Bothin Marsh Open Space Preserve

SEA LEVEL RISE ADAPTATION PLANNING & COMMUNITY VISION

TEAM

MARIN COUNTY PARKS
PRESERVATION · RECREATION

+

ONE TAM

GOLDEN GATE NATIONAL PARKS CONSERVANCY


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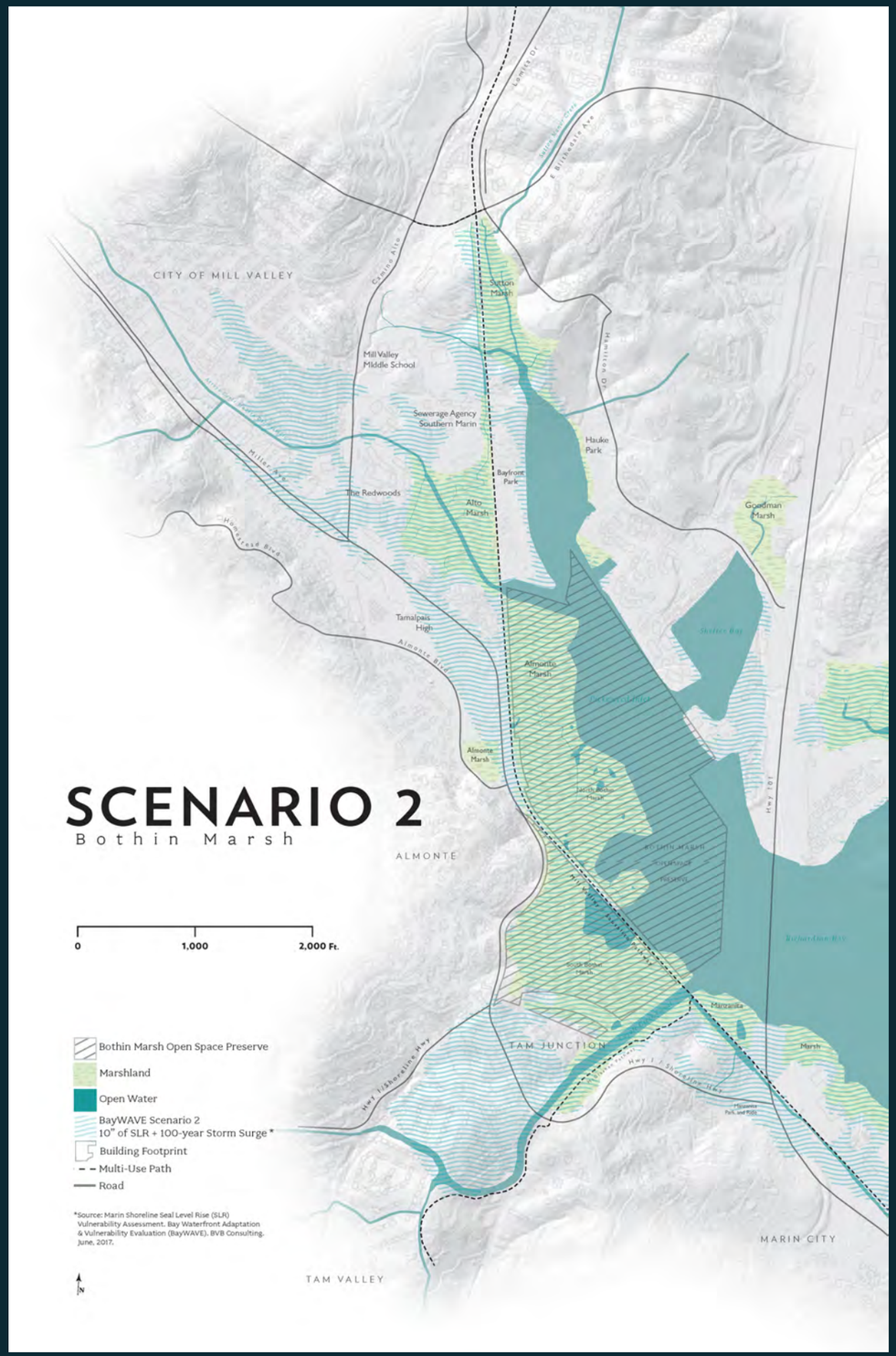
SCENARIO 2
Bothin Marsh
CITY OF MILL VALLEY
ALMONTE
TAM JUNCTION
MARIN CITY
TAM VALLEY
Cascade Arts
Lagunitas Cr
E Blithedale Ave
Bothin Marsh
Mill Valley Middle School
Sewerage Agency Southern Marin
Hauke Park
Bayfront Park
The Redwoods
Alto Marsh
Goodman Marsh
Homestead Blvd
Tamalpais High
Almonte Marsh
Skiffies Bay
Richardson Bay
Manzanita
Marsh
0
1,000
2,000 Ft.
Bothin Marsh Open Space Preserve
Marshland
Open Water
BayWAVE Scenario 2
10" of SLR + 100-year Storm Surge*
Building Footprint
Multi-Use Path
Road
*Source: Marin Shoreline Seal Level Rise (SLR) Vulnerability Assessment. Bay Waterfront Adaptation & Vulnerability Evaluation (BayWAVE). BVB Consulting. June, 2017.
N


5/2017
1852 Tidal Marsh


5/2017

PROJECT GOAL

In partnership with Bothin's community of visitors and neighbors, develop a shared vision for near term protection and long term adaptation of the Bothin Marsh Open Space Preserve in response to sea level rise and climate change.

PROJECT GOAL ELEMENTS

1 Thriving Biological Diverstiy

2 Healthy Natural Processes

3 Community Innovation

4 Recreational Opportunities

5 Active Transportation Corridor

6 Sense of Place

Work to Date

March 2019

Bothin Marsh Geomorphology, Ecology, And Conservation Options

Introduction

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And

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Advised by

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San Francisco Estuary Institute
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josh@sfei.org

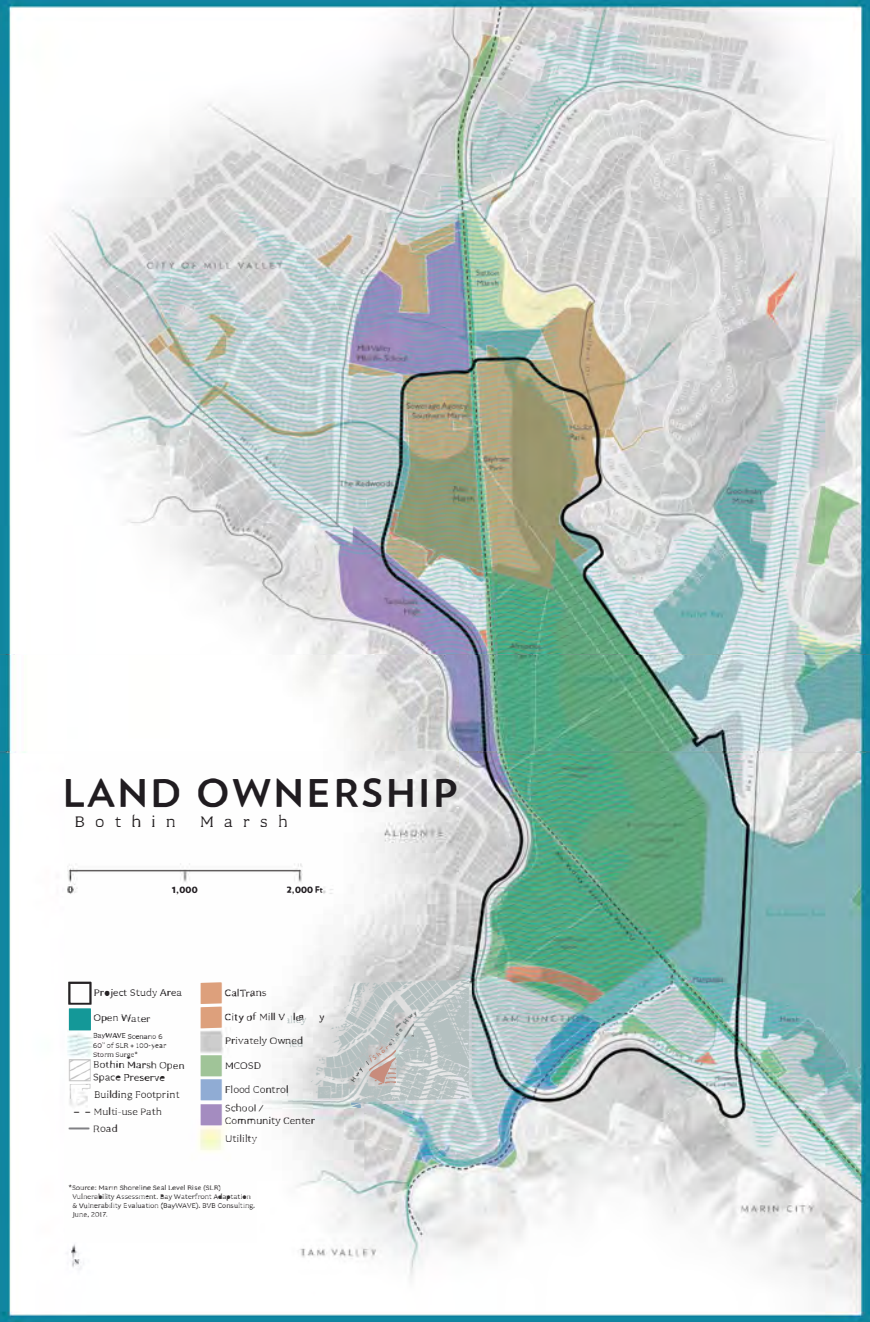
On behalf of the

Marin County Open Space District

January 2018

Suggested Citation:

Collins, LM, PR Baye, and JN Collins. 2018. Bothin Marsh geomorphology, ecology and conservation options. Prepared for the Marin County Open Space District, San Rafael CA.


LAND OWNERSHIP
Bothin Marsh
0
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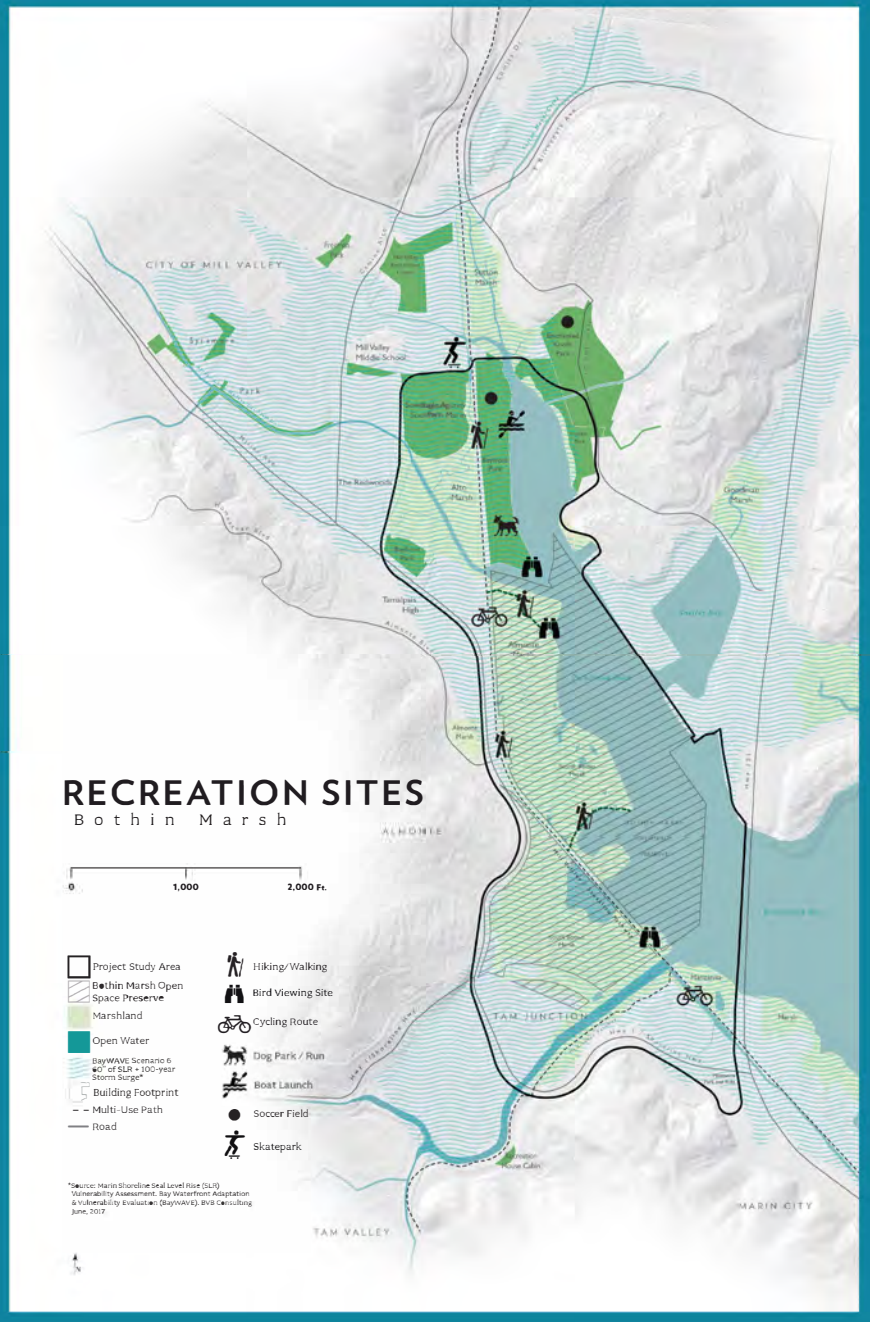
Project Study Area
Open Water
BayWAVE Scenario 6 60" of SLR + 100-year Storm Surge*
Bothin Marsh Open Space Preserve
Building Footprint
Multi-use Path
Road
CalTrans
City of Mill Valley
Privately Owned
MCOSD
Flood Control
School / Community Center
Utility
*Source: Marin Shoreline Seal Level Rise (SLR) Vulnerability Assessment. Bay Waterfront Adaptation & Vulnerability Evaluation (BayWAVE). BVB Consulting, June, 2017.
CITY OF MILL VALLEY
ALMONTE
TAM JUNCTION
MARIN CITY
TAM VALLEY


RECREATION SITES
Bothin Marsh
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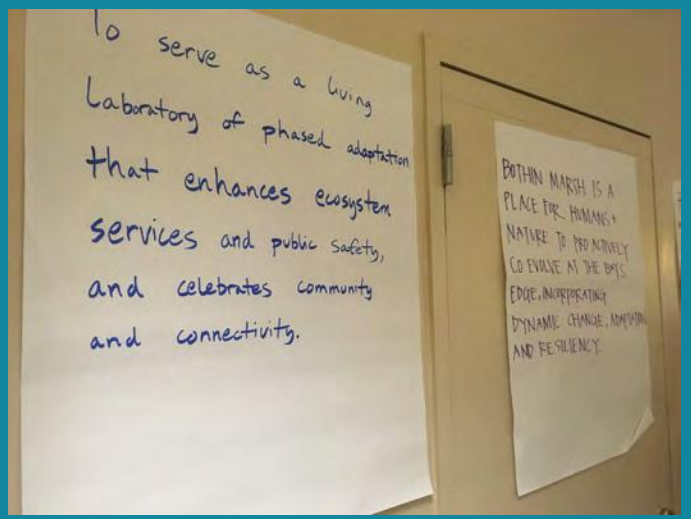
1,000
2,000 Ft.
Project Study Area
Bothin Marsh Open Space Preserve
Marshland
Open Water
BayWAVE Scenario 6 60" of SLR + 100-year Storm Surge*
Building Footprint
Multi-Use Path
Road
Hiking/Walking
Bird Viewing Site
Cycling Route
Dog Park / Run
Boat Launch
Soccer Field
Skatepark
*Source: Marin Shoreline Seal Level Rise (SLR) Vulnerability Assessment. Bay Waterfront Adaptation & Vulnerability Evaluation (BayWAVE). BVB Consulting, June, 2017
CITY OF MILL VALLEY
ALMONTE
TAM JUNCTION
MARIN CITY
TAM VALLEY


to serve as a living
Laboratory of phased adaptation
that enhances ecosystem
services and public safety,
and celebrates community
and connectivity.
BOTHIN MARSH IS A
PLACE FOR HUMANS +
NATURE TO PRO ACTIVELY
CO EVOLVE AT THE BAYS
EDGE, INCORPORATING
DYNAMIC CHANGE, ADAPTIVE
AND RESILIENCY

Evolving Shorelines

Bothin Marsh Open Space Preserve and Pathway

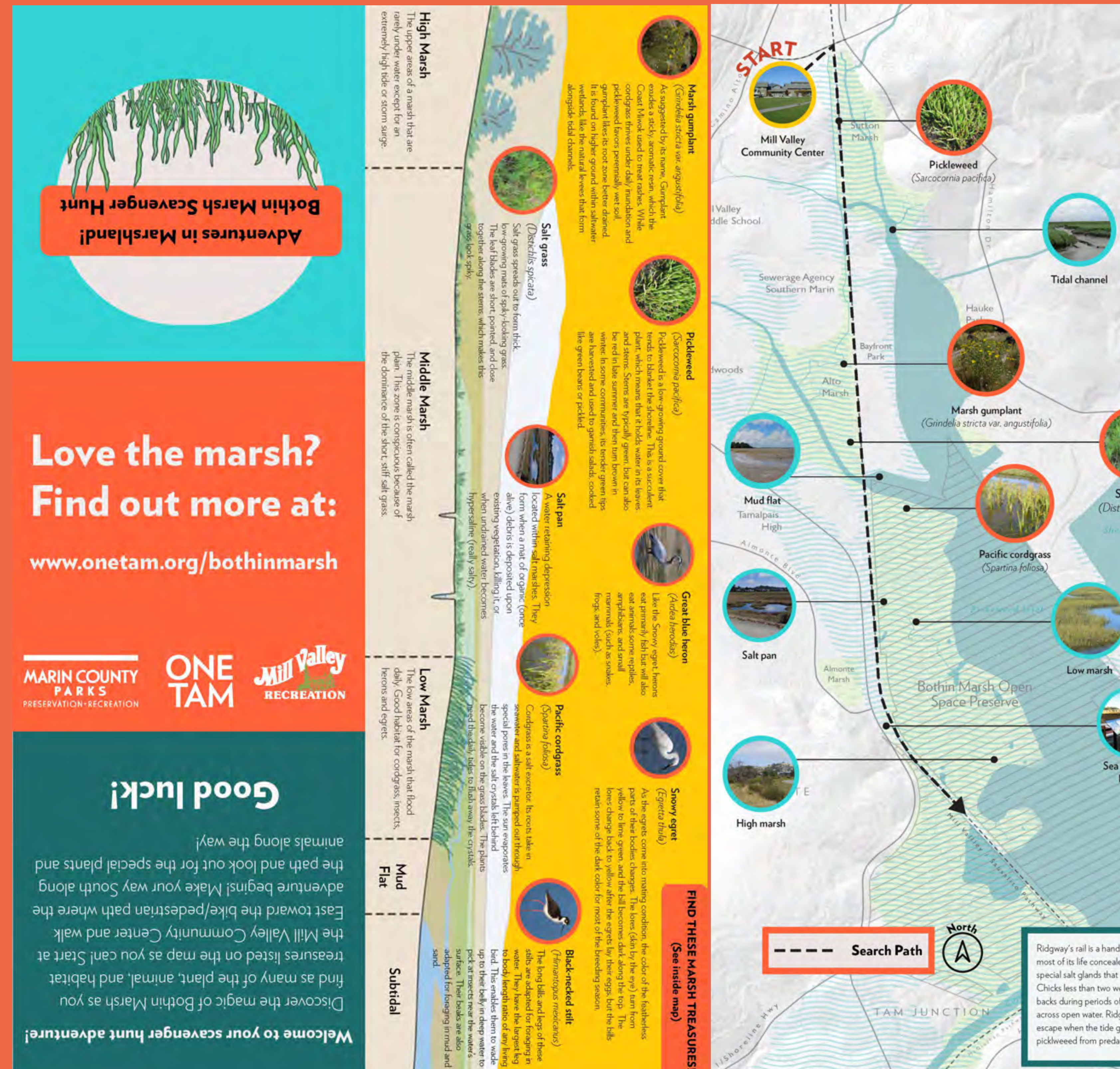

EXIT


Come say hi and learn about Mt. Tam!
ONE TAM


Come say
hi and
learn
about


Evolving Shorelines
WE WANT TO HAVE A CONVERSATION ABOUT OUR COMMUNITY SHORELINE
SHARE YOUR IDEAS


MARSH
PLANTS!


Love the marsh?
Find out more at:
www.onetam.org/bothinmarsh
MARIN COUNTY PARKS
PRESERVATION • RECREATION
ONE TAM
Mill Valley RECREATION
START
Mill Valley Community Center
Pickleweed
(Sarcocornia pacifica)
Tidal channel
Marsh gumplant
(Grindelia stricta var. angustifolia)
Mud flat
Pacific cordgrass
(Spartina foliosa)
Salt pan
Low marsh
High marsh
Bothin Marsh Open Space Preserve
Search Path
North
TAM JUNCTION

BOTHIN MARSH OPEN SPACE PRESERVE

EVOLVING SHORELINES: A VISION FOR THE FUTURE AND A PLAN FOR TODAY

To Come

SRING-FALL 2019: Continued Community Based Planning and Engagement

SUMMER 2019: Publication of Vision Document

SUMMER 2019: Design Services RFQ and Technical Advisory Committee

FALL 2019: Conceptual Design Alternatives

THANK YOU!

CARING FOR WHAT WE HAVE · 2012-2021 ·

MARIN COUNTY PARKS
PRESERVATION • RECREATION

ONE TAM

SLR Adaptation Approaches: Green vs Gray?

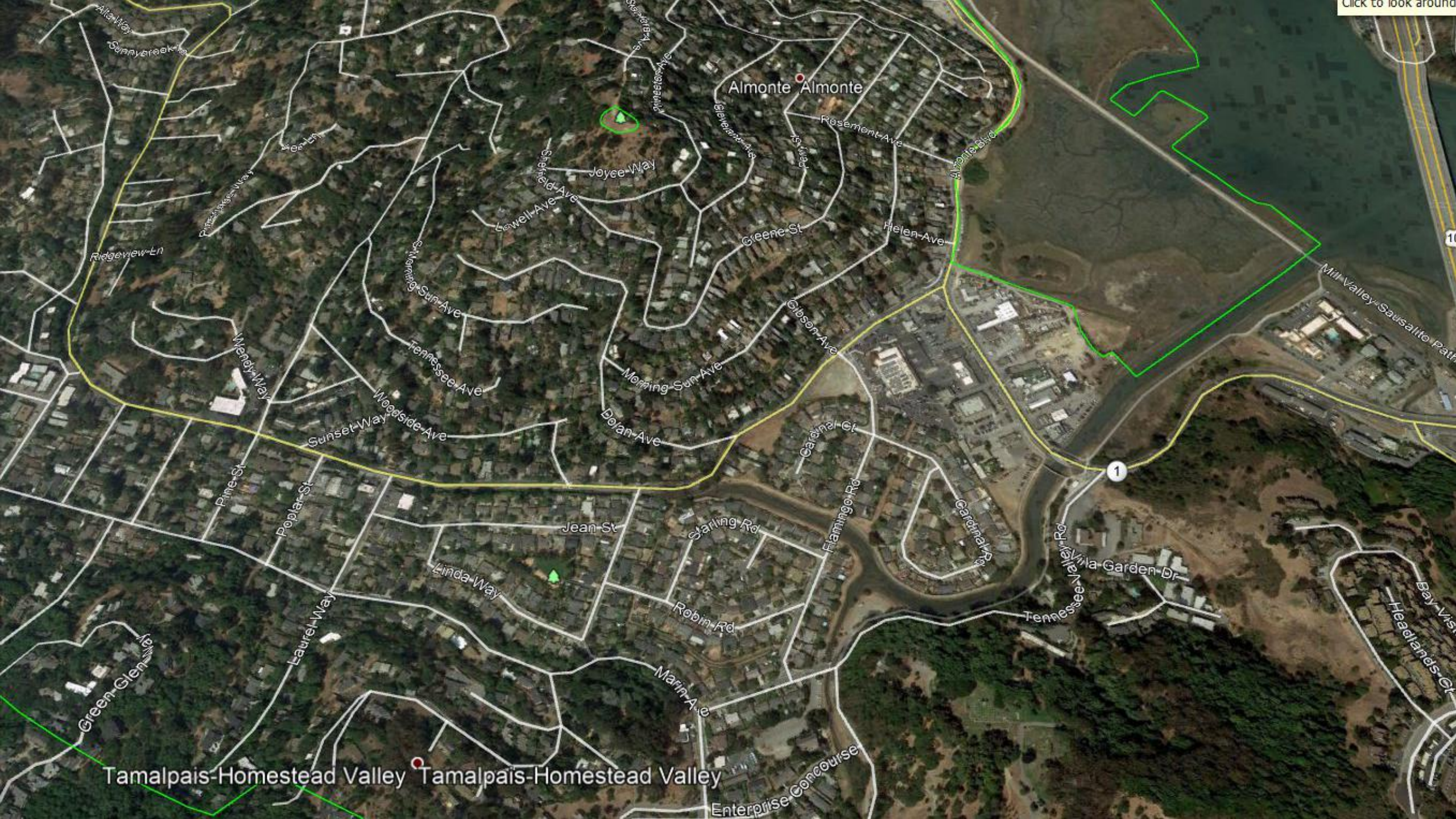
We may need to consider both.


WHY DON'T THE GREENHOUSE GASES ESCAPE THROUGH THE HOLE IN THE OZONE LAYER?

Coyote Creek Levee Evaluation

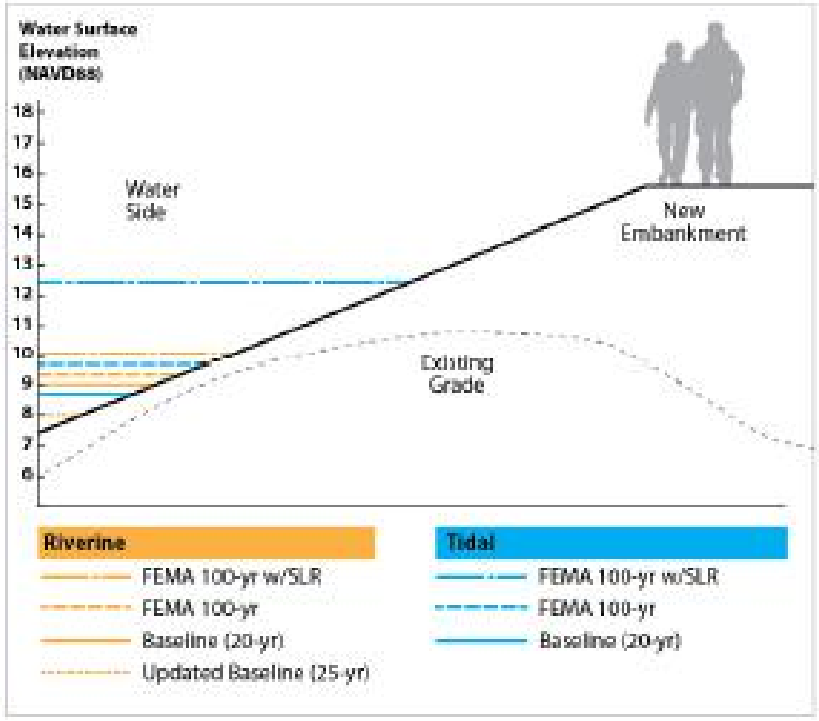
Presented by

Scott McMorrow
Marin County Flood Control & Water Conservation District

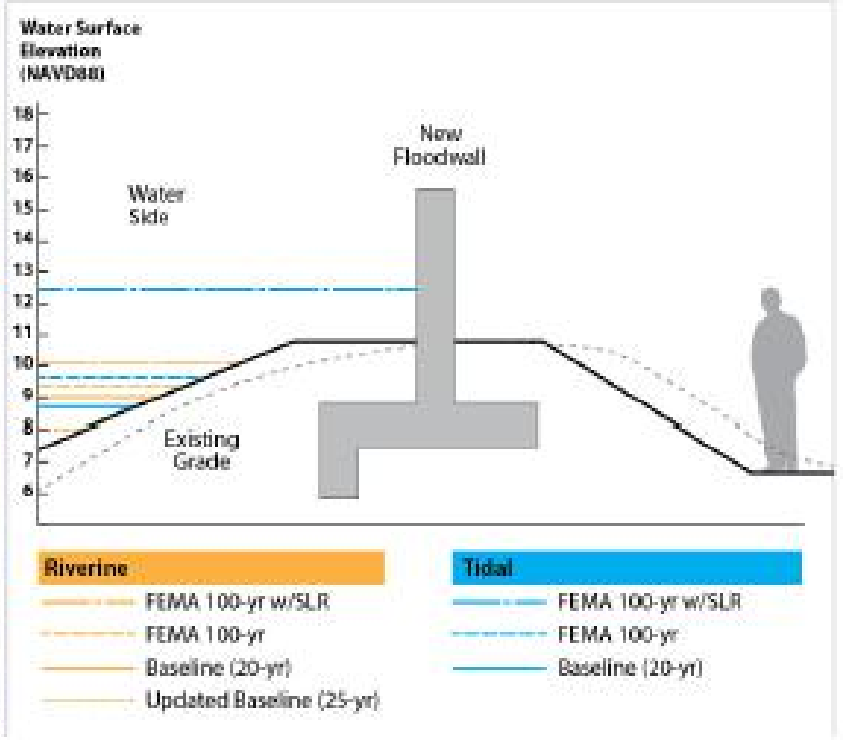

Almonte
Almonte
Tamalpais-Homestead Valley
Tamalpais-Homestead Valley
Rosemont Ave
Joyce Way
Sterling Ave
Lowell Ave
Greene St
Helen Ave
Almonte Blvd
Ridgeview Ln
Morning Sun Ave
Gibson Ave
Wendy Way
Tennessee Ave
Woodside Ave
Sunset Way
Dolan Ave
Pine St
Poplar St
Jean St
Starling Rd
Flamingo Rd
Cardinal Ct
Cardinal Rd
Linda Way
Robin Rd
Laurel Way
Marin Ave
Green Glen Ave
Tennessee Valley Rd
Villa Garden Dr
Enterprise Concourse
Mill Valley-Sausalito Path
Click to look around

Scenarios Name	1 Baseline	2 Updated	3a Enhanced A (District 2-percent annual exceedance probability event)	3b Enhanced B (District 1-percent annual exceedance probability event)	4 FEMA Accredited	5 FEMA Accredited with SLR
Geometry Description	Existing Topography Conditions[1]					
Riverine Hydraulics Flow Assumption	5-percent annual exceedance probability event (1960s Corps Design Flow) Coyote Creek 900 cfs[2] Nyhan Creek 650 cfs[3]	4-percent annual exceedance probability event (District Flow + 15%) Coyote Creek 473 cfs[2] Nyhan Creek 473 cfs[3]	2-percent annual exceedance probability event (District Flow + 15%) Coyote Creek 555 cfs[2] Nyhan Creek 559 cfs[3]	1-percent annual exceedance probability event (District Flow + 15%) Coyote Creek 641 cfs[2] Nyhan Creek 651 cfs[3]	1-percent annual exceedance probability event (FEMA Flow) Coyote Creek 910 cfs[4] Nyhan Creek 920 cfs[3]	1-percent annual exceedance probability event (FEMA Flow) Coyote Creek 910 cfs[4] Nyhan Creek 920 cfs[3]
Riverine Hydraulics Downstream Boundary Condition Assumption	MHHW (1960s - 5.4 ft)	MHHW (Present day 5.9 ft)				MHHW (2050 - 8.9 ft)
Tidal Downstream Boundary Condition	MHHW (1960s - 5.4 ft)	MHHW (Present day 5.9 ft)	FEMA 1-percent annual exceedance probability event and still water elevation (9.7 ft)			FEMA 1-percent annual exceedance probability event and still water elevation + Sea Level Rise (2050 - 12.7 ft)

1. - Existing topography per *Topographic Survey of Portion of Coyote Creek City of Mill Valley* survey by Meridian Surveying Engineering Inc., dated March 2013. Flow is assumed to be contained to the channel.
2. - Flow at Spruce Street District Gage.
3. - Flow at Confluence with Coyote Creek.
4. - Flow at Ash Street; approximately one city block upstream of Spruce Street (District gage).



Coyote Creek Levee Evaluation Marin County	GEI Consultants	Illustration Comparing Existing Embankment, FEMA with Sea Level Rise Embankment Raise Option, and Design Water Surface Elevations
Marin County FCWCD		February 2016 Figure E-10



Coyote Creek Levee Evaluation Marin County	GEI Consultants	Illustration Comparing Existing Embankment, FEMA with Sea Level Rise Floodwall Option, and Design Water Surface Elevations
Marin County FCWCD		February 2016 Figure E-11

Thank You!

Point Blue's

***S**tudents and **T**eachers **R**estoring **A** **W**atershed*

STRAW Program

Point Blue

Climate-Smart Ecological Restoration

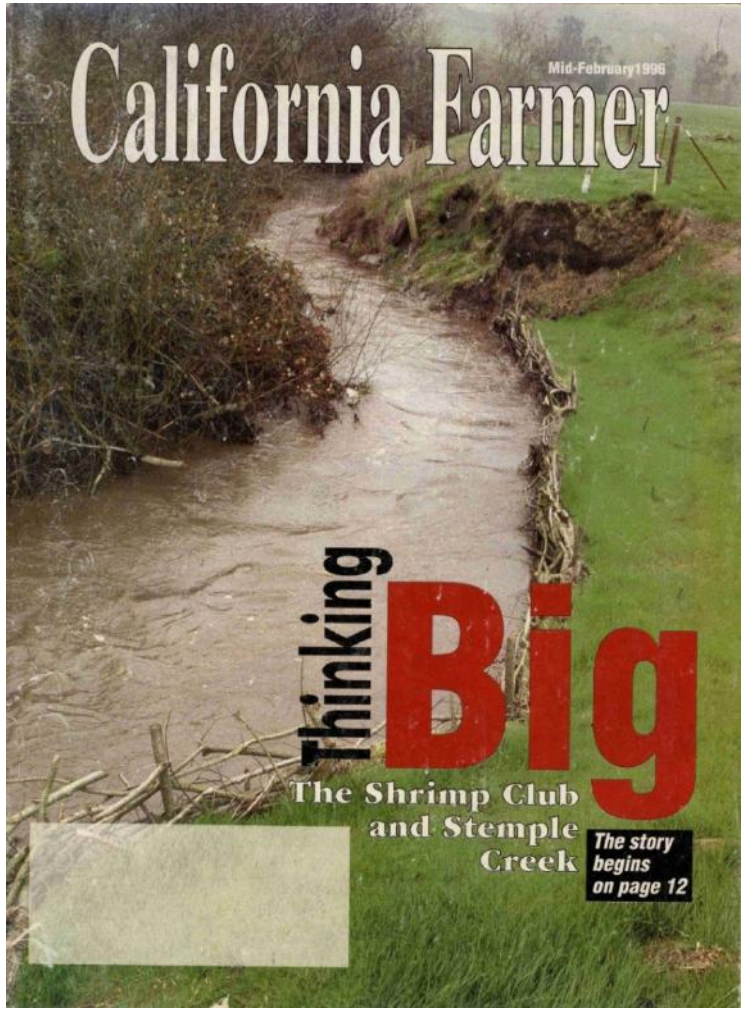
Adapting To Climate Change

Point Blue

The Big Picture

Since 1992:

- Over 50,000 Students
- More than 11,000 volunteers
- Over 650 restorations
- Over 50,000 native plants
- Over 40 miles of riparian habitat



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Partners!

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The Marsh/Upland Transition Zone

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STRAW Restoration

Wetland- Upland Transition Zone

Hamilton Restoration

Point Blue

Some STRAW Restoration Benefits

BIRDS AND MORE BIRDS: The number of bird species detected at STRAW sites has **gone from as low as 0 species to as high as 30.**

ECONOMIC VALUE: $1: $14 For every dollar invested in STRAW, California citizens receive a return value of $14.22 in environmental benefits. *(Does not include additional value from carbon emission offsets or benefits of science education.)*

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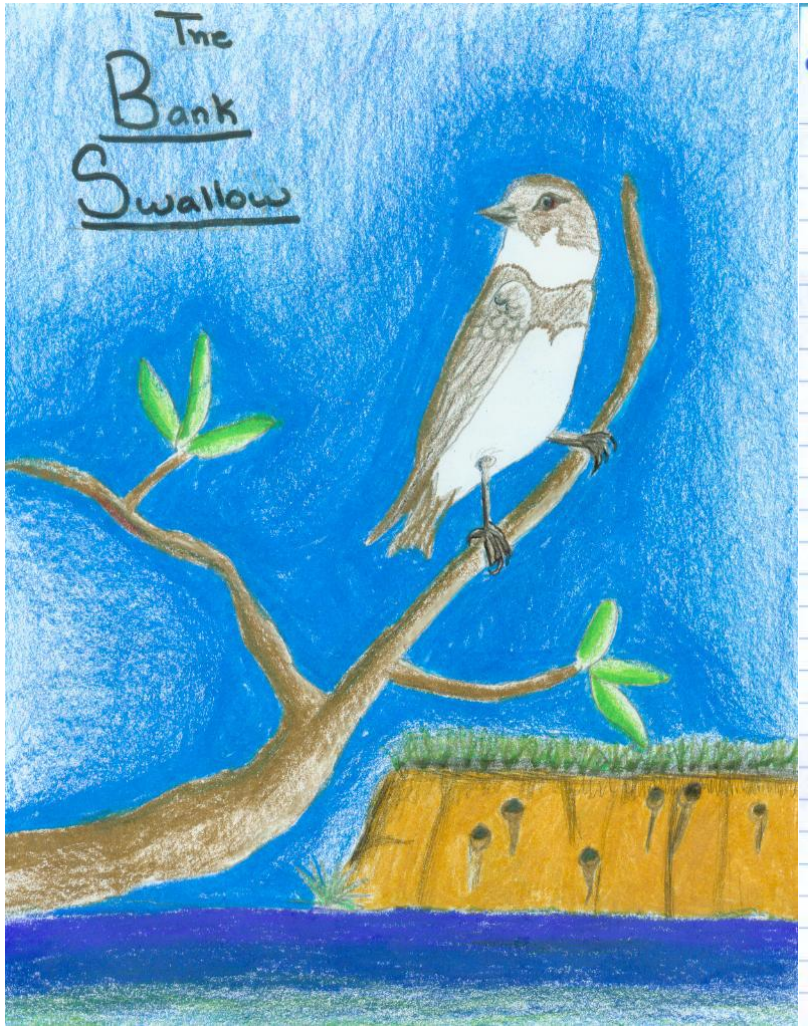
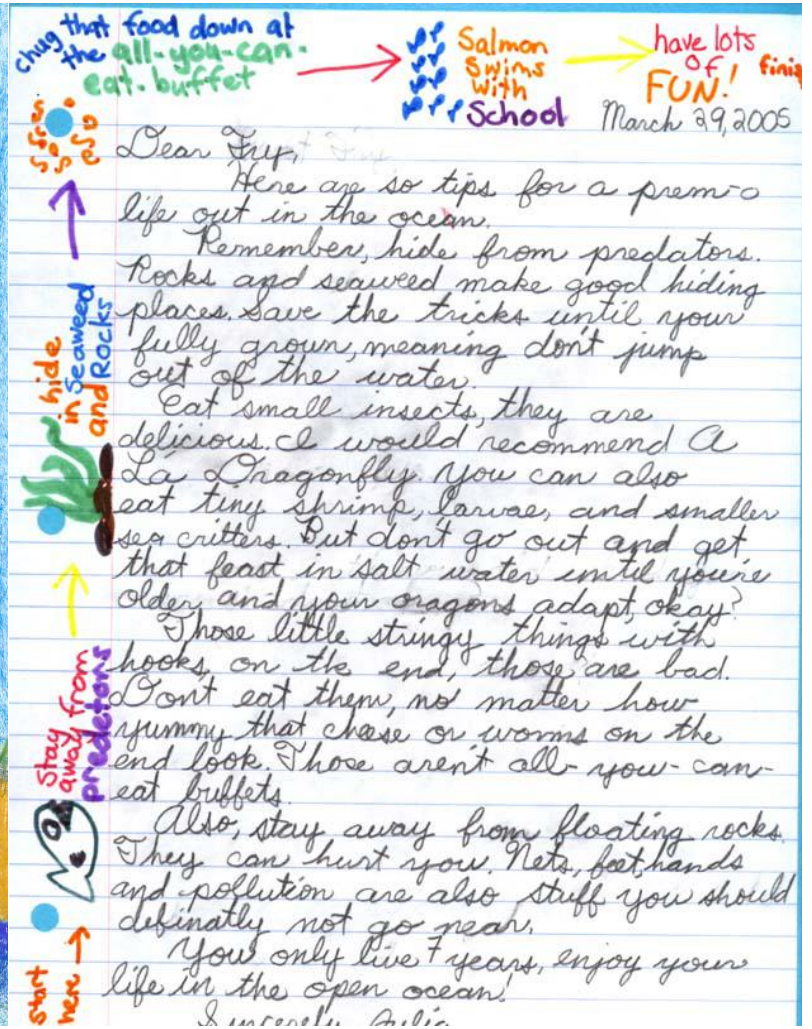
Career Education

Hands-on Science

Point Blue

Extended Learning





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Developed planning matrix

We created a tool to evaluate appropriate plant species and their environmental qualities

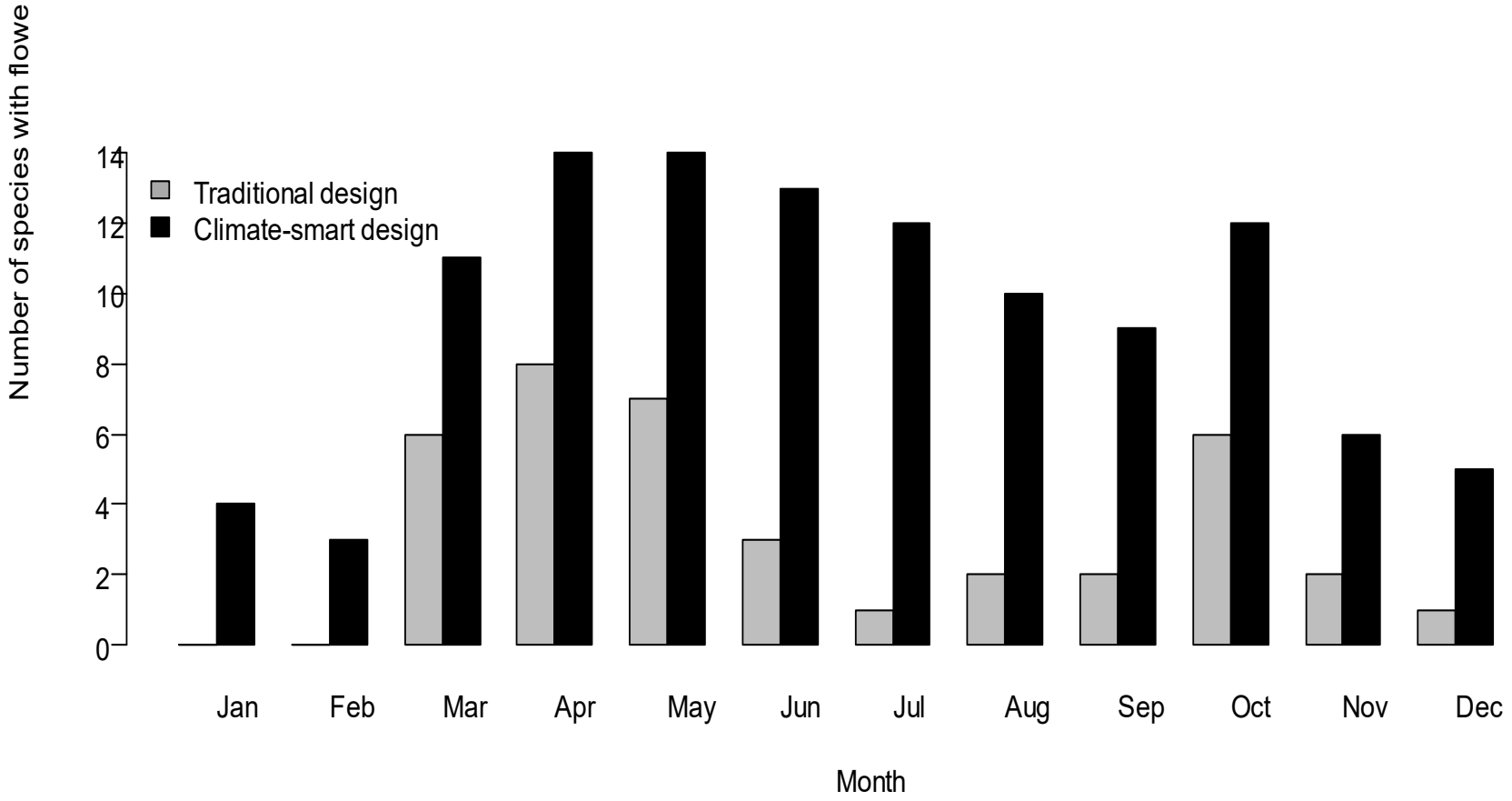
Common Name	Tolerates full or partial sun	Tolerates clay soil	Tolerates wet conditions	Tolerates dry conditions	Evergreen	Fire Adapted	Wildlife fruit source	Wildlife Nectar source	Wildlife Seed Source	Insectary Plant
Sticky manzanita	1		0	1	1	1	1	1		1
common manzanita	1	1	0	1	1	1	1	1		1
Bearberry	1	1	0	1	1	1	1	1		1
Marin manzanita	1		0	1	1	1	1	1		1
CA Sagebrush	1	1	0	1	1	1	0	1	1	1
Salt Marsh Baccharis	1	1	1	1	0					1
coyote brush	1	1	1	1	1	1	1	0	1	1
spice bush	1	1	1	1	0		0	0	0	1
Ceanothus	1			1	1	1	0	1	1	1
blue blossom	1		0	1	1	1	0	1	1	1
Mountain Mahogany	1	1	0	1	0	1	0	1	1	1
Creek dogwood	1	1	1	0	0		1	1	0	1
hazelnut	1	1	1	0	0		0	1	1	1
Hawthorne	1	1	1	1	0		1	1	1	1
Western leatherwood	1	1	1	0			1			
fremontia/ flannelbush	1	1	0	1	1	1	0	1	1	1
Toyon	1	1	0	1	1		1	1		
Creambush	1	1	1	1	0		0	1	1	1

Developed planning matrix

And evaluated timing of flowering/seeding to maximize the number of months that resources (food) are available for wildlife

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sticky manzanita	1	1	1	1								
common manzanita	1		1	1	1						1	1
Bearberry			1	1	1	1						
Marin manzanita												
CA Sagebrush								1	1	1	1	1
Salt Marsh Baccharis							1	1	1	1		
coyote brush	1							1	1	1	1	1
spice bush				1	1	1	1	1				
Ceanothus			1	1	1							
blue blossom			1	1	1	1	1	1	1	1		
Mountain Mahogany			1	1	1							
Creek dogwood					1	1	1					
hazelnut	1	1	1	1				1	1	1		
Hawthorne				1	1							
Western leatherwood	1	1	1									
fremontia/ flannelbush					1	1	1					
Toyon						1	1			1	1	1
Creambush					1	1	1	1		1	1	
Pitcher Sage												

Implementation: Practices on-the-ground



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Ensuring a Resilient Tidal Marsh Ecosystem through Healthy Upland Transition Zones: Assessment and Recommendations

Point Blue

Transition Zone Study Sites

Restoration Recommendations

- Restore for dense vegetation >30 cm, >30 %
- Plant tall plants 50-100 cm
- Design wider Tzones
- Don’t focus on single plant species
- Don’t remove grasses

Photo: Rick Lewis

Photo: Rick Lewis

Looking towards the future…

Point Blue

Point Blue

Marin County Sea Level Rise Adaptation Workshop – March 21st, 2019

1) Belvedere Lagoon – Pump Station Replacement: Presented by Kyle MacDonald
2) Novato Creek Tide Gauge Installations: Presented by James Kulpa

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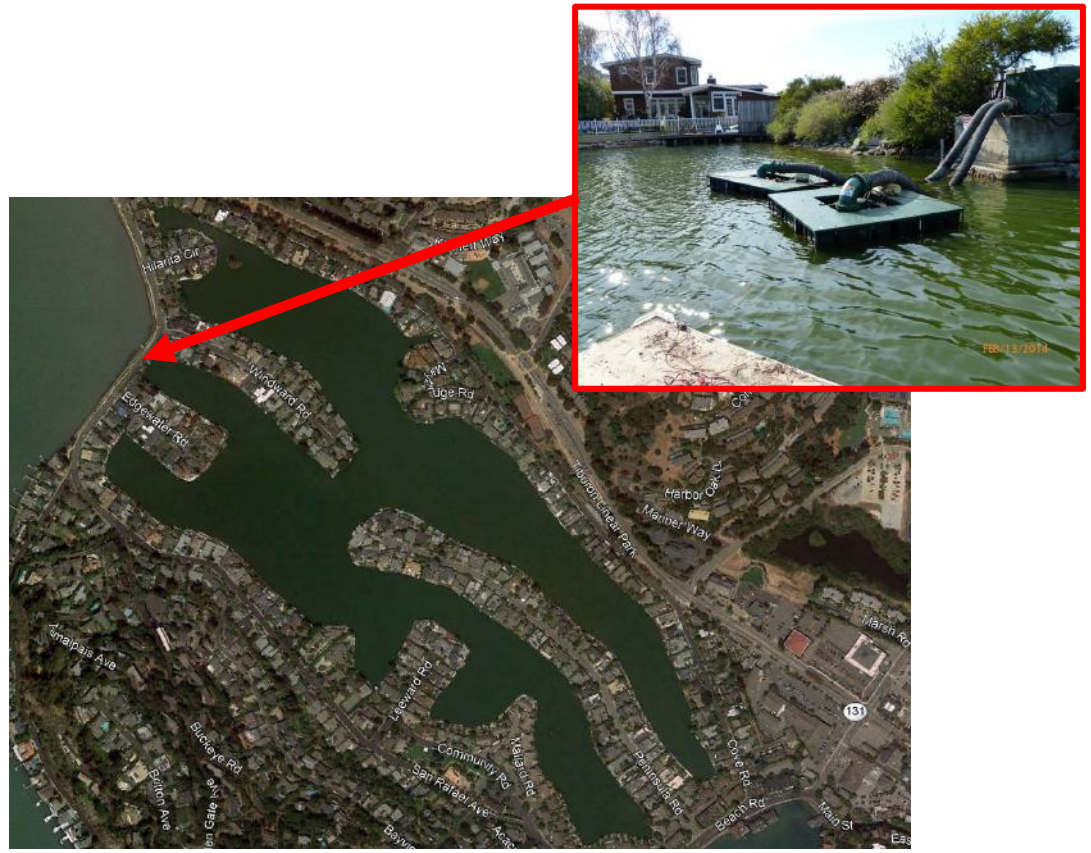
Belvedere Lagoon: Pump Station Replacement

- Foth has been working with the Belvedere Lagoon Property Owners Association (BLPOA) to upgrade their existing flood control mechanisms since 2013
- The lagoon acts like a closed system that accepts storm water and relies on gravity to discharge flood waters to Richardson Bay via two (2) gate structures
- Est. $480,000,000 in real-estate is situated on the lagoon enhancing the need to manage flood waters and future SLR impacts



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Belvedere Lagoon: Pump Station Replacement

- One existing flood control structure (R) allows water from the lagoon to flow into Richardson Bay when the tides allow
- The new structure (L) replaces an older floating pump system which was undersized, subject to manual deployment, and lacked reliability.
- The new vault box is several feet higher than previous. Water is pumped from the lagoon up to the vault where gravity allows the water to flow into Richardson Bay

New system: Water pumped upwards into vault. Increased head allows discharge even at higher tides / storm events.

Secondary Existing System: Waters discharged via gravity only. Ineffective when water elevation in Richardson Bay is at or above that of the lagoon

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Belvedere Lagoon: Pump Station Replacement

- The new vault is three (3) feet higher than the previous (8.0 NAVD 88 → 11.0, which is also the new BFE for the area)
- The structure is adaptable as the vault can be modified to increase the height which increases the delta between the vault and Richardson Bay increasing head
- A second pump is also able to be installed for future needs (underway)
- The adaptable vault / pump system will help reduce capital expenditure costs by modifying components instead of the whole system as SLR becomes more prominent

Adaptable design to allow a 2nd 10,000 GPM pump to be added. Also, the vault lid can be increased to add more head to the system in the future

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Novato Creek Tide Gauge Installation

- Foth / CLE installed 2 non-contact tide gauges on Novato Creek (NC)
- Gauges are programmed to measure, record and report water surface elevations in the NAVD88 geodetic datum
- Time series data will be used for a tidal datum reckoning study
- Data are logged continuously and are available for public access via **marin.onerain.com**

Upper Novato Creek

Lower Novato Creek Tide Gauge

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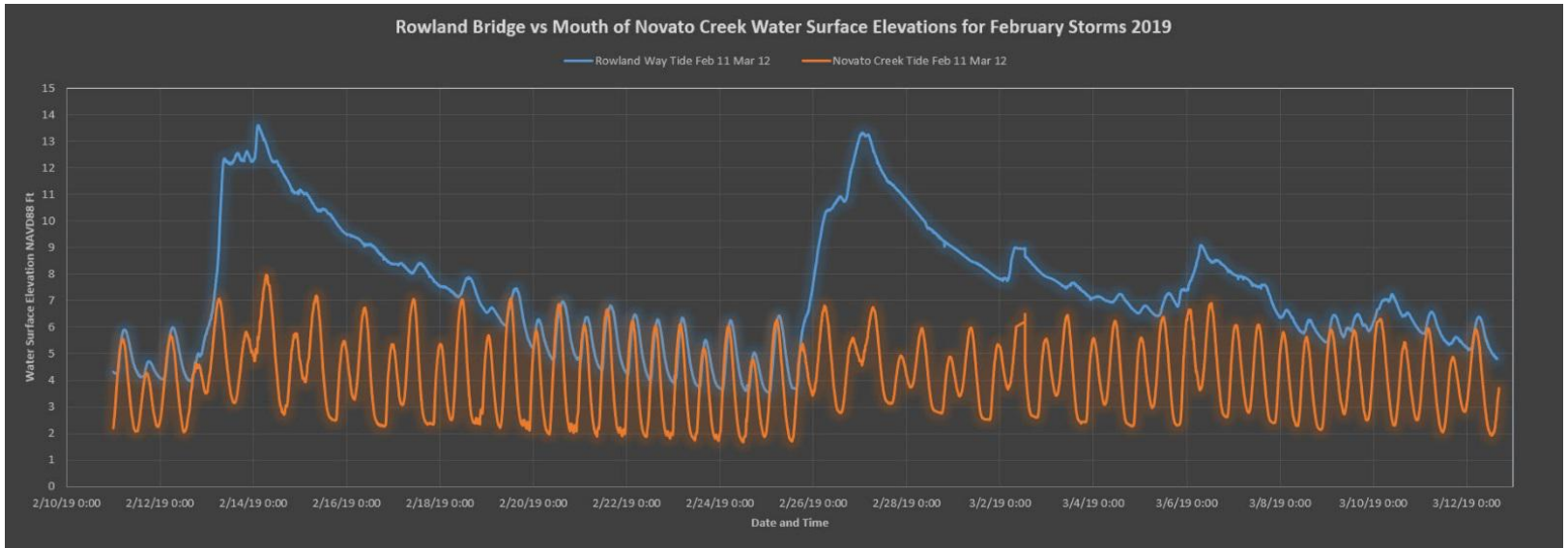
Novato Creek Tide Gauge Installation

- Water surface elevations are recorded continuously providing both real-time and logged data made available to local, regional, state, and federal agencies including the general public
- Resultant time series data, in conjunction with high-resolution bathymetric mapping, will provide valuable calibration information for future flood control modeling efforts
- Water surface elevation varied during the February 2019 storms by ~ 8’ over the approx. 5.8 miles between the two gauges



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Novato Creek Tide Gauge Installation

- Planners can utilize gauge data coupled with SLR predictions to ensure modeling of the watershed is designed and updated appropriately to assist in reducing future flooding impacts which will be exacerbated by SLR
- Foth / CLE is utilizing a suite of modern data collection techniques such as multibeam bathymetric sonar and shoreline laser scanning surveys, channel flow monitoring and automated sensors and telemetry
- Resultant data “paints a more complete picture” in terms of sea-level rise, shoreline retreat and hydrologic regime changes

February 2019 Storm Event. Image Source: Foth / CLE

Image Source: Google Earth

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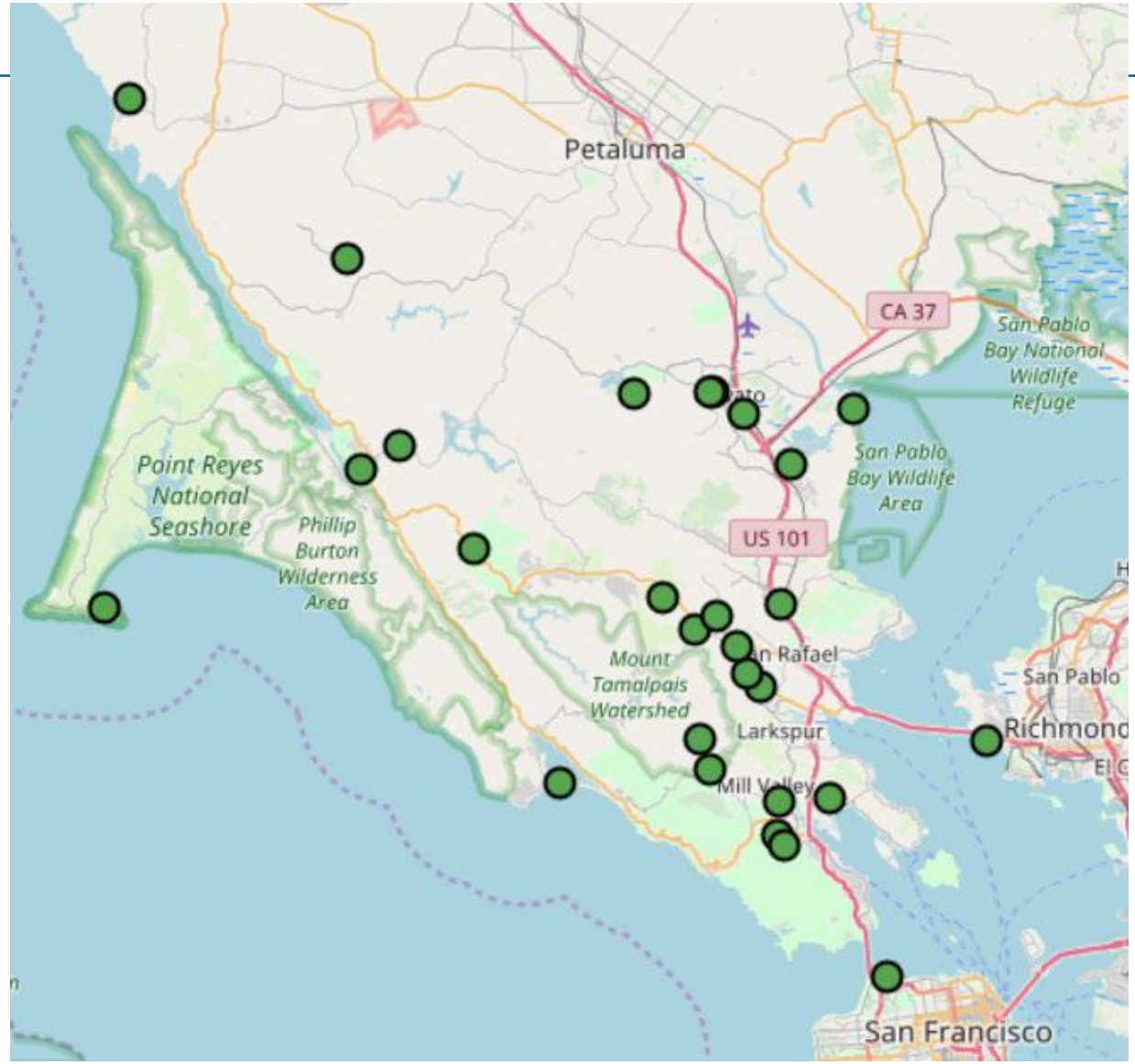
Novato Creek Tide Gauge Installation



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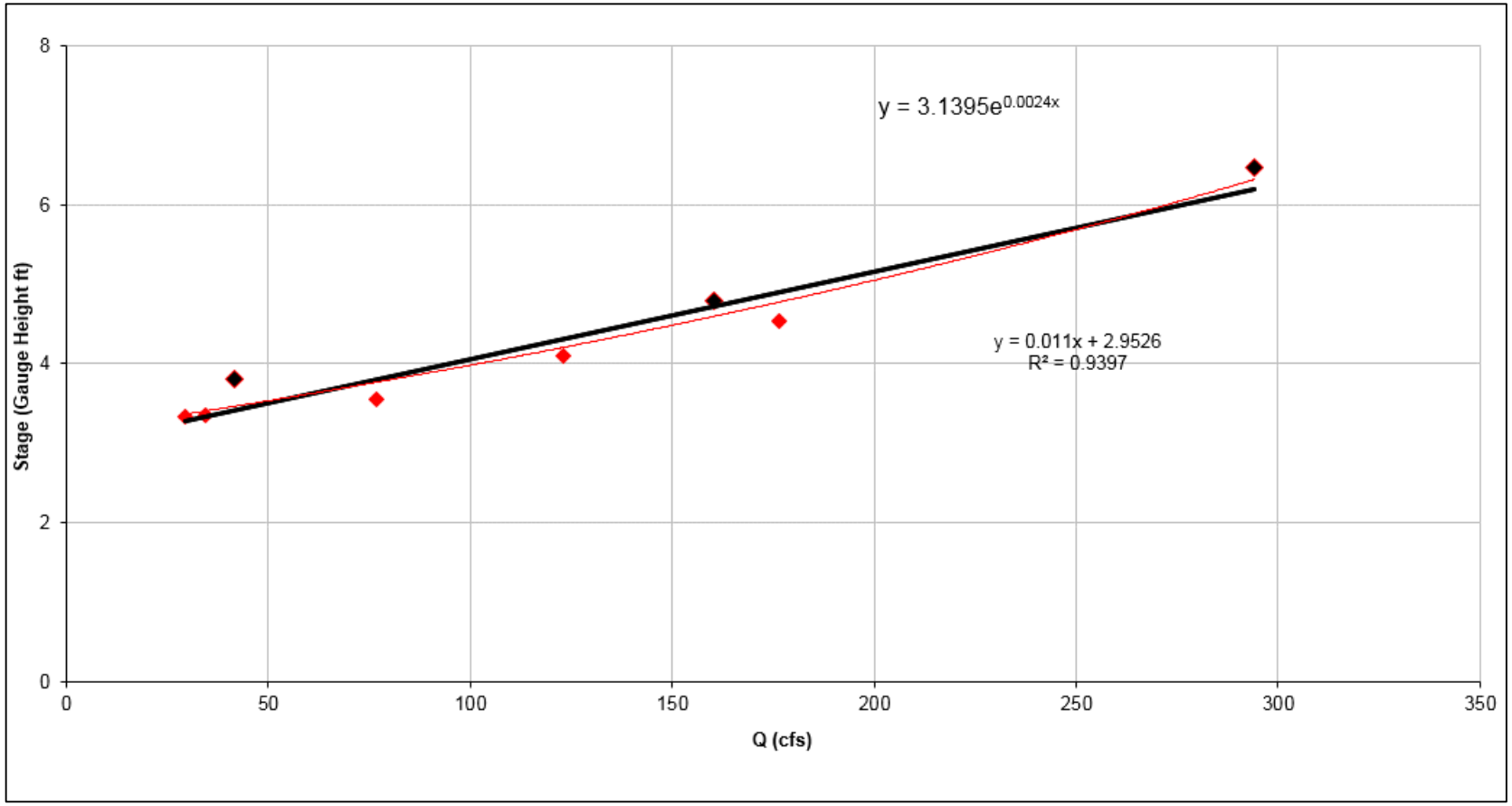
Novato Creek Tide Gauge Installation



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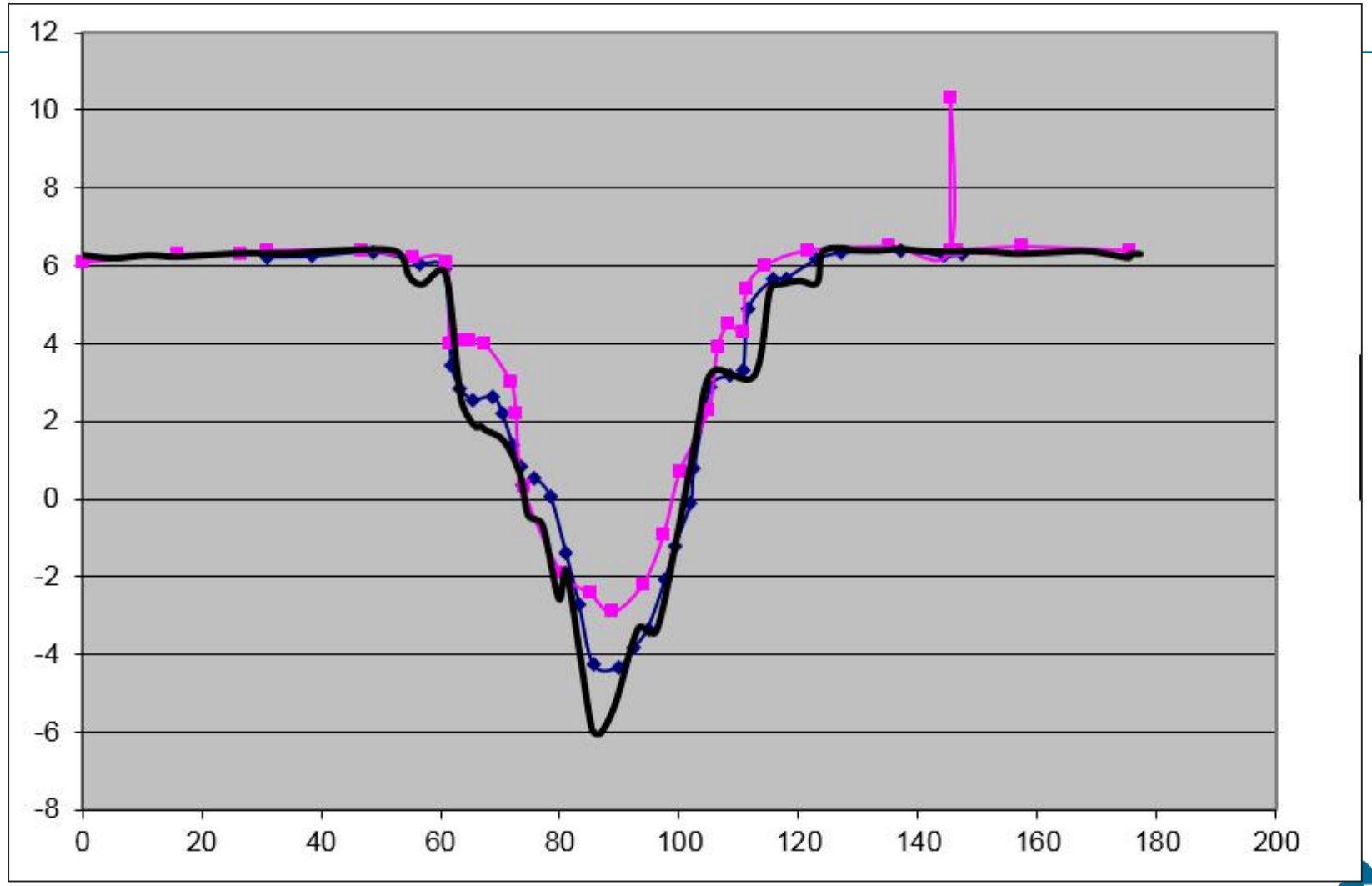
Tracking Change Through Bathymetric Mapping



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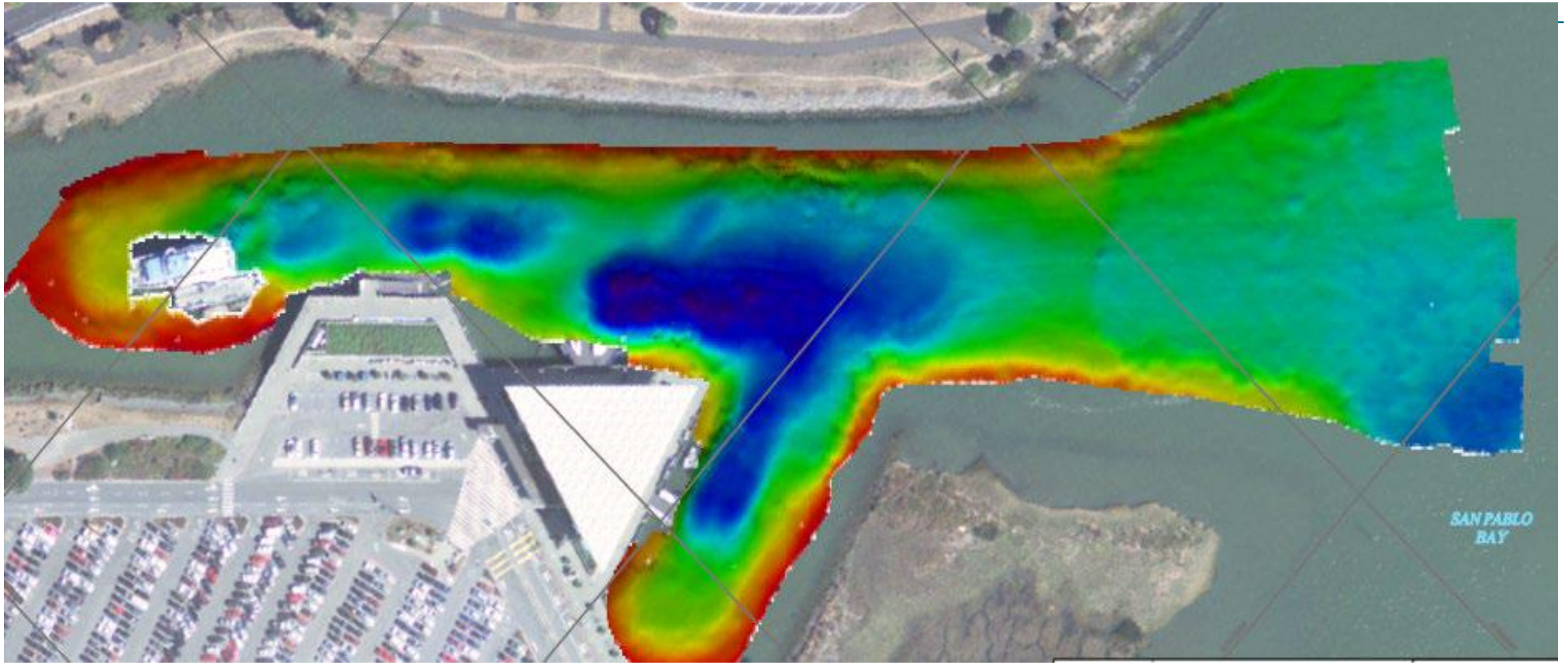
Tracking Change Through Bathymetric Mapping



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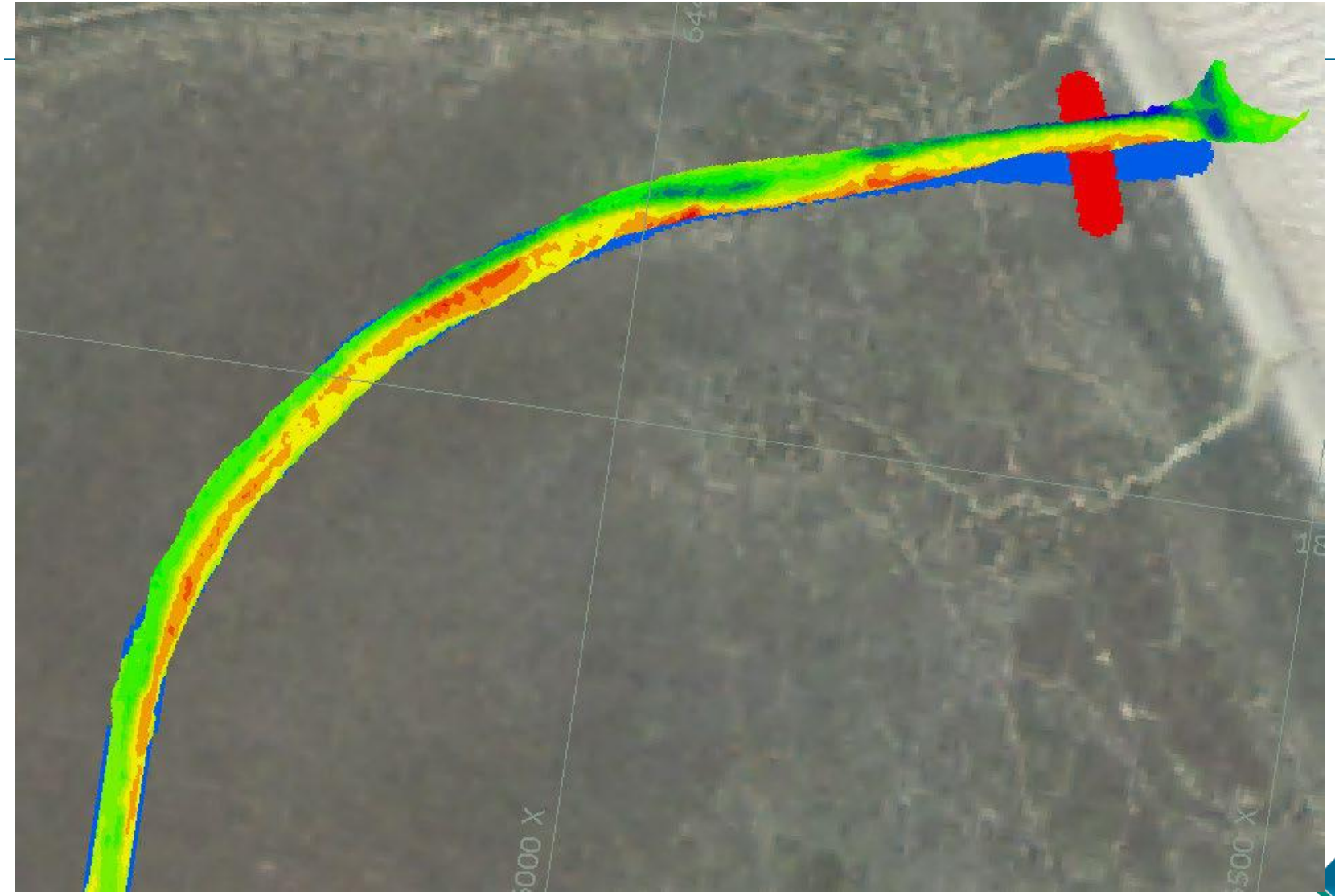
Tracking Change Through Bathymetric Mapping



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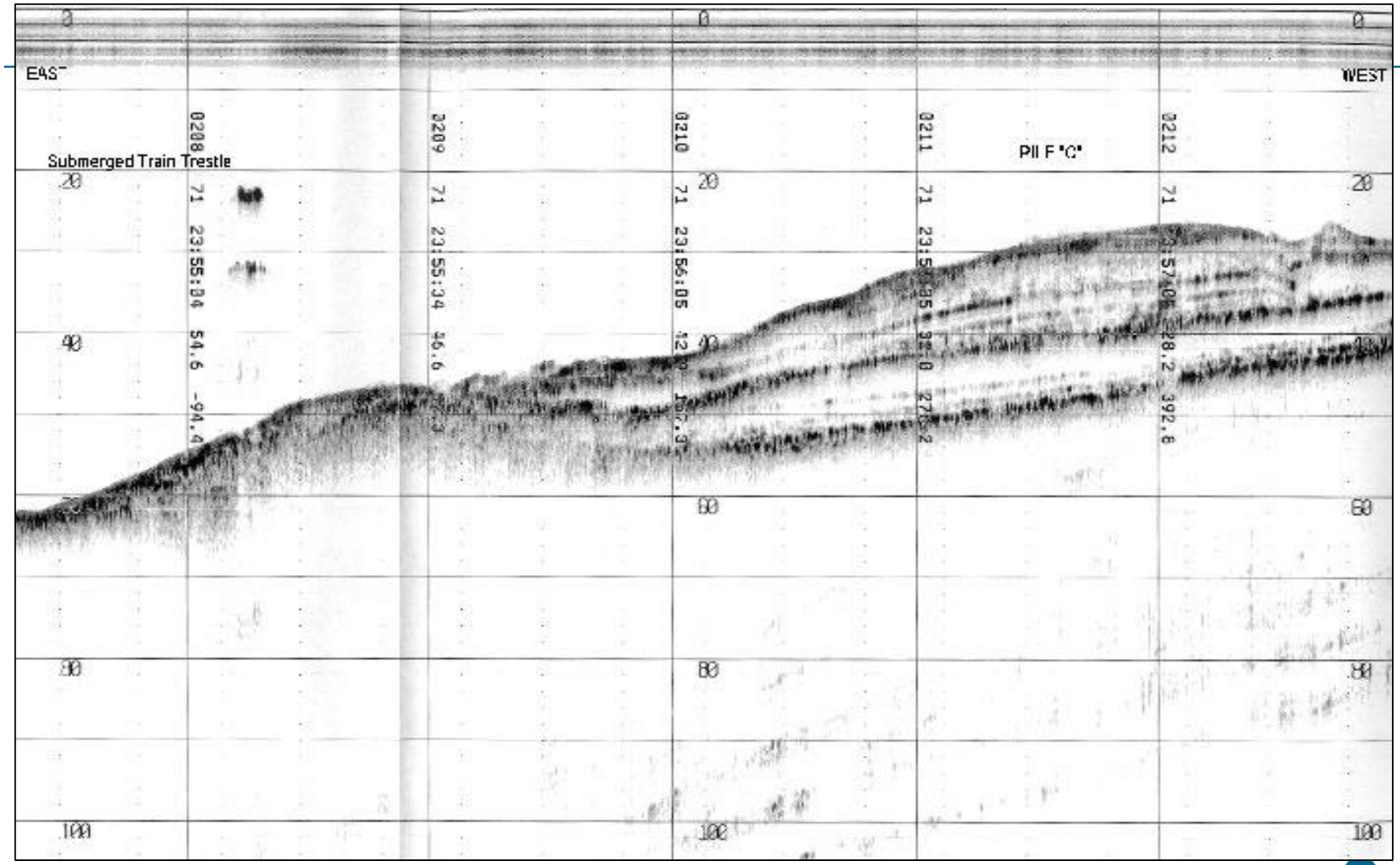
Tracking Change Through Sub-Bottom Profiling



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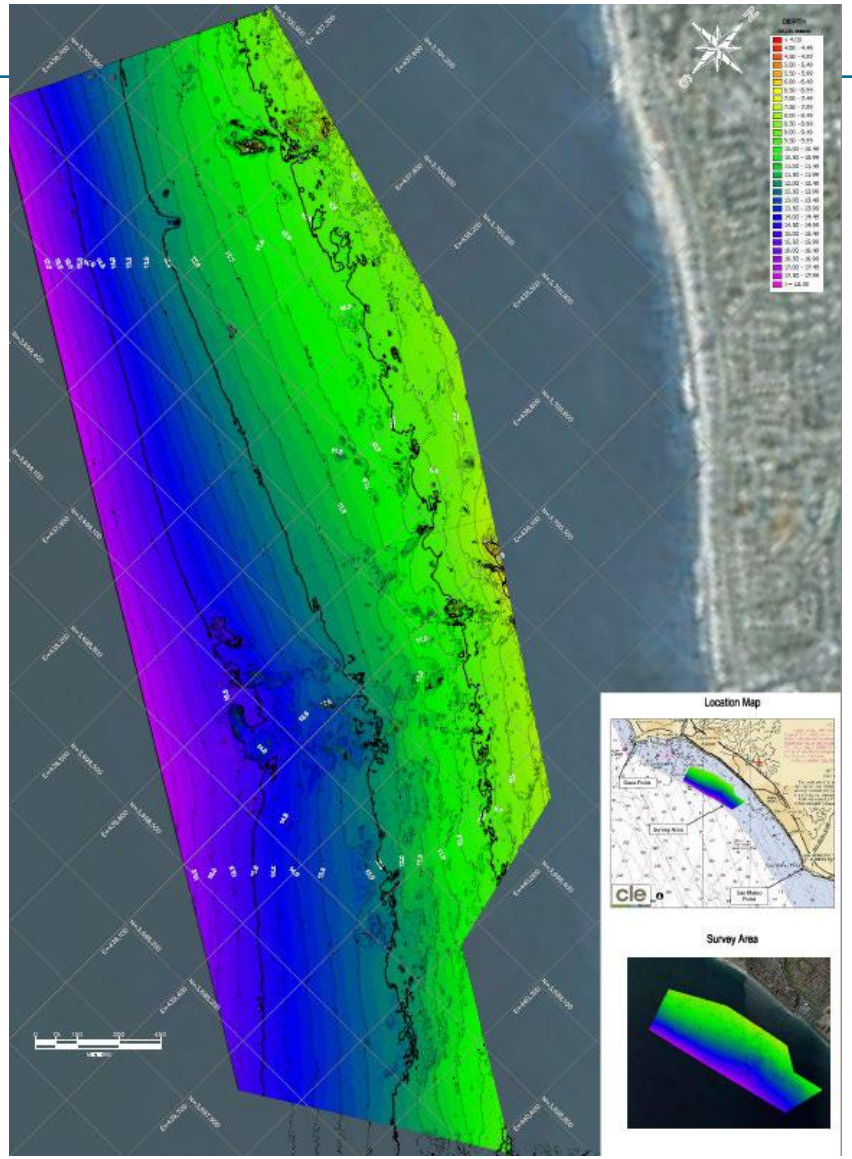
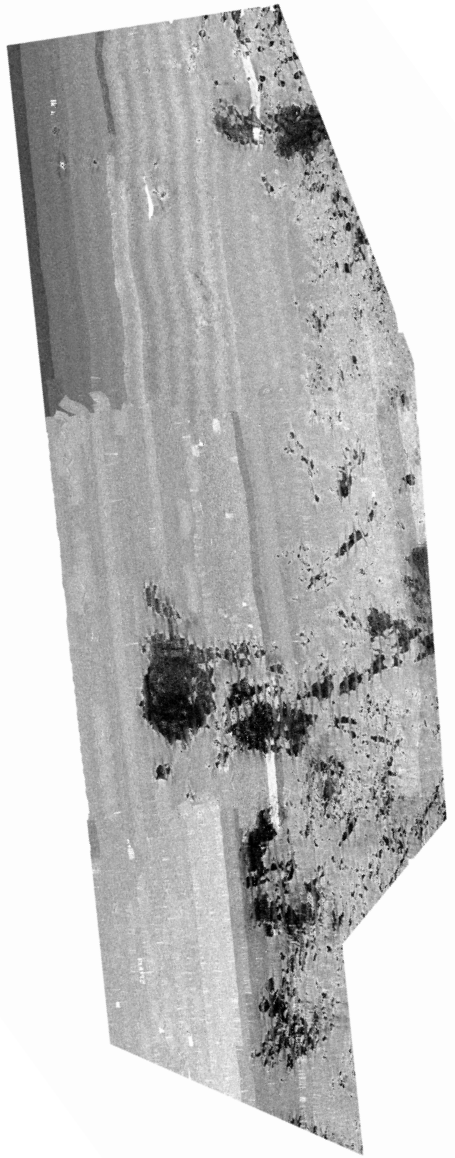
Seafloor Classification Mapping





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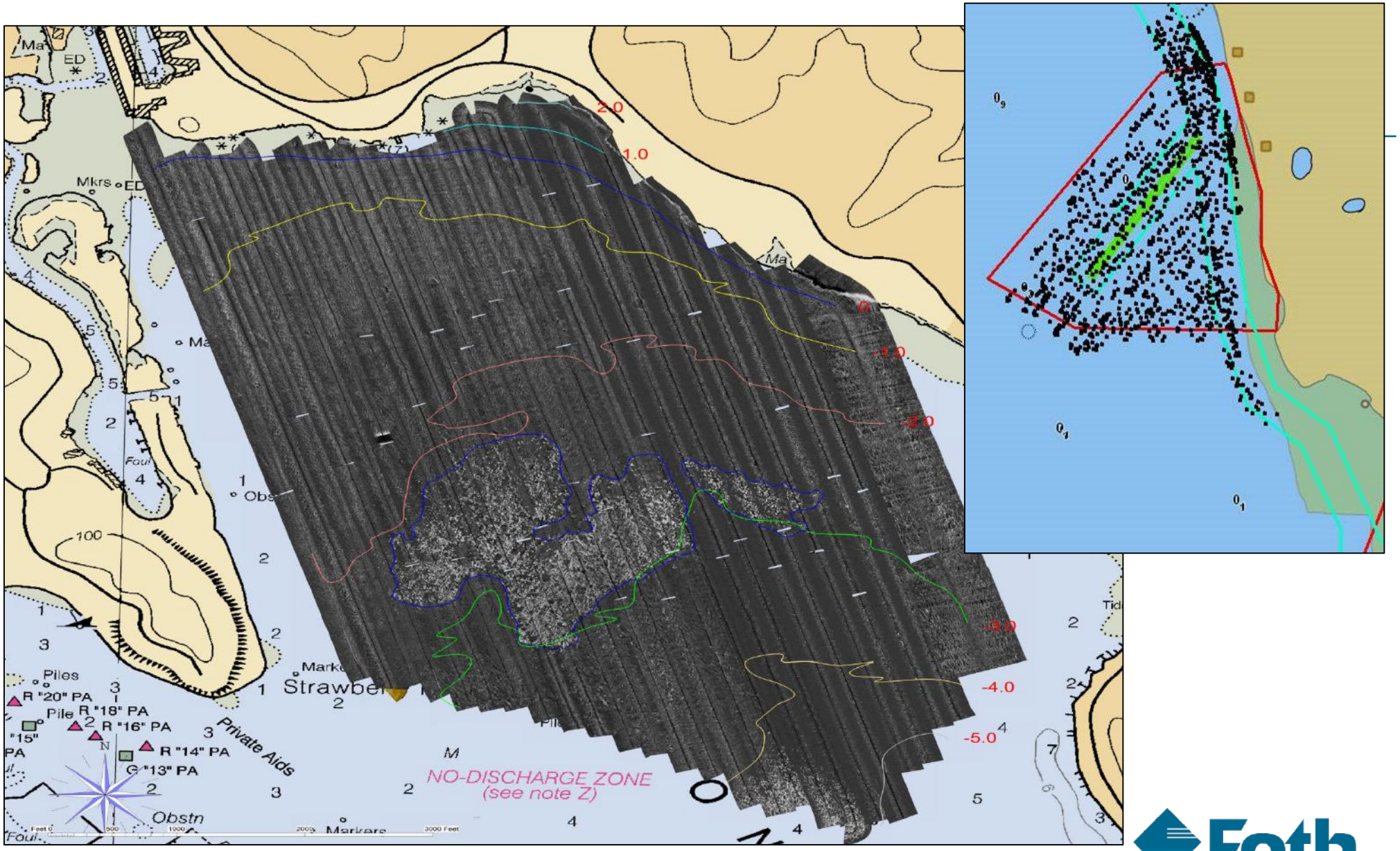
Habitat Mapping



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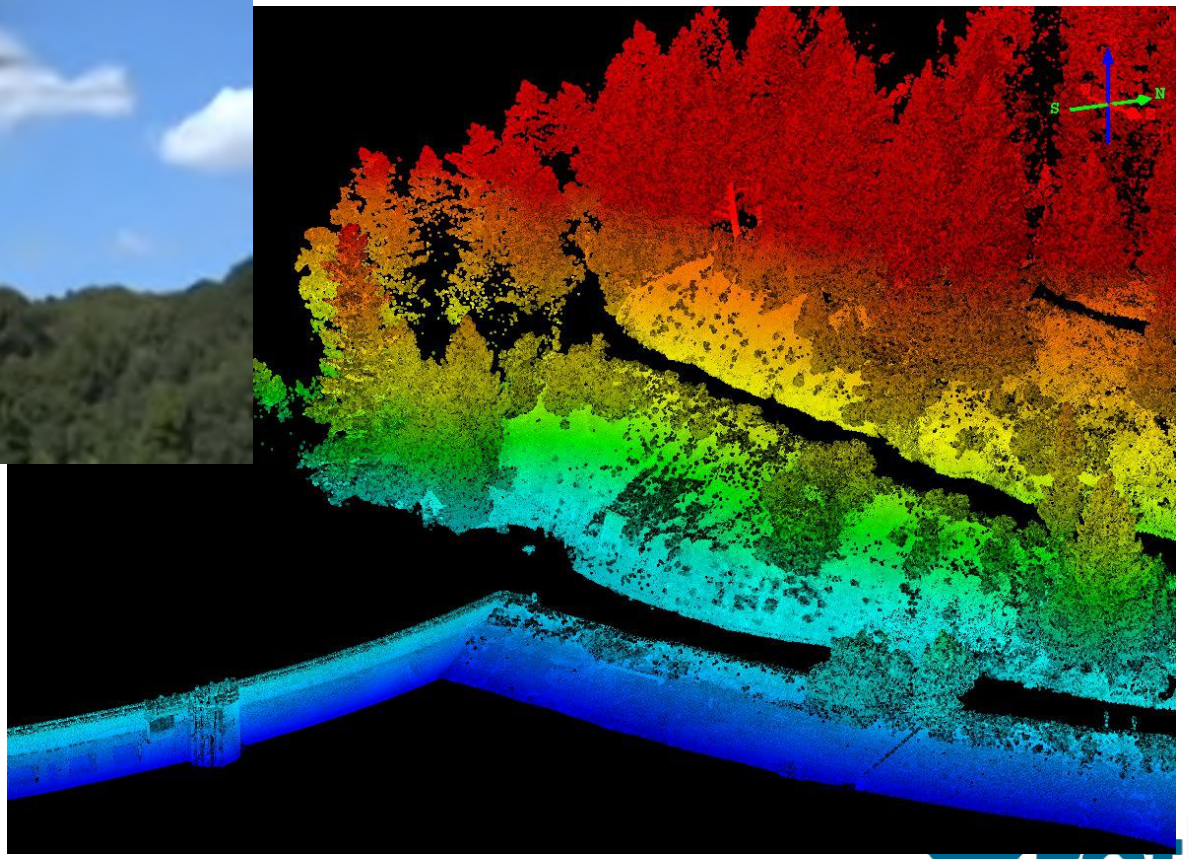
Topographic Mapping Utilizing LiDAR



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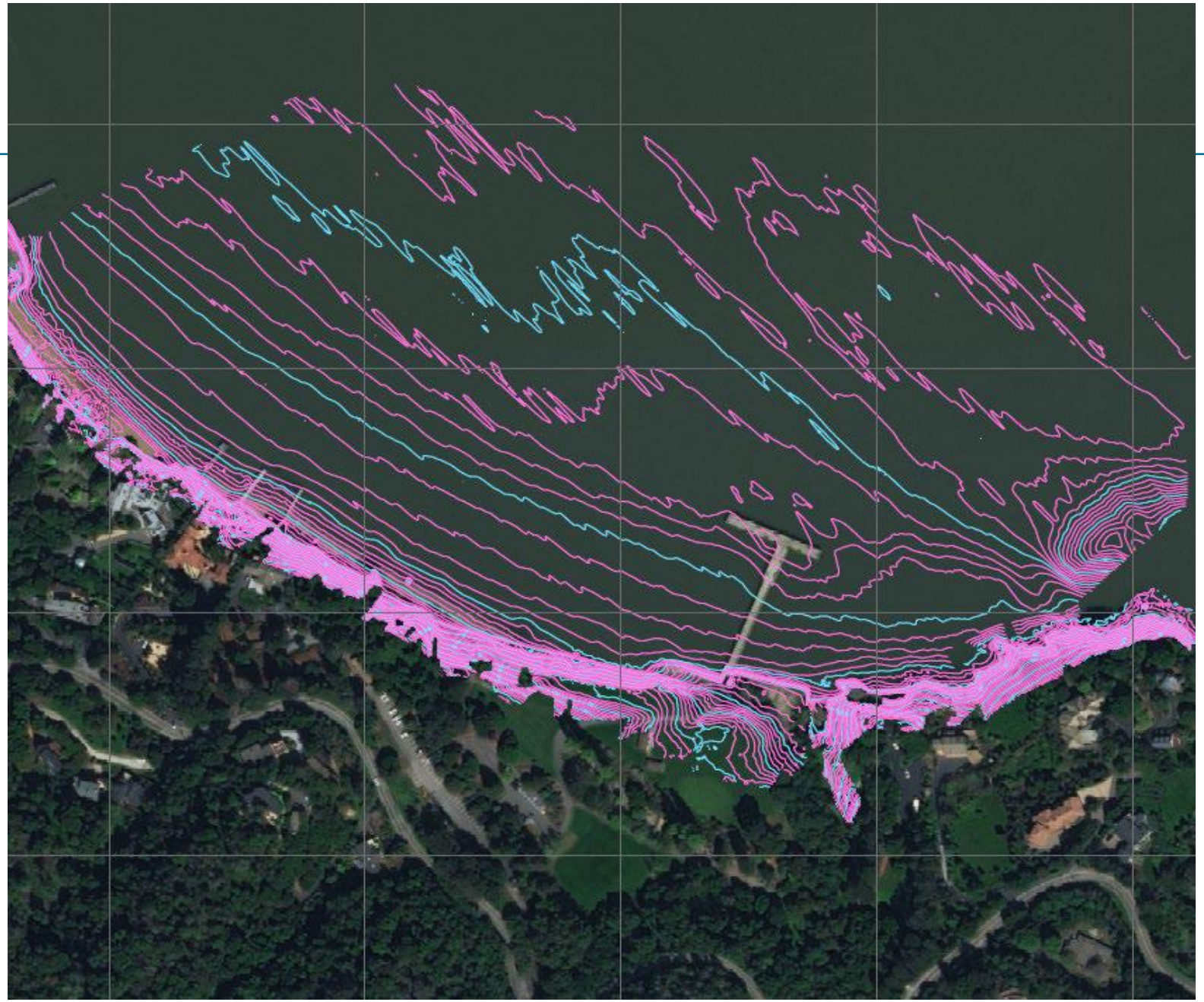
Topographic Mapping Utilizing LiDAR



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Ross Valley Flood Protection & Watershed Program

Lower Corte Madera Creek Improvement & Geomorphic Dredge Studies

March 21, 2019

Larkspur Est. 1908

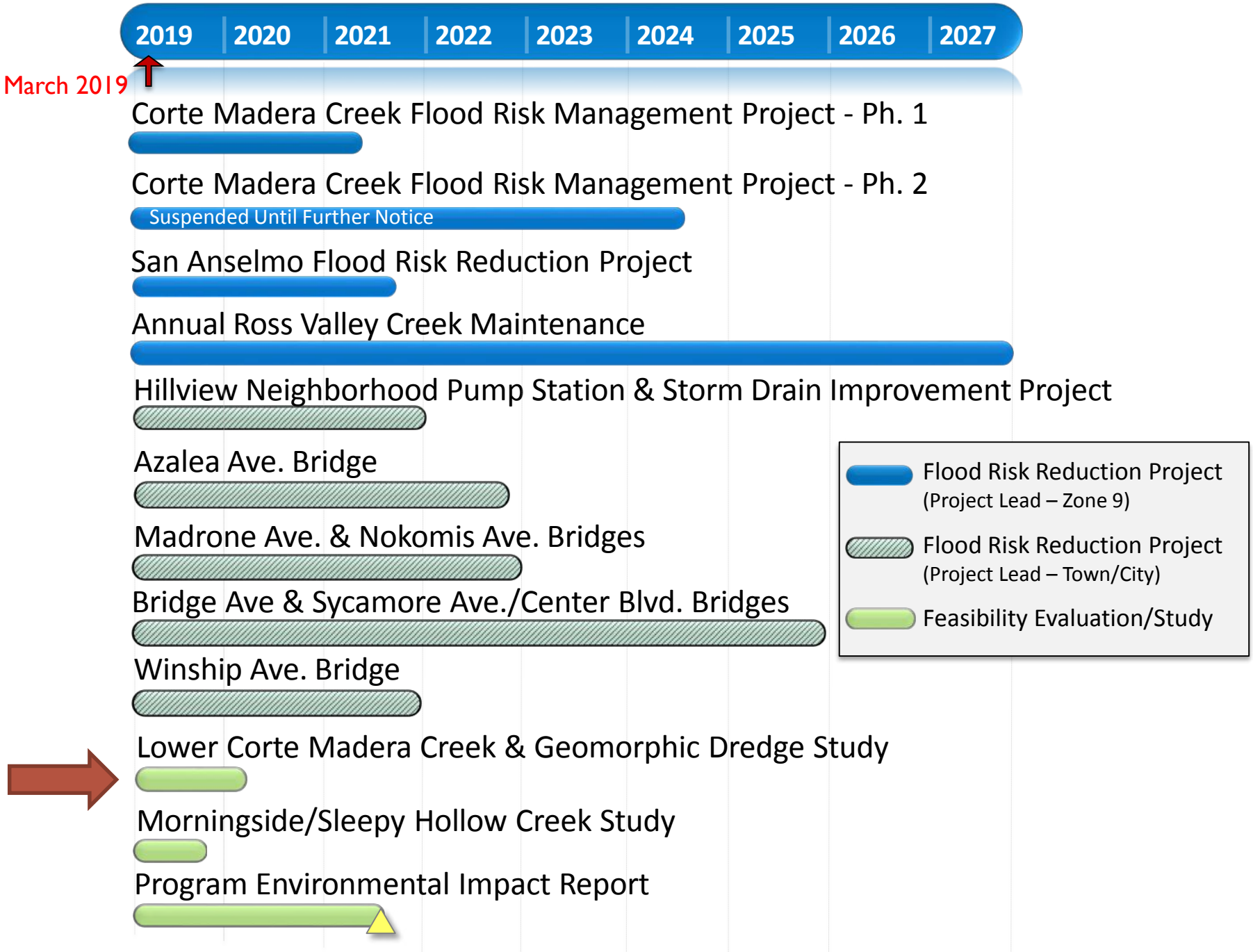
Town of Ross California

COUNTY OF MARIN

TOWN OF SAN ANSELMO EST. 1907

MARIN COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT

Ross Valley Program 2019 – 2027 Work Plan Timeline



Historic Flooding in Lower Corte Madera Creek

1973, Larkspur & Corte Madera (Hwy 101) High Tide and Storm Flooding Event

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Lower Corte Madera Creek Improvement Study

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Lower Corte Madera Creek Improvement Study

Goals:

1. Identify current flood capacity and assess need for improvements
2. Based on need, develop potential scenarios for improved capacity that considers future sea level rise

Tasks:

A. Land and water survey

B. Hydraulic modeling

C. Geotechnical investigation

D. Alternatives assessment

Funding: Dept. of Water Resources Grant $250,000 & Flood Zone 9 Stormdrainage Fee $200,000

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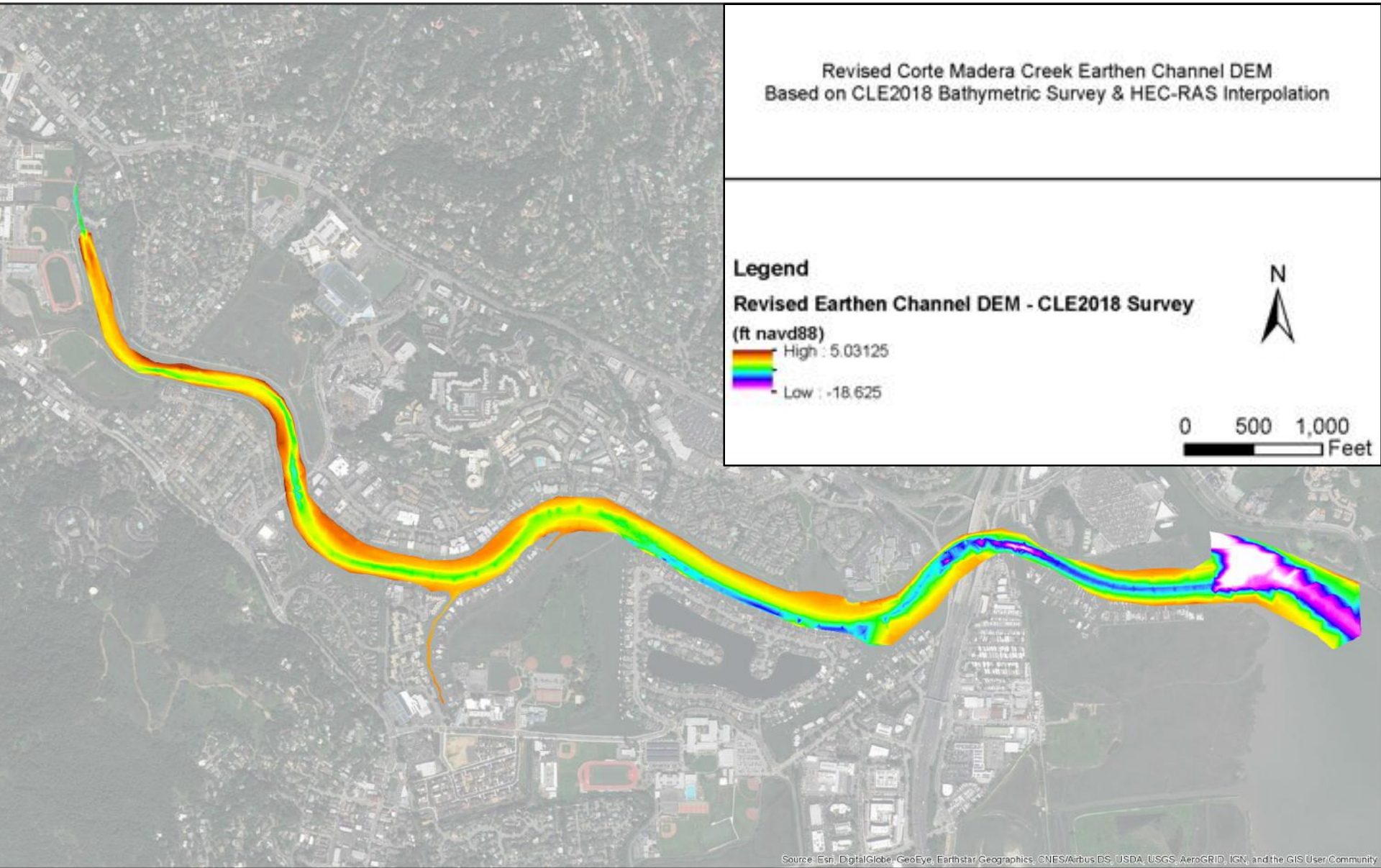
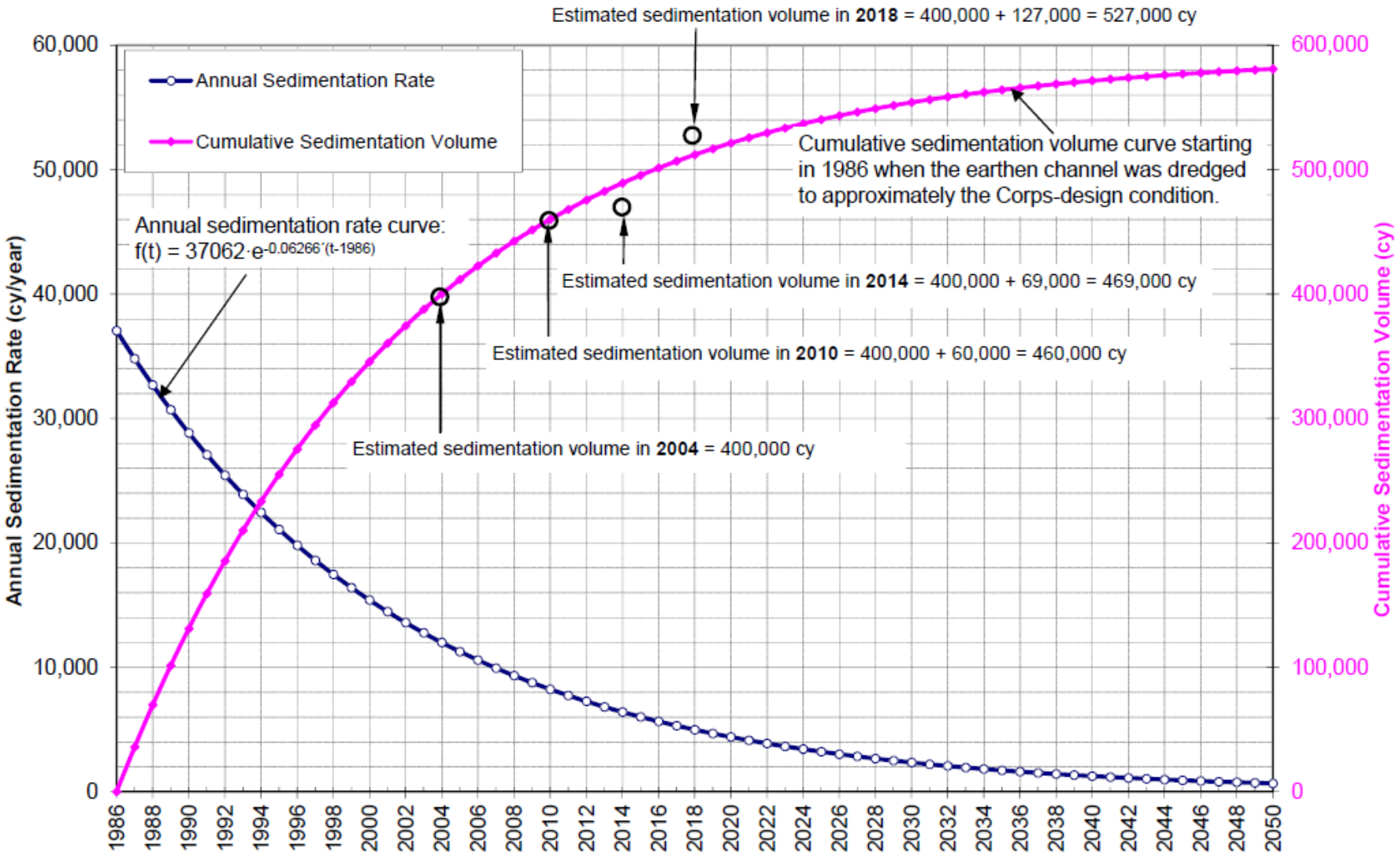
Lower Corte Madera Creek Improvement Study



Sedimentation in Corte Madera Creek

Figure 8 Estimated Annual Sedimentation Rate and Cumulative Sedimentation Volume since 1986 in the Corte Madera Creek Earthen Channel under Existing Conditions



Hydraulic Modeling

Assumptions:

State of CA Sea Level Guidance- 2018 Update

1. High Emissions
2. Low risk Aversion in Likely Range
    a. 2050
    b. 2100

Design Scenarios:

HEC-RAS 2D Hydraulic Modeling

1. Q100 fluvial event at MHHW with SLR
2. Q10 fluvial event at FEMA 100-yr tide with SLR

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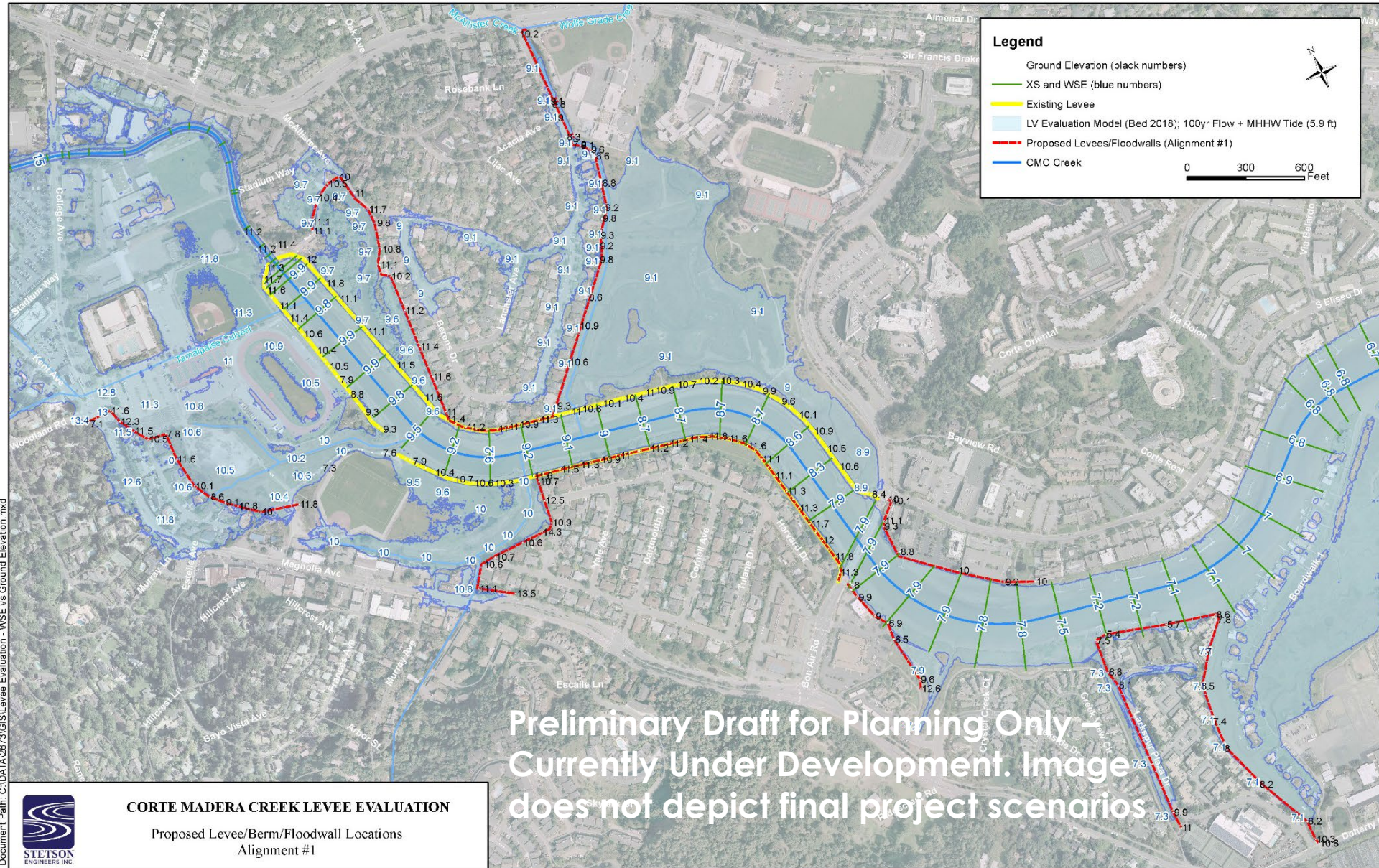
Potential Future Projects

- Sediment Removal / Geomorphic Dredge
- Levees
- Interior Drainage Improvements
- Tidal Prism Enlargement

Lower Corte Madera Creek Improvement Study



Geomorphic Dredge Study

Goals:

1. Baseline evaluation of “sustainable” channel under current and future conditions
2. Identify sustainable strategy for dredging that balances flood mitigation with equilibrium of natural creek/tidal system
3. Assist in future dredge permitting issues
4. Lower capital and permitting costs

Tasks:

A. Statistical analysis of data

B. Develop equilibrium channel dimensions

C. Integrate findings with maintenance dredge planning

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Thank You

Sign up for email alerts about meetings and program updates at **www.RossValleyWatershed.org**

ABOUT ZONE 9 | PROGRAM | PROJECTS | MEETINGS | MAINTENANCE | NEWS | MAPS | RESOURCES

Topics

The Ross Valley Flood Protection & Watershed Program has information on local conditions, meetings & events related to Ross Valley. You can also find resources, learn about watershed science, and learn how you can be involved.

- **Events & Meetings**
- **Maintenance**
- **Weather Gauges**

MEETINGS & EVENTS

See what's coming up.

CURRENT PROJECTS

See what's going on around Ross Valley

MARIN COUNTY FLOOD CONTROL

Stay Connected! Sign up to receive emails from us, including announcements and info on upcoming events and meetings.