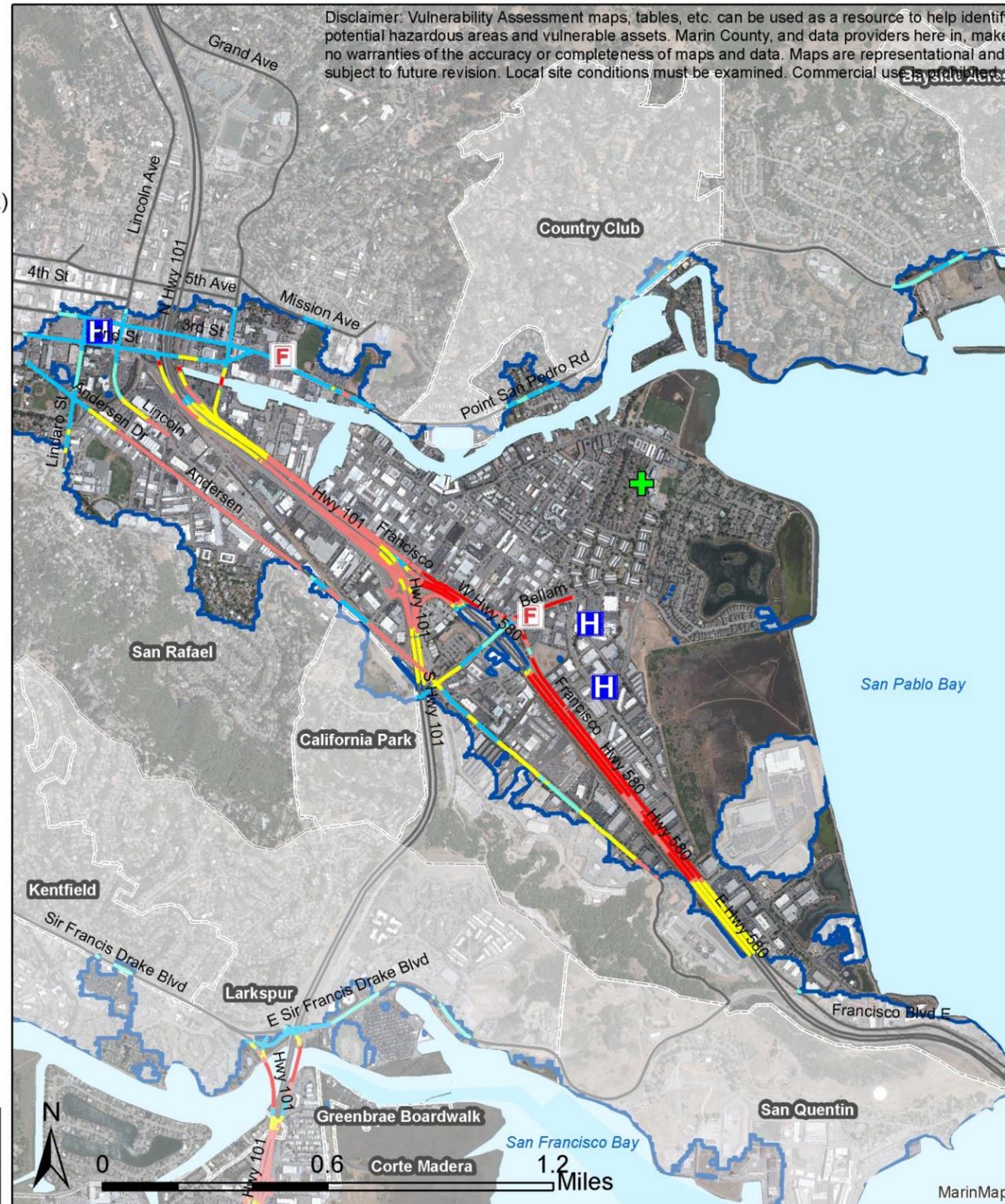
-  Fire Station
-  Medical Facility
-  Emergency Shelter

## 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



Marin County



Date: 2/14/2017



# SAN RAFAEL

## Cultural Resources

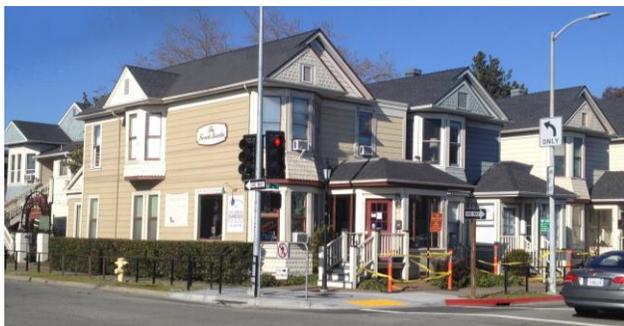
Much like other communities in Marin, San Rafael was once home to Miwok Indians prior to European settlement. San Rafael the home of Mission San Rafael Arcángel (1817), the last mission Spanish missionaries constructed in California. In 1879 the San Francisco and North Pacific Railroad reached San Rafael. The national rail network linked with San Rafael in 1888 leading to increased settlement and economic growth.<sup>207</sup>

San Rafael's vulnerable historic resources could be vulnerable to both tidal flooding and 100 year storm flooding from San Rafael Creek, generally in close proximity to highway 101. Resources include the Litchfield Sign (local landmark), the French Quarter, 2 potentially historic areas (Ritter Street and Gerstle Park (partial)), and 4 potentially historic structures. Archaeological resources could be present in the exposed area.

Table 109 ranks select vulnerable assets discussed above by onset and maximum flood depth at MHHW. A few public resources that are not likely to suffer tidal flooding under these scenarios, but could suffer during scenario 6, with 100-year storm surge and five feet of sea level rise. These are:

- Glenwood Elem. School,
- Department of Public Works, and
- US Post Office-Bellam Blvd.

Nevertheless, these properties could anticipate difficulties in accessing the site because the roads leading to these sites would be flooded.



San Rafael's French Quarter Historic District includes Victorian Homes now used for local businesses. Credit: Marin County CDA

<sup>207</sup> Wikipedia, San Rafael, California. Last updated December 15, 2016. en.wikipedia.org/wiki/San\_Rafael,\_California

Table 109. Example San Rafael Vulnerable Assets by Sea Level Rise Onset & Flooding at MHHW

Asset	Scenarios		
	Near-term 1	Medium-term 3	Long-term 5
Canal area Bay Trail & open space	10'3"	11'1"	25'4"
John F. McInnis Park	7'6"	8'6"	10'6"
Starkweather Shoreline Park	5'4"	6'	16'3"
Pickleweed Park	5'	5'8"	8'9"
Hwy 580 East bound	0-4'	0-4'10"	4"-7'8"
Kerner Blvd	0-4'	0-4'7"	8"-7'5"
Francisco Blvd E	0-3'10"	0-4'7"	1'-7'5"
Bellam Blvd.	0-3'5"	0-4'	0-7'3"
Canal St.	0-3'4"	1'2"-4'2"	2'-7'11"
Bahia Way	2'-3'3"	2'4"-3'11"	5'2"-6'10"
Hwy 580 West bound	1"-2'10"	1"-3'7"	1"-6'5"
Bay Trail	0-2'3"	0-3'	0-10'3"
Castro Street Fire Station 54	1'6"	2'7"	6'7"
San Rafael Yacht Harbor	1'2"	4'	10'4"
San Rafael Municipal Harbor	1'	2'	6'
Lowrie Yacht Harbor	9"	3'7"	8'5"
Bahia Vista Elem. School/ Trinity Preschool	8"	2'3"	4'8"
Hi-Tide Boat sales & services	6"	3'4"	8'5"
Marin Yacht Club	1"	1'6"	3'9"
Marin County Health Innovation Campus	1"	1'3"	3'
Beach Park		8'11"	11'10"
Peacock Gap		6'3"	9'

# SAN RAFAEL

Asset	Scenarios		
	Near-term	Medium-term	Long-term
	1	3	5
Neighborhood Park			
Grand Avenue		0-6'	7"-9'
Andersen Dr.		0-5'	3"-8"
Francisco Blvd W		0-4'9"	1'8"-9'5"
Peacock Drive		0-4'	9"-6'8"
SMART Rail		1'8"-3'9"	1'2"-6'8"
Loch Lomond Marina		3'7"	9'7"
Peacock Gap Lagoon and Golf Course homes		1"-3'6"	2"-8'9"
San Rafael Airport		3'5"	8'10"
Canal neighborhood		1"-3'	2"-7'8"
Marin Lagoon		5"-2'5"	1'-6'
Hwy 101 North bound		0-2'5"	6"-5'3"
Davidson Middle School		2'3"	5'9"
Pt. San Pedro Road		0-2'2"	4"-5'10"
San Rafael Yacht Club		2'2"	5'7"
Hwy 101 South bound. off ramp		0-2'	1'4"-5'
GGBHTD Headquarters & Bus Depot		1'8"-2'	4'2"-5'
Downtown		1"-1'3"	3"-3'3"
PG&E Office & Yard		1'2"	3'
Pickleweed Park facilities		1'2"	3'
Montecito Plaza		1'	2'3"
Transit Center		11"	2'5"
Marin Community Clinic		10"	3'8"
San Rafael High School		10"	2'
3 <sup>rd</sup> Street		5"	10"-3'10"
SMART rail			1"-10'3"

Asset	Scenarios		
	Near-term	Medium-term	Long-term
	1	3	5
Lincoln Avenue			10"-7'4"
Schoen Park			4'2"
4 <sup>th</sup> Street			1'-3'5"
2 <sup>nd</sup> Street			1'-3'4"
Ritter Clinic			2'10"
Hetherton St.			1'4"-2'4"
Marin County Emergency Services			2'2"
Peacock Lane			1'4"-1'11"
San Rafael Canal	Water resource		
Marin Lagoon	Water resource		

Source: *MarinMap*, *CoSMoS*

# SAN RAFAEL

Map 105. San Rafael Vulnerable Cultural Resource Assets

## Vulnerable Historic Buildings

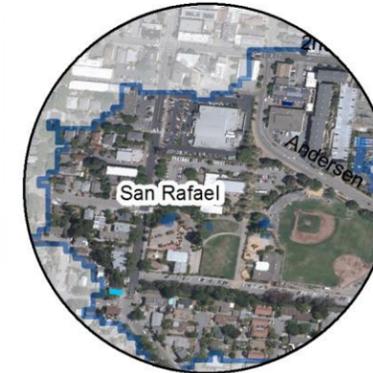
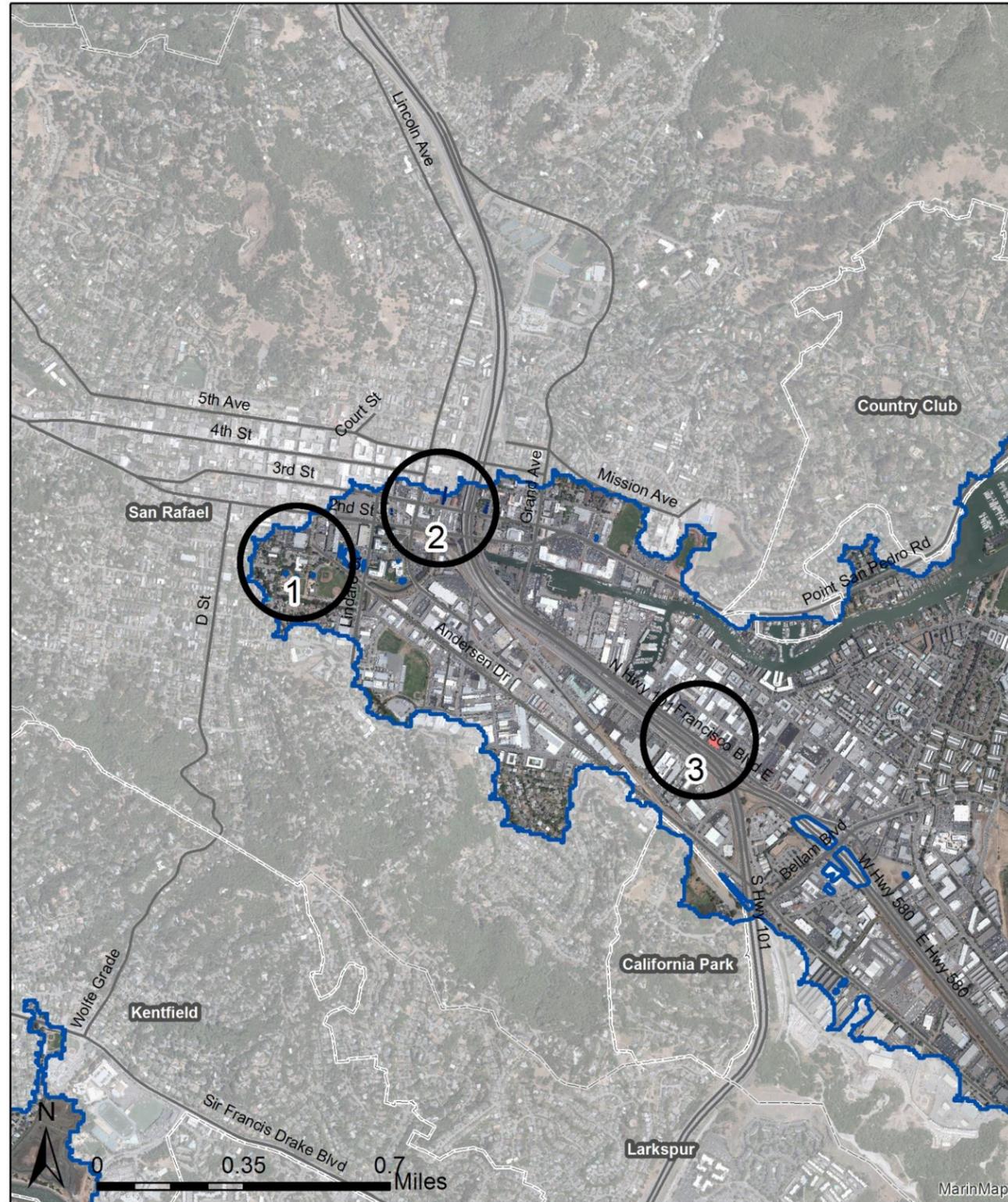
- Scen. 1: 10" Sea Level Rise (SLR)
- Scen. 2: 10" SLR+Storm Surge
- Scen. 3: 20" Sea Level Rise
- Scen. 4: 20" SLR+Storm Surge
- Scen. 5: 60" Sea Level Rise
- Scen. 6: 60" SLR+Storm Surge

## Location Indicators

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

Source: Marin Map, CoSMoS, Historic Properties List (San Rafael), San Rafael Historical/architectural Survey. Credit: Marin County CDA

Archaeological resources may be present



1: West San Rafael

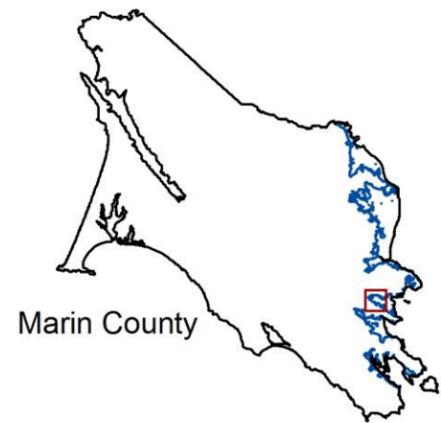


3: Ritter Street and French Quarter



3: Litchfield Sign

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Date: 2/17/2017

