This corridor adaptation study is funded through Senate Bill 1 (SB 1) 2018 Adaptation Planning Grant.
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• Bay Area Regional Collaborative (BARC)
• Bay Institute
• Bay Planning Coalition
• Baylands Group
• Bay Conservation and Development Commission (BCDC)
• Blackpoint Improvement Club
• California Department of Fish and Wildlife (CDFW)
• California Native Plant Society, Marin Chapter
• CA Assembly Member Marc Levine
• CA Congressman Jared Huffman
• CA State Senator Mike McGuire
• Federated Indians of Graton Rancheria
• Golden Gate Bridge Highway and Transportation District
• Green Point Advisory Committee
• Marin Audubon Society
• Marin BayWAVE Steering Committee
• Marin Community Foundation
• Marin Conservation League
• Marin County Farm Bureau
• Marin Economic Forum
• Marin Open Space District
• Marin Sonoma Vector Control District (MSVCD)
• Metropolitan Transportation Commission (MTC)
• North Bay Leadership Council
• North Marin Water District (NMWD)
• NOAA - National Marine Fisheries
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Glossary of Terms

ABAG  Association of Bay Area Governments
ACOE  US Army Corps of Engineers
BAAQMD  Bay Area Air Quality Management District
BARC  Bay Area Regional Collaborative
BATA  Bay Area Transit Authority
BCDC  Bay Conservation and Development Commission
BMKCS D  Bel Marin Keys Community Services District
BMKV  Bel Marin Keys Unit V
CCC  California Coastal Commission
CDFW  California Department of Fish and Wildlife
CEQA  California Environmental Quality Act
CoSMos  Coastal Storm Modeling System
DAA  Design Alternative Assessment
DMU  Diesel Multiple Units
ESA  Endangered Species Act
FHWA  Federal Highway Administration
GGBHTD  Golden Gate Bridge Highway and Transportation District
GHG  Green House Gas emissions
IPCC  Intergovernmental Panel on Climate Change
ITS  Intelligent Transportation Solution
LTS  Level of Traffic Stress
MCF  Marin Community Foundation
MCFCWCD  Marin County Flood Control and Water Conservation District
MCY  Million cubic yards (measurement)
MHHW  Mean Higher High Water
MOU  Memorandum of Understanding
MTC  Metropolitan Transportation Commission
NAVDB88  North American Vertical Datum of 1988
NBWRA  North Bay Water Reuse Association
NBWRP  North Bay Water Reuse Program
NEPA  National Environmental Policy Act
NMWD  North Marin Water District
NOAA  National Oceanic and Atmospheric Association
NPDES  National Pollutant Discharge Elimination System
NVTA  Napa Valley Transportation Authority
NWP(RR)  Northwestern Pacific Railroad (Network)
OPC  Ocean Protection Council
PA/ED  Project Approval and Environmental Document
PTC  Positive Train Control
RAMP  Regional Advanced Mitigation Program
RM-3 Funds  toll revenue allocated by MTC to address Bay Area traffic congestion
RWQCB  Regional Water Quality Control Board
SCC  California State Coastal Conservancy
SCTA  Sonoma County Transportation Authority
Segment A-1  Portion of SR-37 between US Hwy 101 and Petaluma River Bridge
SHOPP Project (Caltrans)  State Highway Operation and Protection Program
SIP (FHWA)  Safety Improvement Program
SLR  Sea Level Rise
SMART  Sonoma-Marin Area Rail Transit
SR-37  State Route 37
STA  Solano Transportation Authority
TAM  Transportation Authority of Marin
TRB  Transportation Research Board of the National Academies
UPRR  Union Pacific Railroad
USGS  United States Geological Survey
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Figure 1. A Key Issues Along SR-37 in Marin

Key Adaptation Issues
- Integrated highway, transit, rail, and trail Sea Level Rise planning
- Multi-beneficial Levee siting, design, and management
- Compatibility with wastewater, flood control, and public utility operations
- Accommodation of established and planned marshlands
- SR 37 interchange re-design requirements at Atherton & US 101
- Impacts to private property
- Long-term habitat governance and management
- Expanded public awareness
- Diverse and equitable funding strategy

Legend
- Continuing Public, Wastewater, Flood & Utility Operational Facilities
- Potential Marshland Restoration Sites
- Restoration In Progress
- Restored Habitat
- Protected Open Space
- Priority Levee Analysis Locations
- Interchange

2/18/20
1.01 Introduction

Funding to complete this study originates from a Senate Bill 1 (SB 1) Adaptation Planning Grant provided by the State of California. Additionally, the County and TAM have each contributed funds to this study to maximize their understanding of the challenges and choices facing not only Caltrans, but also public infrastructure, private property, and the general public along the SR-37 corridor. This report summarizes the decades of earlier studies related to transportation planning, climate change, ecology, and land use completed by public agencies, environmental groups, and private entities for the SR-37 corridor. In addition, it summarizes the key challenges and opportunities, as well as gaps in information that will require resolution in order to support the selection of a preferred alternative that reduces the impact of sea level rise to the corridor.

This report is intended to support both Caltrans and MTC in their current in-depth research, analysis, and public outreach associated with developing an approach to improving SR-37. Based upon the previous studies as well as discussions with stakeholders and community members, the report presents several visions to protect SR-37 from sea level rise. The visions range from a traditional levee model; a robust causeway that restores marshlands; and a near term improvement to protect the corridor. Each vision provides public agencies and the larger stakeholder community an opportunity to consider trade-offs between time of completion, cost, ecological integration, and other civic interests. Most important, the report prioritizes the next steps required to build momentum towards developing a lasting solution.

While many variables must be weighed, the Ultimate Solution eventually pursued will need to address the critical importance of SR-37 to both the region and the North Bay’s transportation system. At the same time, the outcome should reflect the best practices available for nature-based solutions as a reflection of
the sustainable development ethos embodied by the community of Marin County.

1.02 Grant Purpose

On April 28, 2017 the governor signed Senate Bill 1 (SB 1), the Road Repair and Accountability Act of 2017 which invests $54 billion over the next 10 years to repair roads, freeways and bridges in communities across California. These funds are equally split between state and local investments and administered by Caltrans. In addition to improving infrastructure, SB 1 provides planning funds of $20 million over three years through Adaptation Planning Grants offered to local and regional agencies for climate change adaptation planning. The program specifically seeks to identify solutions to climate change impacts on California’s transportation assets such as sea level rise (SLR), high heat and storm surge. The County of Marin applied and received a grant to develop a resiliency strategy for Segment A-1 on SR-37. Specific requirements to comply with the grant requires this study to include the following elements:

• Collect previous studies and synthesize contents related to SR-37 Segment A-1;
• Identify additional information needed to identify a preferred approach increasing resiliency to climate change;
• Provide guidance to Caltrans and MTC regarding approach alternatives and priority next steps to protect the corridor from flooding resulting from high tides, sea level rise, and storm surge.

Marin County Department of Public Works administered the grant and must complete the study by the end of February 2020.

1.03 Study Outreach

The SR-37 Corridor Adaptation Study implemented a combination of outreach techniques to support its preparation. A Technical Advisory Group (TAG) provided direction and comment on the study’s approach and findings. The TAG met on April 18, June 6, and November 12, 2019 and invited the following members to participate:

• County of Marin;
• Transportation Authority of Marin;
• County of Marin Flood Control;
• Bel Marin Key Community Services District;
• State of California Department of Transportation;
• California Coastal Conservancy;
• City of Novato;
• Pacific Gas and Electric (PG&E);
• Sonoma County Transportation Authority;
• Sonoma Marin Area Railway District;
• Novato Sanitary District

To supplement the outreach effort, the study team completed in-person meetings with the following agencies and parties:

• City of Novato including a field trip to the US-101/SR-37 interchange area on August 27, 2019;
• Novato Sanitary District on September 10, 2019;
• North Marin Water District (by phone and email);
• Sonoma County Transportation Authority on September 5, 2019;
• Sonoma Marin Area Rail Transportation Authority on September 6, 2019;
• Pacific Gas and Electric (PG&E) (by phone and email); and
• Representatives of private property landowners adjacent to Segment A-1 on August 22, 2019.

On November 21, 2019, the County and TAM sponsored a community presentation at the Hamilton Community Center in Novato to review a draft of the study’s finding and receive public comment. On December 5, 2019, the County presented the study’s findings to the State Route 37 Policy Committee Board.
1.04 Basis of Study

The SR-37 Corridor Adaptation Study follows eight years of ongoing state and regional transportation agencies’ planning efforts focused on the entire 21-mile SR-37 corridor between US-101 in Marin County and I-80 in Solano County. Segments of SR-37 also travel through Sonoma and Napa Counties.

In February 2018 the Metropolitan Transportation Commission (MTC), Solano Transportation Authority (STA), TAM, SCTA, Napa Valley Transportation Authority (NVTA), and Caltrans published the SR-37 Transportation and Sea Level Rise Corridor Improvement Plan which expresses three broad goals:

- Integrate transportation, ecosystem and sea level rise adaptation into one design;
- Improve mobility across all modes and maintain public access; and
- Increase corridor resiliency to storm surges and sea level rise.

The integration of environmental restoration into the planning of SR-37 follows the nearly 30 years of work that groups have invested to restore tidal marshes in the North Bay along the SR-37 corridor. These restoration projects include the development of the San Pablo Bay National Wildlife Refuge including expansions of the Cullinan and Haire Ranch restoration projects. To advise regional transportation planners on the ecologic benefits along the SR-37 corridor, a coalition of environmental non-profit organizations as well as the California Coastal Conservancy formed the Baylands Group. In October 2017, they published the San Pablo Baylands: Ensuring a Resilient Shoreline which offers, “concerns around the critical importance of protecting, enhancing, and restoring the tidal wetlands, natural resources, ecosystem services, and habitats of the San Pablo Baylands.”

1.05 Segment A-1 Challenges

Segment A-1 is typically not subject to the travel delays found in the eastern segments of SR-37. However, the storms of 2017 and 2019 illustrate how flooding in Segment A-1 can disrupt the North Bay’s transportation network and impact SR-37’s 30,000 daily users. Segment A-1 is especially at risk to the impacts of climate change and sea level rise as it has the lowest elevation of the entire corridor and is generally protected by levees originally constructed to create agricultural lands. The following summarizes specific challenges for the segment:

Public Urgency

The public seeks a near-term solution to the SR-37 Segment A-1 flooding and is frustrated that solving the problem may take more than 15 to 20 years. This sentiment was clearly made by the general public and stakeholders in focus groups held in Marin, Sonoma, Napa, and Solano Counties as part of MTC’s SR-37 corridor-wide planning process. Public comment made during preparation of this study reinforced this priority. To address the potential for flooding in the near term along Segment A-1, Caltrans completed emergency repairs in 2017 and 2019 which raised the pavement, installed floodwalls, and repaired levees. They are currently developing a long term solution identifying a preferred alternative by 2023 through a State Highway Operation and Protection Program (SHOPP).

Increasing Frequency of Flooding

The most defining issue for SR-37 Segment A-1 is its vulnerability to closure because of flooding. In the past 100 years, Novato has experienced major floods
at a rate of one per decade. Levees were breached intentionally in 2006, 2008, and 2014 to protect Novato’s downtown and residential neighborhoods from greater flooding. SR-37 was closed for 27 days in winter 2017 due to flooding. In 2019, flooding caused closure of SR-37 Segment A-1 for 7 days, further increasing public and legislative focus on the problem. Flooding impacts extend well beyond the SR-37 highway; US-101, Atherton Avenue, Redwood Boulevard, Marsh Road, Hanna Ranch Road, and Rowland Boulevard all remain at risk, as well. The railroad lines owned by SMART located parallel to SR-37 segment A-1 are also vulnerable to flood impacts.

Climate change resulting in higher temperatures will raise sea levels, which will exacerbate flooding. The Ocean Protection Council in its 2017 report entitled *Rising Seas in California* notes that flood water levels could increase by up to 6.9 feet if there are no significant efforts to reduce global emissions for the 0.5% probability in the year 2100. TAM’s 2018 *State Route 37 - Segment A Sea Level Rise Corridor Improvement Study* concluded that minimum roadway elevation in Segment A-1 would need to be no less than 21.7 feet according to the North American Vertical Datum of 1988 (NAVD88). Note that this does not include the additional elevation that could be required to accommodate structural elements should the roadway be a causeway or similar structure. This is the high-risk aversion category which is the summation of current mean higher high water (6.2 feet NAVD 88), 100 year storm surge of 3.6 feet, three feet of wave action, two feet of freeboard, and the expected end of century sea level rise of 6.9 feet. This is a worst case scenario, which the State of California recommends for use when facilities or structures have a low tolerance for risk. *Figure 1.B* graphically illustrates the degree of inundation adjacent to Segment A-1 for the worst case SLR event at the end of century should the levees be breached. As the existing roadway within Segment

![Figure 1.B Future Sea Level Rise Inundation](image-url)
HIGHWAY 37 CORRIDOR ADAPTATION STUDY

A-1 is about 2 to 6 feet in elevation, the roadway would need to be raised at least 21 feet to an absolute elevation of 23 feet as shown in Figure 1.C to minimize the impact of flooding by the end of the century.

Highly Sensitive Environmental Setting
In the 1800’s settlers to the North Bay drained the marshlands and constructed levees to farm the area adjacent to the present-day SR-37. Currently, SR-37 Segment A-1 lies within an area fully involved in marshland restoration to improve habitat and ecological connectivity. Examples include the Coastal Conservancy’s 1,600-acre Bel Marin Keys Unit V Restoration and Marin County’s restoration planning for Deer Island Basin through a San Francisco Bay Restoration Authority Measure A-A planning grant.

38 animal and 28 plant special status, endangered, or threatened species and habitats have been documented within five miles of SR-37, protected by one or more statutes and agencies. Based on comments received during MTC’s corridor-wide focus groups, Marin County stakeholders expect transportation improvements to also protect environmental resources.

Few Mobility Options
Automobile travel is the only real means of travel between the US-101 and the west bank of the Petaluma river. There is currently no transit service available and the Travel Behavior and Transit Feasibility Study completed by NVTA concluded that dynamic ridesharing solutions (carpooling supported by social networks) is the primary alternative. In order to implement transit service, the current bottlenecks that create congestion during peak travel hours must be eliminated.

Caltrans allows bicyclists to use SR-37 but high vehicle speeds and volume, coupled with limited shoulder width and debris, greatly discourage their use. In 2019, SMART evaluated the cost to provide passenger rail service along the corridor, but no implementation funding is currently available. Park and Ride facilities exist at the Atherton interchange, but no bus stop or organized ride-sharing programs currently operate from there.

During MTC’s Focus Groups, expansion of regional transit options was recommended. Additionally, regional planners seek to include a Class 1 trail along SR-37 corridor consistent with the goal of completing the San Francisco Bay Trail.

Figure 1.C Understanding Roadway Elevation Requirements visually demonstrates how the elevations are derived, and illustrates the relationship between the various components involved in determining the process of sea level rise.
Governance
During MTC’s Focus Groups, public comment identified a lack of a formal process as an impediment to expeditiously advancing the improvements to SR-37. Currently, no formal governance structure exists for integrating individual agency needs into a comprehensive adaptation solution. Closer coordination among the many public agencies, stakeholder organizations, and private interests is beneficial to develop a holistic solution and inclusive funding plan.

While there is general agreement on the perceived risk of doing nothing to SR-37, there is less agreement on how to define the merits of potential options and fund the improvements. Through MTC’s research, the public has expressed an aversion to creating new regional authorities or the assignment of collective responsibility to any existing agency.

Funding
Full funding for Segment A-1 transportation modifications has not been identified. Caltrans has reported that relying solely on existing state and local funding sources would require as many as 60 years. A tolling feasibility study undertaken by MTC in 2017 estimated that a $6 toll in one direction on SR-37 would generate approximately $1 billion for the entire corridor over a 50-year period; well below the total cost. At the same time, MTC’s focus group research indicated that public support for new tolls cannot be relied upon.

As project financing and tolling decisions are made, the financing program should address needs of disadvantaged travelers. Funding strategies should reflect Caltrans’ environmental justice goal of ensuring that when transportation decisions are made, low-income and minority communities have a full opportunity to participate in the decision-making process and receive an equitable distribution of benefits, and not a disproportionate share of burdens.

The costs for permanent Segment A-1 highway improvements could exceed $1 billion, and additional ecosystem investments in the corridor will add considerably to that amount. At the same time, MTC’s Focus Group analysis determined that currently public support for new tolls does not exist.

1.06 Segment A-1 Opportunities
The extensive study along SR-37 provides a strong basis for identifying solutions to minimize the impact of climate change. The opportunities include the following:

Increase Mobility Choices
Improving the corridor provides the option to integrate the San Francisco Bay Trail into the preferred alternative and make available options for bicyclists and pedestrians to safely experience the area, as well. The development of electric-assist bicycles also makes biking a commute option for corridor users. Based on the recently completed transit feasibility study managed by Napa Valley Transportation Authority, vanpools, improved park & ride facilities, expanded car sharing, and targeted express bus services on SR-37 could be included in both near-term and long-term improvements. Finally, SMART has expressed interest in active participation in long-term corridor planning to provide passenger rail service.

Integrate Marshland Restoration
SR-37 Segment A-1 traverses the San Pablo Baylands, an area that has been a restoration priority of Federal and State resource agencies, scientists, and environmental non-profits for over thirty years. It is identified as the prime candidate for demonstrating the natural protection benefits that restored marshes can provide within the entire San Francisco Bay region.

Tidal marsh habitat stores more carbon from the atmosphere than almost any other habitat type on earth. Reengineering levees to create gently sloping transition zones would buffer storm-wave run-up and erosion, lower flood risk, while facilitating landward
migration of the marsh within an adequate transition zone.

Including marshland habitat restoration within an integrated transportation design solution is consistent with the approach being used by both Caltrans and MTC across the entire SR-37 corridor.

Build a Collective Partnership

SR-37 is not the only public infrastructure in the study area at risk from increasing flooding and sea level rise. SMART infrastructure, potable water, wastewater, and electrical utilities all face increasing capital and operational challenges resulting from sea level rise. Reaching consensus on the scope and structure of an adaptation-based partnership could focus the effort and increase delivery effectiveness.

Partners would be brought to the table early to help design the relationship, increase buy-in, and maximize the likelihood that the partnership takes full advantage of the resources and capabilities of the groups. A partnership could lay out clear objectives, including specific goals, a project delivery approach, roles, responsibilities, funding sources, and communication strategies.

However, partnerships do not manage themselves and require commitment to maintain relationships and momentum. There should be especially strong effort to collaborate with the Sonoma County Transportation Agency, given the shared interest in the Petaluma River Bridge, the RM-3 funds, MTC’s current SB 1 Adaptation Planning Grant study, and overall performance of the highway.

Collaborate with the Community

The closure of SR-37 Segment A-1 several times in the past three years has increased public interest in finding a solution to the flooding. In addition, the Marin Audubon Society, Marin Conservation League, Sustainable Marin, North Bay Leadership Council, Novato Chamber of Commerce, adjacent private property owners, nearby homeowner associations, and bicycling advocacy groups have long been involved in matters related to or within the vicinity of the highway. Developing a framework for informing and including these and other stakeholders will be especially useful to creating a sustained level of support over the long time frame that will be required to complete all improvements.

1.07 Segment A-1 Related Studies Key Findings

MTC, Caltrans, Federal and State resource agencies, and numerous environmental groups have reached consensus that transportation solutions should integrate ecological restoration and climate adaptation into planning and development. There have been six State, regional, and local studies published since 2013, addressing SR-37 corridor transportation and climate change issues. Most of the studies included significant public outreach and stakeholder engagement. Such an approach could be less risky and more beneficial for both environmental and transportation needs. The section “2. Summary of Studies” on page 46 is comprised of a summary of all known public studies completed for SR-37, however, the following are key findings that are useful in understanding basic conditions along the corridors:

Memorandum of Understanding (MOU) The transportation agencies in Solano, Napa, Sonoma, and Marin executed a SR-37 memorandum of understanding (MOU) in 2015. The MOU commits all parties to collaborate on the entire corridor, while allowing individual segments to proceed independently. There is a 12-person policy board comprised of three elected officials from each county, an Executive Steering...
Committee (ESC) of transportation agency senior management, and a Project Leadership Team (PLT) with technical staff from each agency.

**Low Elevation** Segment A-1 has the lowest roadway elevation within the entire SR-37 corridor. It traverses historic marshlands comprised of bay mud which is a thick deposit of soft, unconsolidated silty clay, saturated with water. From Novato Creek to Atherton Avenue, SR-37 is relatively low-lying with an elevation of approximately 4 to 6 feet NAVD88 and relies upon the Novato Creek levees, which range in elevation from approximately 10 to 13 feet NAVD88 for protection. The MCFCWCD inherited these levees from previous agricultural use, which were never designed to function with a level of protection suitable for flood control purposes. The placement of fill atop the existing bay mud to raise elevation will often cause consolidation of underlying soils and differential settlement.

**Vulnerability Assessment** Caltrans developed a *Climate Change Vulnerability Assessment* that provides guidance to identify segments of the State Highway System vulnerable to the impacts of precipitation, temperature, wildfire, storm surge, and sea level rise. The report anticipates an increase in the scale and frequency of flooding on SR-37 and proposes a three-step follow-up process to:
1. identify specific asset exposure;
2. determine the consequence of expected impacts;
3. prioritize necessary actions.

**Sea Level Rise** SR-37 Segment A-1’s road surface needs to be raised approximately 20 feet to address long-term impacts of sea level rise and storm surge. Previous parties have developed conceptual solutions for the segment, which include a continuous raised causeway as well as a hybrid that includes raising a portion of the roadway on embankments. The crossings of Novato Creek and Simmons Slough must be widened to accommodate stormwater flows.

**Levee Ownership** A significant portion of the Novato Creek left bank levees are upon land owned and managed by the Marin County Flood Control and Water Conservation District. Segments of the levee system south of SR-37 are owned by SMART or the Ronsheimer Trust. Levee ownership in other areas remains uncertain.

**Connecting to SR-37** Interchanges at US-101 and Atherton Avenue will need to be reconfigured to conform to a raised SR-37 elevation. Existing access from SR-37 to Novato Sanitary District (NSD) lands also must be maintained or relocated, both north
and south of the existing highway alignment. Water, wastewater, and electricity utility lines may require relocation.

**State Rail Plan** The Caltrans’ 2018 State Rail Plan recommends linking SMART commuter rail with Capitol Corridor trains by 2040. SMART’s Passenger Rail Service Feasibility Study, published in 2019, estimated that limited service could begin on the 41-mile-long “Brazos” line between Novato and Suisun City stations within 4 to 6 years after funding is identified. Costs were estimated to be between $780 million to $1.3 billion depending on the amount of reconstruction included. An operating agreement with Union Pacific would be required from American Canyon to Suisun City. No sea level rise considerations were included, and no SR-37 studies have integrated rail and bus transit with highway planning to date.

**Transit Access** In 2019, the State Route 37 Policy Committee received a report entitled the Travel Behavior and Transit Feasibility Report which evaluated current demand and propensity to use transit or non-single occupant vehicle options on SR-37 to relieve congestion and address equity concerns. The analysis included fixed-route transit, micro-transit, and improved pooling service along the corridor. The corridor serves mostly long-distance work-related trips to and from Marin. In 2018, during the 4-hour morning commute peak, there were approximately 25,000 westbound trips with 30 minutes of delay. During the 4-hour evening commute peak, there were approximately 28,400 eastbound trips with 80 minutes of delay. Congestion between Vallejo and Sears Point impedes the opportunity to provide transit access as there is no potential to reduce travel time.

**Marshland Removal** The majority of Novato Creek marshlands were leveed, drained, and reclaimed for agricultural land uses between 1850 and 1920. Disconnecting marshlands from tidal action reduced

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**Figure 1.D Lower Novato Creek Watershed Flow** shows the relationship between MCFCWCD infrastructure and the movement of water through the watershed (graphic: Marin County Flood Control and Water Conservation District, 2019)
Figure 1.E SR-37/US-101 Interchange Considerations

Key Interchange Considerations

1 - US-101 faces flooding due to sea level rise between the SR-37 interchange and the De Long exit requiring a protective levee or elevation of the highway and the interchange

2 - New on/off ramps at Hanna Ranch Road and Marsh Drive necessary to connect with elevated roadway

3 - Access to Novato Sanitary District lands impacted by elevating SR-37

4 - Potential exists for new road and trail connections from Bel Marin Keys Blvd. to SR-37
sediment deposition, causing decomposition of peat soils and subsidence to occur. These historic practices have had a negative impact on flood safety and the ecology of the area.

**Biological Conditions** The 1999 *Baylands Ecosystem Habitat Goals* report was the first comprehensive assessment of historical and current biological conditions of the San Francisco Baylands. It recommended restoring a wide, continuous band of tidal marsh along Marin’s bayfront with a natural transition to uplands and an upland buffer beyond. Its 2015 update, *The Baylands and Climate Change* identified five overarching recommendations:

- Restore estuary–watershed connections that nourish the baylands with sediment and freshwater.
- Design complexity and connectivity into baylands landscape at various spatial scales.
- Increase coordination among baylands stakeholder organizations to promote the successful implementation of landscape scale restoration.
- Create plans that factor in ecological outcomes after extreme events and other disasters.
- Engage the citizenry in stewardship of the baylands.

**Endangered Species** 38 animal and 28 plant species designated as protected by one or more statutes have been identified within five miles of SR-37. The 2013 USFWS *Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California* addressed land management for five endangered species: *California clapper rail*, *salt marsh harvest mouse*, *Suisun thistle*, *soft bird’s-beak*, and *California sea blite*. Additionally, the stretch of Novato Creek within the project area has been designated by USFWS NOAA as critical habitat for steelhead.

**Natural Flood Protection** SFEI and MCFCWCD studies proposed redirecting flood protection strategies from more traditional, hard engineering solutions to those that work with natural processes. They emphasized the importance of marsh plain and stream sediment management, reconnecting marshlands to adjacent areas, building wide sloping levees, dispersing wastewater on horizontal levees, and rerouting creeks to support seasonal wetland habitat with freshwater and sediment inflow. Removing levees on Novato Creek downstream of SMART’s mainline bridge and reestablishing tidal inundation within the historic tidal marsh would increase floodwater conveyance. Where restoration of seasonal fresh wetland systems is precluded by development, upper edges of transition zones could provide for limited high-marsh and brackish-marsh zones by discharging treated wastewater and storm water along wide, sloping engineered terraces.

Elevating SR-37 and the SMART rail line either partially or wholly onto a viaduct structure would allow tidal flows to approach historic extents.

**Novato Creek** Widening Novato Creek’s channel at the SR-37 crossing would be beneficial above and below the highway crossing. The channel width in the Lower Baylands Reach (downstream of SR-37) varies from approximately 140-feet wide at the mouth to about 40-feet wide near SR-37 today. Based on historical maps, the 1854 channel width was estimated...
to be 900 feet wide at the mouth and 300 feet wide at the SR-37 crossing.

**Sediment Needs** Tidal marsh restoration will require significant amounts of sediment to raise elevations in subsided areas. Also, while re-engineering levees to create gently sloping transition zones can buffer storm wave run-up, reduce erosion, lower the flood risk, and facilitate landward marsh migration, ecotone profiles also require significant fill.

**Marshland Restoration Effort** Substantial marshland restoration projects are well underway within the SR-37 Segment A-1 Study Area. The State Coastal Conservancy is restoring its 1600-acre Bel Marin Keys Unit V property, plus 200 adjacent State Lands Commission acres to a mosaic of tidal, seasonal, and transitional habitat by constructing flood control features, placing dredged material to elevate the diked, subsided baylands, and reintroducing tidal waters to bayside portions of the site. At BMK, the restoration will include vegetated ecotone slopes, constructed on top of the base protection levee to accommodate the retreat of transitional habitat as the sea level rises.

The Marin County Flood Control and Water Conservation District is planning for the Deer Island Wetland restoration project which will reconnect areas within Deer Island Basin to the tidally influenced section of adjacent Novato Creek. They sit at a critical habitat junction, where fresh flows from Novato Creek enter the mixed salinity flow regime of San Pablo Bay; one of only a handful of locations in the entire Bay within this mixing zone where potential remains to restore tidal marsh. The primary constraints on flood control and habitat enhancement are the NSD facilities; restoration would disrupt the District’s operations and require alternative means of water treatment.

**Simmons Slough** Simmons Slough is currently drained by pump facilities operated by the MCFCWCD and the NSD. The approximately 1,840-acre watershed is comprised primarily of agricultural lands bounded by small field dikes, with residential uses in upland

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**Figure 1.F Corridor Land Use** Illustrates how land use around SR-37 has changed over the last century (graphic: San Francisco Estuary Institute)
areas. Fields drain predominantly through small shallow flow channels, including Simmons Slough, to the pumping facilities.

**Pacheco Pond** Pacheco Pond is an artificial lagoon created as mitigation for construction of an adjacent industrial park in 1980. The entire Pacheco Pond area is approximately 120-acres. Before the pond was constructed, a slough drained Pacheco Creek and Arroyo de San Jose into Novato Creek. Outflows are limited by water levels in Novato Creek. Larger storm events generate reduced outflows from Pacheco Pond, which fills and overtops to adjacent parcels during 50 year and 100 year storm events.

**Sea Level Rise** The *State of California Sea-Level Rise Guidance* recommends using the upper end of SLR scenarios for critical infrastructure. For the San Francisco Bay Area, those numbers range from 2 to 7 feet in 2050 and 2100 respectively under the 1-in-200 chance (.5%) scenario. The report states that it is more likely that sea level rise will not exceed one foot by mid-century and 3.5 feet by 2100.

![Habitat Extent](image)

**Climate Risk** The 2018 update to the *Safeguarding California Plan* is a roadmap showing how California’s state government is taking action to respond to climate change. It was produced with assistance from representatives of 38 state agencies. The report states that climate risks and impacts need to be fully integrated into existing and planned management activities on California’s coastlines. Additionally, to ensure resilient communities, coastal and ocean planning must consider the differential impact of climate risks when evaluating whether disadvantaged communities face unequal burdens from climate risks or inadequate resources to respond to these risks. An explicit effort must be made to build capacity and address resource gaps for adaptation in these communities.

![Figure 1.G Historic and Modern Extent](image)
Local SLR Guidance Two local SLR guidance reports agree on Novato’s exposure to climate change. The County of Marin Bay Waterfront Adaptation and Vulnerability Evaluation (BayWAVE) and Novato’s Sea Level Rise White Paper both identified Novato transportation facilities that are vulnerable to sea level rise:

- State Route 37 between Atherton Avenue and US Highway 101
- US Highway 101 at the US-101/SR-37 Interchange, Novato: This vulnerable 3,100-foot stretch is currently protected by levees and pumps operated by others.

Novato’s SLR white paper recommends updating the City’s Multi-Hazard Mitigation Plan in order to be eligible for outside funding sources.

Collaboration Conflict UC Davis’ The Governance of Sea Level Rise in the San Francisco Bay Area identified improved collaboration between organizations to address sea level rise as a major challenge. It also indicated that while stakeholders desire an appropriate mix of “gray” and “green” infrastructure, there is an aversion to creating any new regional authority or assigning responsibility to an existing agency to coordinate selection. The report concluded that the risk is not exclusively from SLR, but the combination of rising sea levels and extreme weather events.

Importance of Marshlands The San Francisco Bay Estuary (SFBE) is the largest estuary system on the Pacific coasts of North and South America and is globally recognized for its historic and continued importance to water birds, fish, marine mammals, and other wetland-dependent species. The SFBE provides wintering habitat for more than half of the diving duck population in the Pacific Flyway, is a Shorebird Reserve Site of hemispheric importance, and a RAMSAR designated wetland of global importance despite the devastating habitat loss that has occurred. An estimated 90 percent of the historic tidal marshes in SFBE have been filled or significantly altered over the past two centuries, and an estimated 82 percent in San Pablo Bay, one of three large bays that comprise SFBE.

Historic baylands were leveed off from the bay in the late 1800’s through the early 1910’s. Devoid of bay water to keep peat from oxidizing, and without a new sediment supply brought in on the rivers and tides, these lands are generally subsided 3 to 7 feet below surrounding marshes, depending on when they were leveed off and subsequent land use history (see Figure 1.F). These baylands will continue to subside relative to surrounding marshes and will require substantially greater level of effort to pump water out and to raise and maintain levees as sea level rises and opportunity for gravity drainage becomes increasingly limited.

The following studies provide further ecologic guidance related to Segment A-1:

The Baylands Ecosystem Habitat Goals Report (Goals Report, 1999) recognizes the conservation values of the San Pablo baylands for their undeveloped character and high restoration potential. The Goals Report sets acreage targets in different habitat goal categories for protection, restoration, and enhancement, and identifies the following additional recommendations for the San Pablo baylands:

- restore a broad swath of tidal marsh along the shore as soon as is feasible;
- manage the marsh bordering northern San Pablo Bay to sustain high waters as sea levels rise;
- reconnect major tributaries (Napa River, Sonoma Creek, Novato Creek, Tolay Creek, and Petaluma River) to the bay and extend tidal wetlands into the watersheds;
• restore riparian corridors to connect the baylands to the lower watersheds;
• protect wet meadows, vernal pools, and swales in the lowlands adjacent to the baylands, and increase their connectivity to the baylands;
• work with willing sellers to conserve valleys and plains with low-intensity agriculture adjacent to tidal areas for future marsh and transition zone migration; and
• elevate SR-37 and modify or realign rail lines and other infrastructure to allow the unimpeded passage of water, sediment, and wildlife.

Specific to the Novato Creek region, *The Goals Report* (1999) recommends restoring a wide continuous band of tidal marsh along the bayfront from Black Point to Gallinas Creek, and along Gallinas and Novato Creeks, ensuring natural transition zones from wetlands to uplands, and enhancing managed marshes and seasonal ponds in areas not restored to tidal marsh. *The Goals Report* (1999) recognizes the unique values of this area for restoration because of the rural character, and opportunity to restore full ecosystems, including tidal flats, tidal marshes, natural upland transition zones, with connectivity to adjacent upland wildlife corridors. *The Goals Report* (1999) also recognizes the opportunities for integrating wastewater discharge for freshwater habitat benefits.

The 1999 report was updated with new recommendations to incorporate climate change, in the *Baylands and Climate Change: What We Can Do* (2015). The 2015 Update urges swift action to restore historic baylands to increase their likelihood of staying apace with sea level rise, and makes the following overarchingly recommendations:

1. restore estuary–watershed connections that nourish the baylands with sediment and freshwater;
2. design complexity and connectivity into the baylands landscape at various spatial scales;
3. increase coordination among baylands stakeholder organizations to promote the successful implementation of the recommendations in this report;
4. create plans that factor in ecological outcomes after extreme events and other disasters; and
5. engage the citizenry in stewardship of the baylands.

**Baylands Group: Ensuring a Resilient Shoreline**

The San Pablo Baylands have incredible habitat value and even greater restoration potential. Both of these factors led non-profit conservation organizations, landowners, and the California State Coastal Conservancy to form a collaborative working group to provide restoration and sea level rise adaptation recommendations for the State Route 37 (SR-37) corridor to the Metropolitan Transportation Commission that would integrate restoration planning with transportation infrastructure planning to achieve both restoration and transportation objectives while increasing resilience of the marshes and the infrastructure.

**Flood Control 2.0 and Novato Creek Baylands Vision**

San Francisco Estuary Institute, Marin County Flood Control and Water Conservation District (MCFCWCD), the San Francisco Bay Joint Venture, and multiple other partners collaborated to develop flood protection strategies for the historic baylands around Novato Creek that focused on natural processes that aimed to both increase flood protection and restoration, while improving water quality and increasing resilience to sea level rise. An outgrowth of that effort was the *Novato Creek Baylands Vision: Integrating Ecological Functions and Flood Protection Within a Climate-Resilient Landscape* (2015). Several management strategies were highlighted, including removing levees along
lower Novato Creek, re-establishing tidal inundation within historic baylands, and reusing treated wastewater to create brackish and freshwater plant communities and expand marsh habitat. These strategies would reduce cost of dredging, alleviate flooding and levee erosion, and reconnect subsided baylands.

**Sea Level Rise Adaptation Framework**

Point Blue, SFEI, and the County of Marin co-developed the *Sea Level Rise Adaptation Framework* (2019), which includes an evaluation of restoration and adaptation opportunities for the Novato Creek region. The **Maximize Habitat Minimize Risk Strategy** (see **Figure 1.P**) was highlighted as the best strategy for reduced maintenance costs, biodiversity support, and recreation, though upfront investment was higher.

**Current Nearby Restoration Project Descriptions**

Novato Creek has numerous restoration opportunities as well, including the recently restored Hamilton Air Force Base, Bel Marin Keys V (in planning), Deer Island, and Simmons Slough, among others. These join a growing fringe of wetlands along the north shore of San Pablo Bay. Major large-scale restoration has been implemented along the Napa River corridor of the San Pablo Baylands, beginning with the restoration of the former salt production ponds and the salt production facility known as the Napa Plant Site, followed by the passive restoration of 1,249-acres at Cullinan West. Similar efforts are in the early planning stage along the lower Sonoma Creek corridor, and the Petaluma River corridor. The thousands of acres of Novato Creek baylands in public ownership provide a real and viable restoration opportunity and a chance to achieve the 1999 and 2015 Goals Report recommendations for this region.
Visions for Resiliency

This report presents and compares four alternative Visions to address the challenges facing SR-37 resulting from climate change. These Visions are summarized as follows:

- **Vision 1** referred to as “Hold the Line” seeks to adapt the corridor to future sea level rise by raising and strengthening the existing levees.
- **Vision 2** known as “Move the Line” places SR-37 on a levee restoring the area to the south as marshland.
- **Vision 3**, most robust model, is referred to as “Multi-Beneficial” and places the roadway on an elevated viaduct restoring hydraulic connectivity north and south of SR-37.
- **Vision 4** is known as “Buying Time” and places levees to elevations that will meet mid-century sea level conditions.

All of the options include the following components:

- Bridging of Novato Creek with a structure designed to meet the year 2100 sea level rise high-risk;
- Construction of a new Class I Bay Trail facility south

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<th>Lifecycle Cost</th>
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**Figure 1.H Visions Breakdown** This figure illustrates the relative merits of the various Visions with respect to their sea level resiliency, enhancement of environmental resources, time required to implement, and lifecycle and capital costs. The “Buying Time” Vision has the highest lifecycle cost of the all the Visions as the levees will require maintenance and there will need to be a future effort to modify the highway to protect it from SLR. While being the most expensive to implement, Vision 3 has the overall lowest lifecycle cost as the maintenance of the causeway structure will be comparable to other concrete structures with long service lives.
of the existing SR-37 (except in Vision 4 where it may not be possible);

- Allowing the continued operation of Novato Sanitary District’s dewatering ponds; and

- Completion of the Deer Island Wetlands Restoration project to reduce upstream flood risk and expand marsh habitat.

The following elaborates on the features and considerations associated with each alternative:

**Vision 1 - Hold the Line**

This vision would adapt existing highway and rail infrastructure, add a new segment of Bay Trail south of SR-37, and meet 2100 SLR high-risk standards by reconstructing and elevating the existing Novato Creek’s left and right side levees (looking downstream), and adding new Novato Creek crossings and associated transitions for each mode.

**Key features include the following:**

- A 300-foot-long highway causeway section over Novato Creek at an elevation of 26 feet NAVD88 with transitions of up to 600 feet in length on each side;

- A 300-foot-long rail causeway section over Novato Creek at an approximate elevation of 26 feet NAVD88 with rail transitions of up to 1000 feet in length on each side;

- Construction of a Bay Trail consistent with the Class 1 standards south of SR-37;

- Reconstruction of the existing Novato Creek left side (looking downriver) levee from SR-37 to the Bay;

- Reconstruction of the existing Novato Creek right side levee from Lynwood Basin to the Pacheco Pond outlet, at an approximate elevation of 19.7 feet NAVD88;

- Within Simmons Slough located north of SR-37, expand the storm water retention capacity, install new pumps, place flap gates, and add approximately 100 feet of 48” diameter culvert under the rail line at Simmons Slough crossing;

- Completion of Deer Island Basin restoration, including increased levee height to protect Novato Sanitary District’s dewatering facilities;

- Modifications to Olive and Atherton Avenues to reduce the potential of flooding; and

- Modifications to elevate Atherton Avenue at the SR-37 off and on-ramps.

**Key benefits of this vision would be:**

- Minimizes road and rail replacement;

- Novato Sanitary District facilities unchanged; and

- Allows Deer Island Basin to be restored

**Key limitations of this vision would be:**

- Limits marshland restoration;

- Reduced flood protection;

- Substantial fill required; and

- Requires ongoing levee monitoring and maintenance

The total cost in 2019 dollars to implement this vision is approximately $223 million, which includes the components included in the **Vision 1: Hold the Line** table below:

**VISION 1: HOLD THE LINE**

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Figure 1.1 Vision 1 “Hold the Line”
**VISION 1: HOLD THE LINE**

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**Vision 2 - Move the Line**

This vision increases the resilience of existing highway and rail infrastructure as well as increases flood plain and restores tidal marsh to year 2100 SLR high-risk standards. This would be accomplished by shifting the existing levee located along Novato Creek to just south of SR-37 allowing the restoration of tidal marshlands.

- Building a causeway crossing Novato Creek (as described in Vision 1);
- Creating a rail causeway crossing Novato Creek (as described in Vision 1);
- Constructing a new Novato Creek levee along the left side (looking downriver) at a location south of and parallel to SMART’s right-of-way;
- Construction of a new right-side levee between Lynwood Basin and Bel Marin Keys CSD property, including a new road connecting Bel Marin Keys Boulevard to SR-37;
- Construction of a paved Class I Bay Trail facility on the new levee protecting SR-37;
- Removal of the existing Novato Creek left side levee south of SR-37 to the Bay;
- Removal of the existing Novato Creek right side levee south of SR-37 to Bel Marin Keys CSD property;
- Modifying Simmons Slough (as described in Vision 1);
- Completion of Deer Island Basin (as described in Vision 1);
- Restoration of flood plain and tidal marsh on MCFCWCD lands south of SR-37;

Figure 1.J **Vision 2 Proposed Section** Illustrated the typical configuration for levee relocation south of SR-37

Key features include the following:

- Modifications on Olive and Atherton Avenues to
Figure 1.K Vision 2 “Move the Line”
reduce flooding;
• Modifications to elevate Atherton Avenue at the SR-37 off and on-ramps; and
• Relocation of approximately 7,000 feet of wastewater transmission line operated by NSD south of SR-37.

**Key benefits of this vision would be:**
• Provides the ability to meet 2100 SLR high-risk standards while retaining the existing highway, rail, and wastewater infrastructure;
• Few Novato Sanitary District facility changes required;
• Reduces flood risk;
• Improves US-101 resiliency to SLR;
• Allows Deer Island Basin to be restored;
• Provides a new connection from Bel Marin Keys Boulevard to SR-37; and
• Increases the floodplain and tidal marsh between SR-37 and San Pablo Bay

**Key limitations of this vision would be:**
• Does not provide for marshland restoration north of SR-37;
• Requires relocation of some Novato Sanitary District facilities;
• Substantial fill required;
• Reduced flood protection;
• Increases flood water management capital and operational costs; and
• Requires ongoing levee monitoring and maintenance.

The total cost in 2019 dollars to implement this vision is approximately $182 million, which includes the components included in the table below.

### VISION 2: MOVE THE LINE

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**Vision 3 - Multi-Beneficial**

This vision incorporates the highway, rail, and trail in a combination of new causeway and earthen levees set at the elevation prescribed for the year 2100 SLR high-risk standards. This concept would include the following:

**Key features include the following:**
• Construction of new causeway on Cast-in-Steel Shell (CISS) piles at an elevation of approximately 26 feet NAVD88, which allows for the structure’s soffit to be above future SLR conditions. The structure would be wide enough to accommodate SR-37 highway, rail, and the Bay Trail between US-101 and the western edge of Novato Sanitary District reservoirs and between the reservoirs east edge and Atherton Avenue;
• Construction of a new earthen levee at an elevation of approximately 19.7 feet NAVD88 across the Novato Sanitary District lands north of SR-37, sufficiently wide enough to accommodate SR-37 highway, rail, and the Bay Trail, as well as provide direct access to district facilities;
• Construction of a new right-side levee along Novato Creek between Lynwood Basin and Bel Marin Keys CSD property, including a new road connecting Bel Marin Keys Boulevard to SR-37;
• Removal of the existing Novato Creek left side
Figure 1.L Vision 3 “Multi-Beneficial”
levee south of SR-37 to the Bay;
• Completion of Deer Island Basin restoration, including increased levee to protect Novato Sanitary District reservoirs;
• Restoration of flood plain and tidal marsh north and south of SR-37;
• Modifications on Olive and Atherton Avenues to reduce flooding;
• Modifications to elevate Atherton Avenue at the SR-37 interchange approach;
• Relocation of approximately 7,000 feet of NSD wastewater transmission line south of SR-37; and
• Removal of existing roadway and rail lines

Key benefits include the following:
• The ability to meet 2100 SLR high-risk standards while providing the maximum marshland restoration opportunities;
• Provides the maximum flood risk reduction and minimum flood management operational costs;
• Protects the US-101 mainline and Novato Sanitary District reservoirs; and
• Provides a new, direct connection from Bel Marin Keys Boulevard to SR-37.

Key limitations include the following:
• Overall greater initial cost compared to the other three Visions

The approximate total cost in 2019 dollars to implement this vision ranges from $600 million to $1 billion and is derived from previous studies completed by Caltrans and TAM.

### VISION 3: MULTI-BENEFICIAL*

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Hybrid (bridge &amp; embankment)</th>
<th>Causeway</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobilize and Erosion Control</td>
<td>$50,000,000</td>
<td>$85,000,000</td>
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<tr>
<td>Roadway</td>
<td>$200,000,000</td>
<td>$65,000,000</td>
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<tr>
<td>Structures</td>
<td>$240,000,000</td>
<td>$675,000,000</td>
</tr>
<tr>
<td>Wastewater Pipeline Modification</td>
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<tr>
<td>Construction Cost</td>
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<td>Soft Costs</td>
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<tr>
<td>Total Costs (Rounded)</td>
<td>$592,800,000</td>
<td>$977,800,000</td>
</tr>
</tbody>
</table>

*Costs derived from State Route 37 - Segment A Sea Level Rise Corridor Improvement Study.

**Vision 4 - Buying Time**

This vision would protect the existing roadway to meet the anticipated year 2050 SLR high level risk standard by installing a levee along SR-37. This concept would include the following:

**This Vision would include the following:**
• Install sheet pile or similar bulkheads to an elevation of about 12.5 feet NAVD88 on the north and south edges of Caltrans’ right-of-way between Novato Creek and Atherton Avenue;
• Providing a segment of Bay Trail south of SR-37.
separated by a concrete barrier where possible;

• Building a causeway crossing Novato Creek (as described in Vision 1);

• Removal of the existing Novato Creek right side levee (looking downriver) south of SR-37 to Bel Marin Keys CSD property;

• Construction of a new right-side levee between Lynwood Basin and Bel Marin Keys CSD property, including a new road connecting Bel Marin Keys Boulevard to SR-37;

• Modifying Simmons Slough (as described in Vision 1);

• Completion of Deer Island Basin restoration, including increased levee to protect Novato Sanitary District reservoirs.

**Key benefits include the following:**

• Meets the year 2050 SLR high-risk standards at a lower initial cost;

• Provides time to develop a more permanent solution and financing plan; and

• The causeway over Novato Creek would be designed meet year 2100 high-risk standards

**Key limitations include the following:**

• The initial lack of a long-term solution;

• The lack of protection for rail facilities;

• The lack of increased flood protection for the City of Novato and US 101;

• The reduced opportunity for marshland restoration;

• Ongoing flood management capital and operational costs including the potential need to pump storm water from SR-37; and

• The visual impact of bulkhead along SR-37.

The total cost in 2019 dollars to implement this vision are approximately $165 million, which includes the components included in the following table.

### VISION 4: BUYING TIME

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Cost</th>
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</thead>
<tbody>
<tr>
<td>Mobilize and Erosion Control</td>
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<tr>
<td>Clearing and Grubbing</td>
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<tr>
<td>Levee Construction</td>
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<tr>
<td>Causeway - Novato Creek</td>
<td>$94,000,000</td>
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<tr>
<td>Simmons Slough Crossing</td>
<td>$2,000,000</td>
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<tr>
<td>Pump Stations</td>
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<tr>
<td>Marshland Restoration</td>
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<td><strong>Total Costs (Rounded)</strong></td>
<td><strong>$165,000,000</strong></td>
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</table>

**Note:** right-of-way costs are not included in the assessment for all of the Visions.

### 1.09 Next Steps

This report represents another step in a continuum leading to improving the resiliency of the SR-37 Segment A-1 from the impact of climate change. There are two key planning processes that are currently underway that support this effort including:

• A Caltrans’ SHOPP grant that is currently focused on SR-37 Segment A-1 is in the process of being revised to include all of Segment A, which extends from the Petaluma River to Sears Point.

• MTC is proceeding with a design alternatives assessment for all of Segment A funded through an SB 1 Adaptation Planning grant.

Based upon coordination with corridor stakeholders, community groups, and a review of existing studies, this report suggests Caltrans and MTC’s planning efforts address the following technical, environmental, economic, stakeholder and governance issues:

1. **Several technical studies will help guide the refinement of options including:**

   • Develop an understanding of future traffic capacity demands at the US-101/SR-37 interchange to determine potential modifications to its con-
Configuration. This will require a study to determine changes needed to the interchange to meet current design standards.

- Complete a Hydraulic analysis of Novato Creek to determine the width of highway and rail bridge spans to meet tidal and flood flows.
- Determine the roadway modifications needed to raise the elevation of SR-37 to conform to Atherton Avenue as well as to Novato Sanitary District lands.
- Prepare research to understand levee ownership and maintenance requirements. Additionally, determine the engineering properties and contamination profiles of levee soils and underlying materials to develop a cost analysis.
- Determine if the staging of construction for improvements to SR-37 will require temporary facilities, the acquisition of private property, and modification to public utility infrastructure.
- Atherton Avenue is subject to future flooding if existing levees are moved. Determine the risk and potential improvements needed to reduce the impact of climate change.
- A portion of Segment A-1 lies within the City of Novato, which is currently updating its General Plan. While doing so, there is an opportunity to consider where to locate long-term fortification against sea level rise and whether to provide other community development opportunities in conjunction with the improvements.
- Confirm that providing an alternative access route from the Bel Marin Keys area to SR-37 is technically feasible and supported by the community.

2. Consideration of the following environmental conditions is essential:

- Restoring marshlands that have been isolated from tidal action for over a century will require a substantial volume of clean fill to raise their elevations to promote tidal habitats. A study to determine the volume and sources of fill material is recommended.
- Identification of private parcels in proximity to SR-37 Segment A-1 that could support habitat restoration, flood protection, and transportation benefits and be eligible for Regional Advanced Mitigation Program (RAMP) funding.

3. Understand the economic issues with improving SR-37 will require the following:

- Complete a cost analysis for raising SR-37 to meet various SLR elevations. Validate if the cost to meet the high-risk category is warranted.
- The cost of addressing both transportation and ecological restoration in the SR-37 Segment A-1 study area are substantial and beyond the capacity of any currently identified sources of funding. In addition, many of the users of this route are low-income communities that could be disproportionately impacted through tolling or other user pay strategies. Develop a realistic funding strategy in coordination with the entire corridor.
- Determine the current costs associated with dredging and pumping storm water to maintain SR-37. This information could support the economic analysis of the life cycle costs of potential development scenarios.
- Studying alternative project delivery methods including design-build could be beneficial to determine if there could be cost savings.

4. Continue the collaboration with corridor stakeholders as follows:

- As SMART has indicated their interest in par-
Participating in the planning of improvements to the SR-37 corridor, continue the collaboration to integrate rail infrastructure into the corridor.

- The Novato Sanitary District owns and leases land north and south of SR-37 to manage treatment of the City of Novato’s wastewater. Its existing operation requires levees to protect treatment ponds from inundation. Given the long-term costs associated with managing these facilities and providing access to them from SR-37, there should be a shared evaluation of alternatives to determine whether a more sustainable and financially feasible treatment technology is available for the long term.

5. **Organizing the selection of alternatives should be through a formal governance process integrating the following elements:**
   - There are numerous public agencies whose facilities lie near the SR-37 Segment A-1 who are equally vulnerable to the risks associated with sea level rise. Ideally, a closely coordinated effort between the parties would address the long-term design, funding, and operation of both infrastructure and habitat restoration. However, there currently is no administrative structure established to facilitate and manage that approach. Discussion should be initiated, beginning with key public agencies and expanding based on initial interest of those involved, to identify a multi-beneficial governance structure.
   - Create a multi-agency regulatory review panel similar to Measure A-A’s Bay Regional Regulatory Integration Team (BRRIT) to provide early and continuing restoration permitting guidance.
   - Development of a compelling outreach campaign intended to build public and political support
   - As SR-37 has a high cost but relatively low traffic counts when compared with other Bay Area roadways, it will be challenged when competing for funding. Creating a compelling outreach campaign intended to build public and political support based on a multi-beneficial message may be an option to win funding.

### 1.10 Project Stakeholders

**The following agencies are involved in SR-37 Segment A-1 corridor**

**Sponsor Agencies**

- **County of Marin** The County has been primarily involved in the SR-37 Segment A-1 study area through Marin County Flood Control and Water Conservation District Zone 1. In addition, the Marin County Open Space District owns and manages Deer Island Preserve. Within the study area, the Marin County Board of Supervisors (BOS) has taken actions associated with both BayWAVE adaptation and county transportation planning. It has addressed SR 37 flooding as an independent Board and as members of the Transportation Authority of Marin Board of Commissioners. The Board has three appointments on the SMART Board of Directors. Currently, one Supervisor serves as Marin County’s representative on MTC, and two Supervisors serve on the 4-County Policy committee that is overseeing SR-37 planning and financing for the entire corridor.

- **Transportation Authority of Marin (TAM)** TAM is the transportation planning, financing, and highway project management agency for Marin County. TAM has a significant planning and construction oversight role for Caltrans’ local projects. TAM has been actively involved in SR-37 corridor-wide planning since 2014, and is a signatory to the 4-County Policy Committee MOU. In 2018, TAM produced the Segment A Sea Level Rise Corridor Improvement Study, which provided conceptual level plans for long-term, integrated
solutions to anticipated sea level rise. It identified the US-101 mainline as vulnerable to increased flooding, but did not take into consideration any SMART rail needs. TAM secured a 4-County Policy Committee commitment of $3 million in RM-3 funds, and will share in designating use of an additional $58 million in Segment A-1 and A-2 with SCTA. It also administers Marin County’s ½ cent transportation sales tax.

Marin County Flood Control and Water Conservation District Zone 1 is the largest landowner in the SR-37 Segment A-1 study area. It currently allows its diked fields to be used by Novato Sanitary District (NSD) for summer irrigation and agricultural production. Costs, lack of available funding, level of effort and substantial requirements by the regulatory permitting agencies, combined with the level of risk and potential damages, have resulted in a lower prioritization for levee maintenance for District-managed levees downstream of SR-37. Storm damages are more easily repaired individually on an emergency basis. In the past decade, the Marin County Flood Control and Water Conservation District (MCFCWCD) has undertaken significant hydraulic study and habitat restoration planning in addition to its ongoing management of flood control facilities throughout the Novato Creek watershed. It completed the Hydraulic Assessment of Existing Conditions/Novato Creek Watershed Project in 2014.

In 2016, MCFCWCD Zone 1 adopted the Novato Creek Flood Protection and Watershed Program. It identified opportunities to integrate flood protection goals with creek and wetland restoration elements. In 2017, the District sponsored a parcel tax to support the plan, but received just over 1/3 voter support. The Deer Island wetland restoration is a Measure A-A grant. The Simmons Slough project is funded in large part by a Department of Water Resources (DWR) grant with significant costs coming from Zone 1 funds. The District has identified Lynwood Basin as an element of their flood control operations that requires long
term protection. It has determined that two other ponds between Lynwood Basin and the Novato Creek main channel may be removed in the future to allow for both widening of the Novato Creek channel and wetland restoration opportunities.

**Local Agencies**

**Novato Sanitary District (NSD)** has its administrative offices, treatment facilities, storage ponds, and summer irrigation operations within the study area. It is the public agency requiring the greatest consideration when planning improvements to SR-37. The District’s Strategic Plan anticipates being permitted to relocate its summer discharge of treated effluent from agricultural fields on the south side of SR-37 to a new freshwater lagoon being created at the Bel Marin Keys Unit V restoration project. Novato Sanitation is one of ten local agencies in the North San Pablo Bay region that formed the North Bay Water Reuse Authority (NBWRA) to put recycled water to its broadest and most beneficial use. NSD lands both north and south of the existing highway are accessed from it, which must be maintained or relocated.

**Bel Marin Keys CSD** is a special district serving the unincorporated, 17,000 person, single-family residential community immediately south of Novato Creek. The neighborhood is built around two man-made lagoons connected to Novato Creek and the bay through locks. The CSD participated in the development of the **Novato Creek Flood Protection and Watershed Program** and attended TWG meetings for this study. In the medium-term, Bel Marin Keys expects impacts from water table and saltwater intrusion. To date, the CSD has not prepared any Climate Change evaluation or Resilience plans. Modifications to land use in the Baylands will require insuring that existing levels of flood protection and recreational boat passage to and from BMK lagoons are maintained.

**The City of Novato** is a general law city of 56,000 persons. Most of SR-37 Segment A-1 lies within the Novato City Limits. The City’s **General Plan** addresses a range of relevant topics, including environmental protection, specific land use, the Bay Trail, and transportation. It acknowledges that effective improvements to the transportation system depend on the

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![Figure 1.P Maximize Habitat, Minimize Risk Strategy](image)

(Point Blue et al., 2019). This strategy reconnects the baylands to tidal action by elevating SR-37 on a causeway, lengthening the SR-37 bridge over Novato Creek, and building ecotone levees between development and areas newly restored to tidal action.
cooperative effort of other agencies such as the State of California, Marin County, adjacent cities and counties, the Metropolitan Transportation Commission, and public transit districts. The land within the study area is zoned either public open space or planned development. City-serving utilities, including water, gas, wastewater, and electricity are vulnerable to increasing damage and maintenance costs as sea level rises. Atherton Avenue, Rowland Boulevard, Hanna Ranch Road, Marsh Road, and Harbor Drive face increasing flooding frequency and soil subsidence. A low-income community lies just upstream of diked baylands in the study area.

**Pacific Gas and Electric (PG&E)** is the electrical power provider of for all of Marin County. It has transmission towers traversing the Study Area and a major substation currently protected by its own levee system. Connection from Bel Marin Keys Boulevard to Marsh Road could be on or adjacent to the PG&E parcel.

North Marin Water District (NMWD) is the potable and recycled water supplier serving the City of Novato and surrounding areas. Its potable and recycled water transmission facilities are the infrastructure assets most vulnerable to SLR.

**Golden Gate Bridge, Highway and Transportation District (GGBHTD)** is a special district that provides regional bus and ferry services in Marin and Sonoma counties. Currently, the District has no routes operating on SR-37, however they have expressed an interest in doing so when traffic congestion barriers are reduced and regional bus service funding support is identified.

**Marin Transit** Marin Transit is a local bus service provider operating exclusively within Marin County. Currently, the District has no routes operating on SR-37, however they have expressed an interest in expanding local service along Atherton Avenue and providing support for other micro-transit programs in the study area.

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**Figure 1.** Existing Public Land Ownership
(graphic: Grossinger et al., 2019)
State and Regional Agencies

Caltrans owns, operates, and maintains SR-37 within a defined right-of-way. It is currently moving forward with a SHOPP program grant funding work through Project Approval and Environmental Document (PA/ED) for Segment A-1. It is expected that its plans will incorporate Intelligent Transportation Systems (ITS) improvements at the junctions of US-101 and SR-37, as well as elsewhere along Segment A-1. In addition, it has over 16 additional active SHOPP projects along the SR-37 corridor, and it is partnering with MTC to increase temporary and permanent traffic capacity in Solano County’s SR-37 Segment B. The agency also administers the SB 1 Adaptation Planning Grant Program, of which several project grants have been awarded within Marin County.

California Coastal Conservancy The California Coastal Conservancy (CCC) is a state agency established in 1976 to protect and improve natural lands and waterways, help people access and enjoy the outdoors, and sustain local economies along the length of Califor-
nia’s coast and around San Francisco Bay. It administers state bond programs associated with parks, land conservation, and water quality. It also is the owner and manager of the Bel Marin Keys Unit V restoration project. The Conservancy also provides staff services that support the SF Bay Restoration Authority.

**Metropolitan Transportation Commission (MTC)** is the region’s planning, financing, and state-owned bridge management agency. It is a signatory to the 4-County MOU. It is taking a lead role to increase temporary and permanent roadway capacity in Segment B utilizing an Ecologically Integrated Design framework. MTC also will administer the dispersal of RM-3 funds. In 2019, it received a $500,000 SB 1 grant to advance conceptual design of an ecologically integrated solution for all of Segment A.

**North Bay Watershed Reuse Authority (NBWRA)** is a group of diverse regional and local public agencies throughout the North Bay region working to craft regional approaches to managing our common watershed. Association members work cooperatively on water resources issues and go beyond traditional boundaries to promote good stewardship of the North Bay watersheds - watersheds that drain 850 square miles of eastern Marin County, Sonoma County, southern Napa County, and portions of Solano County.

**Sonoma Marin Area Rail Transit (SMART)** is an independent special district formed to develop and operate a commuter rail system in Sonoma and Marin counties. It owns a rail line extending between Novato and American Canyon. In 2018, it received a state grant to produce a Feasibility Study evaluating initiation of commuter rail services between Novato and Suisun City. The report was released in May 2019. It identifies possible schedules, costs, and engineering improvements associated with starting service. It does not consider the effects of climate change on its facilities.

**Sonoma County Transportation Authority (SCTA)** is the transportation planning and financing agency for Sonoma County. It is a signatory to the 4-County MOU. It will share in the designation of $58 million in RM-3 funds with TAM. It also administers Sonoma County’s ½ cent transportation sales tax. Recently, MTC associated SCTA with its SB 1 grant to replicate the community engagement protocols that MTC used for its corridor-wide plan. It is also closely monitoring the two Caltrans SHOPP project at the intersection of SR-37 and SR-121.
Community Stakeholders

Private Landowners  Most of the lands adjacent to SR-37 Segment A-1 are publicly owned. Several parcels fronting on Hanna Ranch and Marsh Road are privately owned and zoned for planned development. In addition, the Stonetree Golf Course adjoins publicly owned lands south of SR-37 toward the eastern end of Segment A-1. It is surrounded by a low levee on MCFCWCD-owned property and recently obtained a use permit that allows a driving range to be located on MCFCWCD property south of the course. To the north of Deer Island Open Space Preserve, Marin Audubon owns properties and manages them for wildlife benefit. Audubon identifies its efforts there as the Simmons Slough Seasonal Wetland Enhancement Project.

Environmental Non-Profits  A number of environmental science, land management, and advocacy organizations have been actively participating in ecosystem restoration and review of transportation projects in SR-37 Segment A-1. The list includes:

- San Francisco Bay Joint Venture
- San Francisco Estuary Institute
- Ducks Unlimited
- Point Blue Conservation Science
- Greenbelt Alliance
- The Nature Conservancy,
- Marin Conservation League
- Marin Audubon Society
- Friends of Novato Creek
- Sustainable Marin
- Sustainable Novato
- Trout Unlimited
- Marin Chapter of the California Native Plant Society
- Sierra Club Marin Group

During development of the SR-37 Transportation and Sea Level Rise Corridor Improvement Plan, an informal association known as the Baylands Group produced a white paper laying out key principles that call for transportation improvements to be integrated with the continued implementation of existing habitat goals and the extensive ecological planning that has already occurred, to ensure ecosystem function and landscape resiliency into the future. In addition to many of the organizations listed above, the Baylands Group includes the Sonoma Land Trust, Sonoma Ecology Center, Sonoma Resource Conservation District, and Friends of San Pablo Wildlife Refuge.

The Bay Fill Working Group was organized by BCDC to identify options for improving the permitting process for multi-benefit wetland restoration projects and associated flood management and public access infrastructure in San Francisco Bay. Its efforts led to the BCDC adoption of restoration-based fill policy changes in the fall of 2019.

Other Local Organizations

In addition to environmental organizations, the North Bay Leadership Council, Marin Economic Forum, and Novato Chamber of Commerce recognize the importance of SR-37 for local economic development.

Two neighborhood homeowner associations, the Black Point Improvement Club and the Green Point Advisory Committee frequently comment on matters in the study area, and were actively involved in the County of Marin’s preparation of Community Plans for each neighborhood, both adopted in 2016.

The Marin Community Foundation (MCF) is a philanthropic organization located in Marin County. MCF has funded a number of studies related to adaptation through its Advancing Nature-Based Adaptation Solutions Grant Program. It provided $203,000 to Point Blue in support of their report entitled, Sea Level Rise Adaptation Framework.

Hamilton AFB & Bel Marin Keys V The Hamilton Air Force Base was decommissioned in 1973. In 1999 the US Congress authorized the Hamilton Wetland
Restoration Project, an approximately 1,000-acre restoration project led by US Army Corps of Engineers (ACOE) and California State Coastal Conservancy (SCC). Bel Marin Keys V (BMKV) property was added to the ACOE SCC project in 2007. The Hamilton Air Force Base was similarly subsided several feet relative to marsh elevation. Dredge sediments were imported to raise internal elevations to create tidal marsh, and site was hydrologically reconnected to San Pablo Bay in 2014. The 1,600-acre BMKV site is being designed to also accept dredged sediments to restore tidal marsh at the mouth of Novato Creek.

Marin County Planning

**Flood Control 2.0, Deer Island Basin, Simmons Slough** MCFCWCD is planning to restore nearly 200-acres in the Deer Island basin, restoring tidal marsh habitat and pond habitat that will also benefit migratory waterfowl. The project included thin layer placement of dredged sediments to build up a levee that will maintain the County’s flood retention ponds. In addition MCFCWCD and Marin Audubon are partnering on an effort to enhance Simmons Slough connectivity at SR-37 by installing improved and enlarged culverts, clearing sediment, and increasing pumping capacity for MCFCWCD and Marin Audubon properties.

**Priority Actions**

Substantial conceptual planning has been conducted for the Novato Creek Baylands by San Francisco Estuary Institute, Point Blue, County of Marin, and other partners. These planning efforts share a restoration vision for lower Novato Creek and its surrounding baylands. SR-37 improvements must be planned in a way that allow a restoration vision to be implemented. While the future is uncertain, sea level is rising and will rise at a faster rate in the future. There is real urgency to restore as soon as possible in order to maximize the likelihood that wetlands can re-establish, and the likelihood that wetlands can persist as sea level rise rates increase in the future. According to *The Goals Report Update* in 2015 restoration implementation for Novato Creek needs to be completed as rapidly as possible.

Restoration projects around San Francisco Bay often spend far more than half their restoration budget to protect existing infrastructure such as highways, rail lines, and power lines. In order to meet the ambitious 2030 timeline, restoration and transportation will need to find mutually beneficial solutions rather than place the burden of infrastructure protection solely onto restoration projects. Restored baylands benefit all of us. Healthy marshes are critical to healthy thriving communities for all the value marshes provide: storm buffering and attenuation, nursery and rearing grounds for fish and native wildlife (including commercially important salmon and Dungeness crab), water filtration, carbon sequestration, and places of beauty and recreation.

For comparison, consider a future where the Novato baylands status quo is maintained – public entities would have an ever-growing need to pump water off their lands (*Figure 1.Q*). The maintenance needs to raise and maintain levees would continue to increase as sea level rises. As sea level rises, the vulnerability of this area to accidental levee breaches or levee over-topping also increases. The habitat benefits would be minimal in comparison to a restored future. The storm reduction and wave attenuation benefits would be minimal because of the decreased amount of restoration.

The general consensus of the restoration community likely recommends developing design alternatives that accommodate both transportation and restoration goals, by integrating restoration opportunities into transportation planning and design, and while taking adjacent land uses and opportunities into consideration. Where possible, SR-37 design should accommodate reconnecting baylands and tributaries. The
Novato Creek watershed is approximately 45 square miles and has six major tributaries: Leveroni, Bowman Canyon, Warner, Vineyard Creek, Arroyo Avichi, Arroyo de San Jose, and Simmons Slough. Land use changes have increased sediment supply and decreased sediment transport, causing the lower reaches of Novato Creek to become shallower. Local tributaries are important sources of sediment supply for the San Pablo Baylands, but have become increasingly channelized, developed along their banks, and incised in the upper watershed. Opportunities for reconnecting tributaries and their alluvial deposition to the landward side of our restoring baylands is also critical to their capacity to keep pace with sea level rise – opportunities are most straightforward for Arroyo de San Jose and Simmons Slough.

MCFCWCD has verified they plan to use the flood retention basin on the north side of the western terminus of SR-37 for the foreseeable future – therefore planning should accommodate that need for flood risk management. Also there is an opportunity to collocate the railroad with SR-37 along the entirety of Segment A – using earthen embankment through this stretch to the eastern edge of the flood retention pond would create an opportunity to gradually bring the rail line up to a higher elevation and would not preclude restoration opportunities for the majority of the historic publicly owned Novato Creek baylands north and south of SR-37 (Figure 1.Q). The existing topographic relief provides natural locations for earthen embankment. Locations where SR-37 traverses historic baylands should be elevated on a causeway. Restoring these deeply subsided lands will increase tidal prism at Novato Creek. Bridge length for Novato Creek should be planned to accommodate the amount of tidal prism that would be present under a fully restored scenario. Interim or even long-term restoration scenarios could include managing wetlands on subsided lands, termed “polders” (Point Blue et al., 2019). A design for SR-37 that would accommodate tidal restoration would also be compatible with inter-

im polder management strategies to halt and reverse subsidence and to achieve interim habitat values for waterfowl and shorebirds.
2. Summary of Studies

2.01 Highway 37 Stewardship Study
(Phase I/II Final Report) UC Davis
(2013/2016)

This “Highway 37 Stewardship Study” was part of a larger research project sponsored by the Federal Highway Administration in cooperation with the American Association of State Highway and Transportation Officials; administered by the Transportation Research Board (TRB) of the National Academies. The study boundary included Highway 37, portions of five counties, and other major routes sharing traffic with the highway.

Led by UC Davis’ Road Ecology Center, in partnership with Caltrans, this study was prepared in two phases: Phase I was a case study (2013) and Phase II was the SR-37 Integrated Traffic, Infrastructure and Sea Level Rise Analysis Final Report (2016). UC Davis subcon-tracted to partner organizations who were leaders in their respective urban and rural communities in planning, conservation, and stakeholder processes. Those included:

- Sonoma Ecology Center (www.sonomaecology-center.org)
- Sonoma Land Trust (http://sonomalandtrust.org)
- Southern Sonoma County Resource Conservation District (http://ssrcrd.org)
- Napa County Resource Conservation District (http://naparcd.org)

The “Highway 37 Stewardship Study” was a test-case for model evaluation tools developed by TRB to address ecological factors in transportation corridor planning. Five distinct alternative concepts were analyzed, though no new data was generated. In developing the scenarios, consideration was given to multi-modal travel, impacts to tidal and brackish marsh habitat in San Pablo Bay, adjacent land-uses, traffic flows, climate change-induced sea level rise, and what constitutes “sustainable transportation”. The study informed later development model behaviors that Caltrans incorporates into its corridor plans. It also provided a list of anticipated federal, state, and regional permitting agencies.

**Conclusions from the study include:**

1. Long timeframes for planning and project delivery do not suit stakeholder expectations for getting started on obvious problems.

2. Providing project funds as an incentive to regulatory agencies will increase their early participation.

3. The most significant data gaps identified related to uncertainty around the predicted rate of sea level rise and the lack of accurate data regarding detailed levee and berm topography and location.

4. The project team recommended that more values be included in the conceptual design framework, such as local economy, community identity, environmental justice, climate adaptation, carbon budget, and possibly greenhouse gas emissions, and/or life cycle analysis.

5. Stewardship-conservation priorities may be more easily met in combination with transportation and conservation planning.
2.02 The State Route 37 Transportation Concept Report Caltrans (2015)

Caltrans sponsored this study, which evaluated SR-37 from US Hwy 101 to I-80. It identified SR-37 as an important regional connection linking the north, east and west San Francisco Bay sub-regions. The purpose of the Transportation Concept Report (TCR) was to evaluate current and projected conditions along the route and communicate the vision for the development during a 25-year Planning horizon. The State Route (SR) 37 TCR utilized information and input from Phase I of the Highway 37 Stewardship Study completed in 2013 and referenced Phase II of the study which is the State Route 37 Integrated Traffic, Infrastructure, and Sea Level Rise Analysis completed in February 2016.

The TCR was developed with the goals of increasing safety, improving mobility, providing excellent stewardship, and meeting community and environmental needs along the corridor through integrated management of the transportation network, including the highway, transit, pedestrian, bicycle, freight, operational improvements and travel demand management components of the corridor.

It referenced three improvement options from Phase II of the SR-37 Stewardship Study: a roadway elevated on a levee, on a “monopod” concrete post causeway, and on wood or concrete “trellis”. Public multi-modal access to the resources in the corridor and the potential for appropriate transit options were also identified for study. This study formed the basis for other subsequent corridor planning documents.

Stakeholder meetings, workshops and other outreach engaging transportation, natural resource protection agency, and community stakeholders were convened to define the corridor context, identify critical issues, and explore alternative improvement strategies for SR-37. The report states that the most defining issue for Highway 37 is its vulnerability to flooding during heavy storms. Flooding has repeatedly occurred in the past, requiring closure of the roadway. With rising sea levels, flooding events will likely grow more frequent.

In Segment A, the highway is built on a levee which constricts the free tidal flow from the Bay to the marshlands. This prevents replenishing marsh and stream nutrients, obstructs cleansing action, and impedes silting. Altering or removing the highway levee could restore natural hydrology, but with so many other factors at play such as privately-maintained levees, sea level rise, buried toxins, and more frequent drought years, restoration of the marshlands is likely to be a lengthy and complex endeavor.

The report states that the most defining issue for Highway 37 is its vulnerability to flooding during heavy storms

Roadway runoff can degrade water quality in adjacent ponds, sloughs, and marshes. The challenge of a highway maintenance or improvement project will be to understand the function of the highway not only as a transportation facility but also as an impediment to the surrounding environment and as a protecting structure to levees and farmland.

Much of the commute traffic on SR-37 results from a stronger job market and a higher cost for housing in Marin County (and to some extent also Sonoma
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County). Many commuters travel from Solano County. This jobs/housing imbalance is one contributor to congestion Bay Area wide, including SR-37. Future traffic volumes were predicted to increase in congestion on the current facility. At this time, capacity increases are not possible, given environmental constraints. Congestion management methods such as ITS technology and providing transit were mentioned for potential implementation.

No designated bike or pedestrian facilities in Segments A were noted except for small sections of the Bay Trail that roughly parallel parts of the corridor. Except for the two bridges in Segment A (Novato Creek Bridge and Petaluma River Bridge), which have less than two-foot shoulder widths, there is sufficient shoulder (> 4 feet) for cycling or walking along the highway, but high vehicle speeds of 60 plus mph make riding and walking very stressful. The study recommends providing links of existing and future bicycle facilities with networks in Napa and Solano Counties to the east, and Sonoma and Marin and the SMART multi-use pathway to the west.

2.03 SR-37 Transportation and Sea Level Rise Corridor Plan

The SR-37 Corridor Plan (Corridor Plan) is a high-level assessment of key current and anticipated issues on California State Route 37 (SR-37) and lays out some near, mid, and long-term improvements to help to address such issues. The study corridor extends from US Hwy 101 in Novato to I-80 in Vallejo. The roadway serves as a commute and recreational route and experiences traffic congestion both on weekdays and weekends. SR-37 also acts as a secondary and reliever route to the interstates and state highways it parallels and is a recovery route for the Richmond-San Rafael Bridge in the event of an emergency closure.

The most critical issues for the study corridor are recurrent traffic congestion, vulnerability to flooding, which will likely grow more frequent with sea level rise, and potential impacts of sea level rise on highly sensitive environmental resources adjacent to the corridor. Rising sea levels due to climate change will critically impact both the study corridor and surrounding sensitive ecosystems.

The Corridor Plan represents an early step of many to proactively identify opportunities and solutions to the transportation, ecosystem and sea level rise for the SR-37 corridor.

This corridor plan encompasses three broad goals:

- Integrate transportation, ecosystem and sea level rise adaptation into one design
- Improve mobility across all modes and maintain public access
- Increase corridor resiliency to storm surges and sea level rise

The Plan recommends integration of ecological enhancements as part of any improvement project. It sets a goal of no net loss of wetlands habitat to mitigate for project widening by integrating restoration elements into the project design. It highlights the role that the Regional Advanced Mitigation Program (RAMP) could have to balance near-term and long-term transportation improvement impacts.

Preparation of the Corridor Plan utilized extensive and diverse stakeholder input. Of particular value, the vision statement and guiding principles for the San Pablo Baylands developed by the SR-37 Baylands Group were cited to help guide the region as it plans,
designs, and implements improvement strategies for the corridor. The plan encourages taking into account the rich ecology and evolving landscape, ongoing and future conservation, restoration efforts, and opportunities to pursue ecological enhancements.

Flooding is an issue along some portions of SR-37 such as Novato Creek, Tolay Lagoon, and Mare Island at this time. The study found that, in general, all segments of the highway would be impacted by permanent inundation with 36 inches of sea level rise and could be exposed to storm surge flooding by a 25-year coastal storm event today and by a 5- to 10-year coastal storm event with 6 to 12 inches of sea level rise. Segment A and Segment B will be completely inundated by 36” of sea level rise by 2100.

Currently, SR-37 flood protection relies on a complex interconnected system of levees along Novato Creek, Petaluma River, Tolay Creek, Sonoma Creek, Napa River, and the San Francisco Bay. According to the projections, Segment A will flood during a 10-year storm surge event and will be permanently inundated around 2050 with roadway flooding depths ranging up to 5 feet, warranting near-term flood protection improvements to address weak links. The extent of levee improvements needed will be dependent on the storm design and planning horizon. Mid-term improvements to raise levee crests are estimated to be $37 million in Marin.

The capacity of this segment is also unusually low, about 400 vehicles per hour per lane less than other similar facilities (about 1,200 versus 1,600), and is primarily due to the short merge distances approaching the lane drops east of SR 121 and Mare Island. Several SHOPP projects are identified that will address operational enhancements to improve efficiency.

While no focused efforts have yet been taken to encourage carpools, establish vanpools, or provide bus, ferry, or rail service connecting the Interstate 80 and US 101 corridors, the Corridor Plan proposes that implementation of improvements also incorporate multimodal access along the corridor.

Transportation improvement projects for SR-37 will likely go through the Caltrans project development process which involves planning/engineering assessments of improvement options, environmental review that includes detailed environmental studies and alternatives assessments, design of the proposed improvement and ultimately construction. Improvements implemented in the near or mid-term should address existing issues such as these and be compatible with and/or not preclude longer-term improvements.

The Corridor Plan concludes with identifying Next Steps. Recommendations include detailed traffic operations analysis for the near-term and mid- to long-term improvements highlighted in the Corridor Plan based on forecasted demand and growth within the corridor. Preliminary engineering design plans and cost estimates will also be developed for the Priority Segment B project.

“The Corridor Plan proposes that implementation of improvements also incorporate multimodal access along the corridor.”
In response to the findings of MTC’s Transportation and Sea Level Rise Corridor Plan, dated September 2017, the Transportation Authority of Marin (TAM) engaged HNTB to prepare a study that included conceptual plans for long-term integrated solutions to the anticipated sea level rise affecting Segment A. Along the SR-37 corridor, Segment A is lower in elevation compared with Segment B and Segment C. If no measures are taken to protect Segment A from sea level rise, the roadway will eventually be inundated on each side and closed to traffic in the future.

TAM and the project team met with local stakeholders to discuss and obtain relevant information for the study. The local stakeholder group included County of Marin Department of Public Works, Sonoma County Transportation Authority, Caltrans, SMART, and the City of Novato Public Works Department.

The single most important design criteria for this study was to establish a conservative design elevation for the roadway surface in order to protect against flooding for expected sea level rise in the year 2100. SR-37 runs northeast-southwest through the middle of the former well-drained tidal marsh of Segment A. The road bisects numerous small historical channels, as well as both Novato Creek and Simmons Slough. The existing roadway is relatively low-lying, about two to six feet NAVD88, except between Atherton Avenue and the Petaluma River Bridge. Most of the road relies on unengineered levees and berms along Novato Creek.

The former marshes have subsided several feet below Mean Higher High Water (MHHW), and the whole area is dependent upon levees and pumping to prevent flooding. When the levees fail, large parts of the surrounding terrain are inundated on each tide. The HNTB study calculated the minimum roadway elevation to be 21.8 feet (NAVD88 Survey Datum) as the basis for developing design alternatives. The roadway elevation was developed based on current understanding of sea level rise criteria for year 2100. The roadway elevation addressed 100 year storm surges (3.6 feet), wave runup (3 feet), sea level rise (6.9 feet), and freeboard (2 feet). Wave runup was included in the overall sea level rise calculation since it is unknown where the ultimate shoreline will be and where marshland and mudflat will be between the proposed structure and the Bay.

The roadway cross section assumed an expressway type roadway per the Caltrans Highway Design Manual, consisting of two 12 foot wide lanes in each direction, a standard shoulder width of 5 feet on the left shoulder and 10 feet on the right shoulder, and a 12 foot wide multi-use path located along the eastbound direction only. When the roadway would be on embankments, the pavement section was assumed based on previous work performed by Ducks Unlimited in coordination with Caltrans during Segment B deceleration lane construction. An enormous amount of dirt would need to be imported to the project site and would require detailed investigation during the environmental documentation phase to determine the most appropriate approach. To offset dirt quantity, alternative materials to consider include cellular concrete and geofoam. However, these materials were not quantified or studied for applicability to this project.

For causeway sections, the soft clayey conditions of the existing soil underlying the proposed alignment informed assumptions regarding how to support...
bridges in the project area and types of foundations to be considered. Geotechnical investigations were not performed for this study.

Hanna Ranch Road and Marsh Drive were expected to be improved to conform to the elevated SR-37. The Atherton Avenue on and off-ramps on SR-37 will need to be addressed to conform to an elevated SR-37. Atherton Avenue’s current elevation is also below projected sea level rise. The study did not evaluate the impacts associated with raising Atherton Avenue.

Where causeway bridges are envisioned, the spans range from 80 -150 feet. The existing Petaluma River Bridge would be replaced with either a long span balanced cantilever structure or a cable supported structure. However, detailed type selection was not part of this report. Bridges function not only as a transportation element and, in the right context, can convey aesthetic sensibilities and culture relevance in their communities. With that in mind, the bridge type and its final shape needs to be considered during the preliminary and final evaluation of structure types.

Based on the historic Baylands Boundary, 2.5 miles of the existing US Hwy 101 mainline will be inundated with water in year 2100. This section of roadway below sea level is along US Hwy 101, between De Long Avenue to the US Hwy 101 southbound on-ramp from Novato Boulevard. To mitigate this, it is recommended to further investigate options that include raising the section of US Hwy 101 mainline that is below sea level, or constructing a levee to protect the this vulnerable portion of this major freeway. Elevating the US Hwy 101 mainline will also require reconstruction of the existing overpass connecting it to SR-37.

The study does not include accommodation for the SMART rail alignment that exists immediately adjacent to US Hwy 101 in this area, though the rail will be inundated by seal level rise, as well. Additional evaluation and right-of-way analysis is also required to determine overall impacts to the surrounding properties. In addition, access rights to existing properties along SR-37 will be impacted by the design and will require future discussions.

Three alternatives were analyzed in this study:

- **Alternative 1** This option proposes to raise SR-37 on a causeway between US Hwy 101 and SR 121. The preliminary planning cost estimate for the Marin portion of Alternative 1 is $842 million in Marin County (Year 2018) / $1.2 billion (Year 2033)

- **Alternative 2** This option is a hybrid option in which segment A will be a combination of embankment and causeway structure. The section of roadway between US Hwy 101 and Atherton Avenue is on a causeway at Novato Creek and Simmons Slough and embankment everywhere else. The preliminary planning cost estimate for the Marin portion of Alternative 2 is $570 million in Marin County (Year 2018) / $810 million (Year 2033)

- **Alternative 3** This option proposes to raise the roadway on a causeway between US Hwy 101 to just east of Novato Creek to achieve an elevation above the projected sea level rise. The preliminary planning cost estimate for the Marin portion of Alternative 3 is $364 million in Marin County (Year 2018) / $522 million (Year 2033)

Costs do not include removal of old bridges or existing bridge modifications. The US Hwy 101/SR-37 interchange was reviewed for sea level rise impacts.
The study did not evaluate the impacts associated to raising Atherton Avenue but no detailed analysis was completed due to schedule limitations of this study. For the Ultimate Project solution, the interchange will need to be elevated along with the off and on-ramps to raise them above the projected sea level rise. The preliminary costs to upgrade the interchange is expected to be in the $75 to $120 million range.

While these alternatives would provide for future integration of restoration, as opposed to precluding them, restoration projects were not evaluated or proposed in the evaluation.

The study did not evaluate any staging concepts for the alternatives. Although alternatives are currently following the existing alignment of SR-37, there are opportunities for adjustments to the north where the right-of-way is more generous.

2.05 The Project Study Report - Project Development Support for SR-37
Caltrans (2018)

This Caltrans document is exclusively focused on improvements for Segment B of the SR-37 corridor. The project study limits for the traffic operations analysis model is the segment of SR-37 from US Hwy 101 to SR 29, including the impacted portion of SR 121. These limits may need to be adjusted during PA/ED to fully account for existing and expected future corridor congestion. The study began when Metropolitan Transportation Commission (MTC), Caltrans, and four North Bay partners (Solano Transportation Authority [STA], the Sonoma County Transportation Authority [SCTA], the Transportation Authority of Marin [TAM], and the Napa Valley Transportation Authority [NVTA]) undertook a Design Alternative Assessment (DAA) of Segment B to plan and expedite the delivery of improvements in the study corridor to address the threat of sea level rise and traffic congestion. With the support and input from a number of scientists, landowners, land managers, and environmental organizations, the DAA refined its original scope to integrate the transportation and sea level rise adaptation with the ecology of the corridor. The study was converted into a PSR-PDS document to expedite initiation of a PA/ED phase for an interim solution.

The PSR-PDS is a first step in proactively identifying opportunities and solutions to the transportation, ecosystem, and sea level rise concerns for the entire SR-37 corridor. This PSR-PDS addresses improvements on SR-37 between the SR 121 intersection and the Mare Island interchange. The document evaluated several alternatives, and recommends proceeding with parallel Project Approval/Environmental Document (PA/ED) phases for Interim and Ultimate Project solutions related to Segment B.

The scope, schedule, and support costs necessary to complete needed studies and work during the PA/ED phase to advance Interim and Ultimate Project solutions are clarified and the study identifies all permitting agencies that will be involved. It also organizes understanding of environmental laws pertaining to the project, and the NEPA/CEQA requirements. The microscopic multi-modal traffic flow simulation software, PTV VISSIM, is recommended as the analysis tool.
The purpose of the Interim Project is to improve traffic flow and peak travel times, and increase vehicle occupancy (the number of people moved per vehicle) within the travel corridor between Mare Island and SR 121 (the project limits).

The purpose of the Ultimate Project is to improve traffic flow at peak travel times, increase vehicle occupancy, accommodate multi-modal use, improve resiliency of transportation infrastructure to sea level rise and flooding, and provide ecological and hydrologic enhancements to facilitate adaptation of the corridor landscape to sea level rise.

It is anticipated that the Interim Project alternatives would impact utilities at both the SR 121 and SR-37 intersection and the Mare Island interchange. For the Ultimate Project alternatives, it is also anticipated that some of the existing PG&E transmission towers running parallel to SR-37 would be impacted.

The Caltrans District 4 Bike Plan (2018) shows that the SR-37 corridor has a high Level of Traffic Stress (LTS) due to high speeds and a lack of separation of bicycles from motor vehicles. The proposed Project alternatives address safety and include provisions for bicyclists, pedestrians, and transit users to the maximum extent feasible; therefore, the Project improvements are consistent with Complete Street policies.

The estimated total project capital outlay cost for the Interim Project alternative is approximately $107 million to $172 million. This includes $103 million to $145 million for roadway items. The estimated total Project capital outlay cost for the Ultimate Project alternative is approximately $3,234 million to $4,052 million. The capital outlay support cost needed to complete the PA/ED phase is estimated to range from $3.5 million to $6.7 million for the Interim Project and $54 million to $66 million for the Ultimate Project.

2.06 California State Rail Plan Caltrans (2018)

Caltrans’ mission in developing the California State Rail Plan is to provide a framework for a safe, sustainable, integrated, and efficient California rail network that successfully moves people and goods while enhancing the State’s economy and livability. Residents and workers in California’s growing mega-regions face increasing vehicle congestion and crippling commute times due to pressures on the housing market and aging transportation infrastructure. Coordination between different modes of transportation and land use planning must drive priorities to ensure no one system is bearing undue burden to provide access and mobility to all of California’s communities. Modern rail is the most cost and energy-efficient transportation technology to quickly, safely, and affordably connect people to their destinations and goods to their markets.

At the statewide level, the 2018 California State Rail Plan emphasizes “connectivity” between transportation services as a key goal. The 2018 California State Rail Plan establishes a statewide vision describing a future integrated rail system that provides comprehensive and coordinated service to passengers through more frequent service, and convenient transfers between rail services and transit. This integrated system uses the existing rail system more efficiently and expands the coverage and mix of rail services in several key corridors. The rail system envisioned in the Rail Plan will improve Californians’ quality of life by mitigating roadway congestion; reducing vehicle emissions; supporting compact land use; and offering
convenient, reliable, and auto-competitive alternative travel and goods movement. Since 2002, State legal and administrative directives have set policies aimed at reducing GHG emissions to limit the harmful effects of climate change.

California recently passed SB1, a law estimated to provide $52 billion in revenue over the next decade to help cover State transportation needs. A substantial portion will be dedicated to rail and transit needs. The State has committed to fund transformative capital improvements that focus on connectivity between systems.

The Rail Plan’s integrated service concept lays the foundation for a coordinated rail network. By integrating high speed rail, intercity rail and bus, and regional rail and local transit, the 2040 Vision benefits residents in rural, suburban, and urban areas across the state. Efficiency and capacity improvements attract trips away from other modes, primarily trucks, potentially saving costs, emissions, and time, as well as improving safety of those trips relative to their original mode. Rail investments contribute to reduced impacts on the environment by offering shippers and travelers a cleaner alternative to motor vehicle and air travel.

California’s freight railroads are owned and/or operated by private companies. Federal regulations exempt freight rail operators from many kinds of state and local regulations that might affect other businesses. Commuter rail systems typically provide passenger service within a single region, and occasionally between regions. Service is more frequent during peak commuting periods. These commuter rail services are essential to supporting and connecting regional economies. Commuter rail capital funding comes from Federal, State, and local sources, while operating funding is the responsibility of local and regional entities. SMART is a voter-approved commuter rail service that runs from Santa Rosa to San Rafael. Rail service on the initial segment commenced in 2018.

The 2040 Vision foresees an efficient network of rail services that provide a statewide mobility solution benefitting both regional and interregional travel needs. The passenger rail network will be developed to provide travel times that are competitive with air travel times in the longest-distance trips between major urban areas, and auto-competitive in regional markets. The service goals and service delivery options identified in the Rail Plan provide a strategic framework for service implementation planning, coordination between the State and rail partners, and prioritization of capital improvements in phases tied to the short-term (2022), mid-term (2027), and long-term (2040).

The Rail Plan defines nine geographic service areas. SMART operates within the North San Francisco Bay Area and the North Coast service area. This region includes the State rail network between Sacramento and Oakland/San Francisco, as well as the North San Francisco Bay Area rail network in Marin, Sonoma, Napa, and Solano Counties. Section 4.6 of the 2018 California State Rail Plan (see Reference 1 of the Plan) recommends evaluating expansion of passenger service connecting the SMART system to the Capitol Corridor system, a passenger rail system that connects Silicon Valley and San Jose up Sacramento.

The 2022 Short-Term Plan regional goals focus on optimizing existing rail services and building on the recently established SMART service from San Rafael to Sonoma County Airport. It also imagines improvements to bus services in order to better connect communities north of Sonoma County Airport (on the North Coast) and in the Napa Valley, with SMART. Key Transportation Studies
components of the 2027 plan include extension of the SMART corridor north of Sonoma County Airport.

The 2040 Vision in the North San Francisco Bay Area will provide for fast, frequent service connecting the Sacramento region and outer Solano and Contra Costa County suburbs to Oakland and San Francisco, with connections to Napa, Marin, and Sonoma Counties. It calls for hourly service between a Solano County hub and Novato, providing timed connections to service between Cloverdale and Larkspur, or through service to Marin or Sonoma Counties.

2.07 District 4 Vulnerability Assessment Summary Report Caltrans (2018)

Caltrans is making a concerted effort to be a leader in identifying vulnerabilities and assessing the impacts of climate change on the State Highway System. The District 4 Vulnerability Summary Report is one of two documents prepared to outline climate change effects in the San Francisco Bay Area (District 4); the other being the Technical Report. This document represents a general summary of identified impacts.

This report does not identify projects to be implemented, nor presents costs associated with those changes. Caltrans plans to resolve these vulnerabilities in subsequent planning and design. The overall intent of this project is to add some definition to a subject with many unknowns. In 2011, Caltrans released the Guidance on Incorporating Sea Level Rise document for use by Caltrans Planning staff and Project Development Teams. The guidance provides initial criteria for consideration to determine whether or not sea level rise needs to be incorporated into project programming and design. Factors that should be considered include: the project design life, the existence of alternative routes, anticipated travel delays, evacuations, traveler safety, and environmental constraints.

Caltrans expects climate change events to increase in scale and frequency. It will be important that actions taken to respond to these events and similar future events increase system resiliency and address potential future conditions. The data analysis presented in this report is largely based on global climate data compiled by the Intergovernmental Panel on Climate Change (IPCC). The model to determine flooding exposure is called the Coastal Storm Modeling System (CoSMoS) and was developed by the United States Geological Survey (USGS). Sea level rise projections for this guidance are adopted from the Ocean Protection Council’s (OPC) 2018 guidance for the State.

In years when extreme climate events occur, the damage and resulting costs of repairing transportation infrastructure can be extensive. In the 2017 year alone, Caltrans sustained approximately $1 billion in storm-related damages. Between January and May of 2017, District 4 experienced weather related damages in 110 locations, with a cumulative cost over $250 million in repairs, largely from heavy precipitation and strong coastal storms.

One of the primary partners of Caltrans in determining these long term risks on the highway system is the San Francisco Bay Conservation and Development Commission (BCDC). In addition to BCDC’s regulatory duties, the BCDC has been leading the sea level rise studies in the region through their Adapting to Rising Tides (ART) Program.

The Vulnerability Assessment’s defined approach includes the following actions:

- **Exposure** the identification of Caltrans assets exposed to damage or reduced service life from expected future conditions;
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- **Consequences** a determination of what might occur to system assets in terms of loss of use or costs of repair;

- **Prioritization** developing a method by which capital programming decisions will be made to address identified risks, including considerations of system use and/or timing of expected exposure;

The report also identifies other climate-related impacts that will affect transportation facilities, including increasing temperature impacts on pavement, increased wildfires, and increased storm precipitation.

2.08 Passenger Rail Service Novato to Suisun City Feasibility Study California State Rail Plan SMART (2019)

The *California State Rail Plan* that was published last year identified the possibility of creating an east-west connection that would greatly improve the travel options in one of the highest growth travel markets in the State, connecting rail systems and providing an alternative transportation choice in a corridor currently experiencing tremendous congestion.

A rail connection between Novato and Suisun could provide much needed relief to commuters that currently rely on State Route 37, a no exit two-lane highway experiencing more annual vehicle hours of delay in Sonoma County than Highway 101. These conditions penalize the region’s economic engine, with workers traveling between Sacramento/Solano/Napa counties and Sonoma/Marin/San Francisco facing punishing transportation conditions on a regular basis. By providing an integrated transportation alternative between Novato and Suisun City, the project offers the opportunity to reduce the number of single occupancy vehicles traveling in the Highway 37 corridor. This will help achieve the State’s goals of congestion mitigation, reduction in fossil fuel use, and greenhouse gas reduction.

The purpose of this report was identified as follows:

- Examine the technical feasibility of implementing passenger rail service between Novato and Suisun City;
- Document the existing physical condition of the corridor;
- Propose limited infrastructure options, and their corresponding operating characteristics;
- Identify potential infrastructure and environmental challenges;
- Prepare order of magnitude schedule and cost estimates;
- Recommend next steps

The railroad corridor connecting the existing SMART Novato-Hamilton station, near Novato, and the existing Capitol Corridor station at Suisun-Fairfield is approximately 41 miles long. SMART owns the right-of-way from Novato-Hamilton station eastward to approximately American Canyon, and Union Pacific Railroad (UPRR) owns from there to Suisun city. SMART calls this east-west corridor the “Brazos Subdivision.” The SMART right-of-way for the proposed project consists of two distinct portions. The first, shorter section of SMART-owned right-of-way is comprised of a 1.6-mile-long portion overlapping with the current SMART north-south operating route. This short section would provide the proposed passenger service with a connection from the rail junction at Novato to the existing SMART Novato-Hamilton station. The Novato-Hamilton station would serve the western
terminus station for the Novato to Suisun trains; once trains arrive at Novato-Hamilton station, they would need time to “change direction” to be prepared to proceed eastward toward Suisun City.

Although SMART owns the track, the Northwestern Pacific Railroad provides freight service on this segment, typically consisting of two round trips per week. The existing freight rail service is provided by two separate freight operators, the Northwestern Pacific Railroad and the California Northern Railroad.

The Feasibility Study inventoried the physical elements of the railroad, performed a high-level review of the natural environment to get a sense of habitat and conditions, and prepared a high-level order-of-magnitude cost estimate. The Study established two implementation options for service:

- a minimal, rapid deployment basic level of service, and;
- a more robust reconstruction of the railroad with higher level of service. There is the ability to scale service in both options as demand warrants which will ensure that this infrastructure investment delivers connectivity for years to come. All options included fundamental elements of a modern passenger rail system such as Positive Train Control (PTC) to provide high degree of safety and providing interoperability with freight operations.

The cost of the two options range from approximately $780 million to $1.3 billion Implementing passenger service would require improvements to the existing trackway and bridges, new stations, and installation of a new signal system with Positive Train Control (PTC). Passenger service could be established in 4 to 6 years once funding becomes available.

Because of the relatively deteriorated condition of the infrastructure (e.g., rails, ties, bridges), lack of a signal system, and lack of a rail system with PTS, passenger rail service cannot be implemented using the current infrastructure. However, with suitable capital improvements, passenger rail service could be implemented.

The majority of the existing rail, ties, and ballast would need to be replaced in order to provide reliable passenger service at speeds over 60 miles per hours. Depending upon the level of infrastructure improvements, the operating speed could range between 60 miles per hour and 80 miles per hour. More improvements would be needed to allow higher speeds. There are no grade crossings on the Marin County section of the corridor. Both options assume that the minor bridges would be replaced, and that the bridge at Black Point would be need upgrades or replacing. The Black Point bridge is at the end of its useful life. It is adequately maintained to accommodate low-speed and low-volume freight traffic, but must be replaced in order to implement reliable passenger rail service.

Agreements for track access would be required between SMART and the freight owners/operators. SMART is in regular discussions with Northwestern Pacific Railroad (NWP) and, while NWP has operating rights over the SMART tracks, SMART retains full ownership and control of the tracks. NWP provides freight service on the SMART-owned corridor between American Canyon and Novato. Passenger rail service would need to be integrated into the existing freight service.

While there are existing stations at Novato-Hamilton and Suisun-Fairfield, these facilities would need to be significantly expanded to accommodate new service. Between these end points, there are no stations, and thus new stations would need to be construct-
In order to comply with the federal mandate, an entirely new (PTC) system would be needed for the proposed service in the east-west corridor between Novato-Hamilton Station and Suisun-Fairfield Station.

The existing SMART system passenger vehicles are Diesel Multiple Units (DMUs); each passenger car has its own diesel engine and control cab. These high-floor vehicles require a high station platform (nominally 48-inches above top of rail) to provide level boarding, in compliance with the Americans with Disabilities Act.

The next steps would be to prepare an environmental evaluation document and initiate preliminary engineering when funding is made available.

**Option 1 assumes limited improvements to the existing railroad embankment, including:**

- Replacement of most existing rail and timber cross ties with new rail and new timber ties;
- Construction of two new passing sidings;
- Construction of additional platforms and passenger connectivity features at the SMART Novato-Hamilton and Capitol Corridor Suisun-Fairfield stations;
- Construction of up to three intermediate stations;
- Rehabilitation of the existing Black Point bridge or replacement with a lift bridge acquired from another location;
- Replacement of all existing timber bridges with concrete bridges;
- Construction of a new signal system;
- Implementation of a Positive Train Control (PTC) system;
- The service characteristics of Option 1 include:
  - Second-hand locomotives pulling conventional passenger cars;
  - Initial capacity would be approximately 2100 passengers per day;
  - Maximum operating speed would be 60 miles per hour, with estimated travel time between Novato-Hamilton Station and Suisun-Fairfield station of approximately 70 to 80 minutes;
  - The conceptual cost range, including contingencies, for Option 1 is $780 million to $898 million. Because the railroad would not be completely reconstructed in Option 1, ongoing maintenance costs would be higher than those in Option 2. Option 1 assumes that basic equipment maintenance could be provided by a local railroad or railroad service entity with a suitable facility. This avoids the cost of constructing a brand new maintenance facility;

Option 1 would establish a connection to the SMART system in Novato by constructing additional tracks and platforms at the existing SMART Novato-Hamilton Station. The new tracks and platforms are necessary because the trains for the new service are presumed to “end” their runs at Novato-Hamilton, allowing passengers a timed, coordinated cross-platform transfer to the north-south SMART system for travel to their destinations in Marin or Sonoma counties.

**Option 2 assumes more significant improvements to the rail line, including:**

- Re-grading, stabilizing, and widening the existing railroad embankment, including a new subballast layer;
- New ballast and new concrete tie track;
- Construction of four new passing sidings to allow additional operational flexibility;
• Construction of additional platforms and passenger connectivity features at both the SMART Novato-Hamilton and Capitol Corridor Suisun-Fairfield stations;
• Construction of up to four intermediate stations;
• Replacement of the existing Black Point bridge with a new bridge;
• Replacement of all existing timber bridges with concrete bridges;
• Construction of a new signal system;
• Implementation of a Positive Train Control system that is inter-operable with Union Pacific’s existing PTC technology.
• The service characteristics of Option 2 would be:
  • Train options could range from new passenger cars and locomotives to DMUs, with the possibility of alternative energy vehicles, such as hydrogen fuel cell or battery powered “green” DMUs;
  • Initial capacity would be approximately 5400 passengers per day;
  • Maximum operating speed would be 79 miles per hour, with estimated travel time between Novato-Hamilton Station and Suisun-Fairfield station of approximately 60 to 75 minutes.

The conceptual cost range for Option 2, including contingencies, is $1.1 billion to $1.3 billion. Because the railroad would be completely reconstructed in Option 2, ongoing maintenance costs would be lower than those in Option 1.

Because the corridor traverses sensitive wetlands and flora/fauna habitat, the level of environmental documentation and mitigation is highly dependent on the extent of the impacts from the constructed project. For both Options, the main resource areas of concern that are anticipated in the CEQA and NEPA evaluation include:

- Public Services, Recreation, Transportation/Traffic Utilities, Energy and Service Systems;
- Cultural Resources;
- Growth-Inducing Impacts;
- Biological Resources;
- Hazards and Hazardous Materials;
- Hydrology and Water Quality;
- Visual Resources

Based on the preliminary desktop and field review, sixty-four (64) special status plant and animal species, such as California alkali grass and the California red-legged frog, were determined to have potential to occur in the vicinity of the project area.

Today, the railroad berm and bridges either pass through or cross over extensive areas of wetlands and numerous waterways. As wetlands, waterways, and riparian communities are protected by various environmental regulations and jurisdictions, railroad improvements that could affect these aquatic habitats may be constrained or may require permits or other authorizations before they may be implemented.

Next steps would include preparation of operational evaluations, preliminary engineering, and environmental research which would better define the project, its challenges, costs, and timelines. The next steps should include:

- Developing operating plans and ridership estimates;
- Refining the project scope;
- Refining capital and operational costs;
- Identifying funding options;
Transportation Studies

- Resolving institutional challenges such as operating rights on Union Pacific’s right-of-way between American Canyon and Suisun-Fairfield;
- Developing preliminary engineering and environmental documentation;
- Identifying required right-of-way and, if necessary, acquiring right-of-way;
- Refining station locations in cooperation with communities and local agencies such as the Transportation Authority of Marin, Sonoma County Transportation Authority, Napa County Transportation and Planning Agency, and the Solano Transportation Authority.

2.09 NVTA Travel Behavior and Transit Feasibility Report Fehr & Peers (2019)

State Route 37 is the most traveled east-west corridor in the North Bay. There is currently no east-west transit service along the corridor. The purpose of this study is to understand the demand and propensity to use transit and non-single occupant vehicle options on SR-37 to relieve congestion and address equity concerns. Fehr & Peers collected relevant baseline data for the entire SR-37 corridor from a variety of sources to clarify how the SR-37 corridor is currently being utilized by auto traffic, quantify auto travel demands, and the origin/destination and demographic characteristics of auto travelers along the corridor. The focus of the analysis was on establishing the size of the potential transit markets for five separate segments of SR-37.

Understanding current travel patterns and travel markets with a high degree of confidence is an important first step for any analysis or investigation into making decisions that will improve the transportation network. The corridor has significant travel delays and storm-related flooding frequently inundates the corridor. Westbound traffic congestion on weekday mornings lasts approximately six hours, causing an average delay of thirty minutes. Eastbound traffic congestion on weekday afternoons lasts roughly seven hours resulting in an average delay of eighty minutes. However, the morning eastbound commute is in free flow across the entire 21-mile corridor, making incentivizing mode shift potentially difficult. A similar situation exists westbound in the afternoon. Although it is congested for many hours of the day, the SR-37 corridor has a relatively low volume of travelers in both directions in the morning and afternoon peak periods, necessitating a high market capture rate to make fixed-route transit feasible.

The report describes the methodological approach and presents an analysis of non-single occupant vehicle options evaluated as part of this study, including a qualitative and quantitative assessment of the potential effectiveness of each option and the reasoning behind the determination, followed by a recommendation of non-highway infrastructure improvements for near- and long-term implementation. Potential improvements evaluated include but were not limited to fixed route bus service, microtransit, and pooling options.

Key findings from the travel markets assessment and transit options evaluation conducted as part of this study include:

- The SR-37 corridor primarily serves lower density, dispersed development patterns. A right-sized transit approach would classify the travel market as a many-to-many demand landscape
Understanding current travel patterns and travel markets with a high degree of confidence is an important first step... that will improve the transportation network with just a few trip centers. A majority of travelers are not going to use a high-capacity rapid transit service;

• The corridor serves mostly long distance, work-related trips. The primary travel market is Solano residents accessing job centers in Marin/Sonoma counties;

• A high percentage of corridor trips are made by those earning at or below the median Bay Area income of $100,000. Tolling is proposed and currently being studied for Segment B, which would likely further incentivize transit and pooling options, especially for users who cannot afford the toll or do not wish to pay the toll;

• The travel markets assessment suggests on-demand and enhanced pooling services as opposed to fixed route service, and that some express bus opportunities potentially exist;

• 29% of daily users said they would be willing to use transit, indicating demand for non-highway infrastructure solutions for the corridor;

• The SR-37 corridor is very congested, with roughly 19% carpooling, indicating there is a market for and an opportunity to bolster existing carpooling rather than providing new mobility options;

• HOV lanes are proposed and currently being studied for Segment B, which would likely incentivize transit and pooling options to bypass congestion.

Travel market assessments suggest there are some fixed route opportunities between Vallejo, Fairfield, and Novato, but that other travel patterns are too dispersed and more efficiently and cost-effectively served by other transit options such as on-demand transit or enhanced pooling services. Two potential limited-stop express bus routes were developed to efficiently serve the Fairfield to Novato and Vallejo to Novato travel markets. Express Service operating costs are approximately $3-5 million annually and would need approximately 5,000 riders per month to meet a 20% fare box recovery.

Numerous Park and Ride lots currently exist along roadways utilized by SR-37 users but only one Park and Ride lot (Atherton Avenue/Black Point in the City of Novato) exists on the corridor itself. Given that, there is a need for additional Park and Ride capacity for SR-37 users to facilitate and incentivize additional pooling as well as the proposed express bus service. Existing Park and Ride capacity at the 240-space Rowland Boulevard Park and Ride lot could be utilized to provide park and ride capacity for the western end of the corridor and to connect to Golden Gate Transit service.

The report encourages facilitation of multiple mobility options such as emerging mobility services or technologies to inform, promote, incentivize, track, and reward non-single-occupant auto pa-
trons. There are numerous van pools operating in the North Bay but limited data is available on how many traverse the SR-37 corridor. There is potential for the North Bay CTAs to partner on a vanpool program that serves SR-37 users.

2.10 Bay Trail Plan

Association of Bay Area Governments (1989)

The plan for the Bay Trail proposes development of a regional hiking and bicycling trail around the perimeter of San Francisco and San Pablo Bays. The Plan was prepared by the Association of Bay Area Governments (ABAG) pursuant to Senate Bill 100, which mandated that the Bay Trail provide connections to existing park and recreation facilities, create links to existing and proposed transportation facilities, and be planned in such a way as to avoid adverse effects on environmentally sensitive areas.

Creation of a region-wide hiking and bicycling trail system can be achieved if Bay Trail planning takes full advantage of opportunities for connections to other existing and proposed recreational systems. The spine trail is the main alignment, intended as a continuous recreational corridor encircling the Bay and linking the shoreline of all nine Bay Area counties. Where the spine trail does not follow the shoreline, spur trails provide access from the spine to points of natural, historic, and cultural interest along the waterfront. Connector trails will link the Bay Trail to inland recreation sites, residential neighborhoods and employment centers, or provide restricted access to environmentally sensitive areas.

Numerous policies guide the Bay Trail’s route, design, and ongoing management. Trail design policies underscore the importance of creating a trail which is accessible to the widest possible range of trail users and designed to respect the natural or built environments through which it passes. Environmental protection policies underscore the importance of the San Francisco Bay’s natural environment and define the relationship of the proposed trail to sensitive natural environments such as wetlands. Transportation access policies reflect the need for bicycle and pedestrian access on Bay Area toll bridges, in order to create a continuous trail and to permit cross-bay connections as alternative trail routes. SR-37 is currently being considered for designation as the 8th state-owned bridge. Implementation policies define a structure for successful implementation of the Bay Trail, including mechanisms for continuing trail advocacy, oversight and management.

Levees will be an important component in the Bay Trail system. Where feasible and consistent with other policies of this plan, new trails may be routed along existing levees. Because levees represent existing bay fill, they are one of the few options for trails in natural areas near the shoreline. Plan Policy language is clear in its intent that additional fill should not be necessary to accommodate the Bay Trail alignment.

Additional buffering/transition areas designed to protect wetland habitats should be provided where appropriate to protect wildlife. Local agencies should be sensitive to the natural environment not only in project planning to implement segments of the Bay Trail, but also in maintaining and managing the trail once built.

It is the goal of the Bay Trail Plan that the full range of trail users be able to enjoy the trail, regardless of physical limitations due to age or disability. Separate standards have not been developed for “accessible
trails”— segments of the trail which would be designed for disabled access. Multiple use of trails will not always be possible or appropriate.

Wherever possible, new trails should be physically separated from streets and roadways to ensure the safety of trail users. Plan guidelines identify minimum standards which meet Caltrans standards for bikeways and incorporate standards for accessibility. The Bay Trail should not be defined as a continuous asphalt loop at the Bay’s edge, but as a system of interconnecting trails, the nature of which will vary according to the locale and the nature of the terrain and resources in the vicinity of each particular trail segment.

Support facilities, such as parking lots, restrooms, water fountains, picnic tables and benches are important components of a trail system. Domestic pets should be prohibited on new trails if the managing agency determines that their presence would conflict with habitat values or other recreational users.

2.11 Baylands Ecosystem Habitat Goals
US Environmental Protection Agency (1999)

This report was a comprehensive assessment of historical and current biological conditions of the San Francisco Baylands and provided recommendations for improving the ecological health of the area, including the kinds, amounts, and distribution of wetlands and related habitats needed to sustain diverse and healthy communities of fish and wildlife resources in the San Francisco Bay Area. It defined a biological basis to guide a regional wetlands planning process for public and private interests seeking to preserve, enhance, and restore the ecological integrity of wetland communities.

The Resource Managers Group, composed of representatives of State and Federal resource agencies, oversaw the Project and was ultimately responsible for the content and format of the Goals. The Goals Project began in 1995 and involved more than 100 participants representing local, State, and Federal agencies, academia, and the private sector. Participants were organized in several groups, each of which had a unique role in developing the Goals. The geographic scope of the Goals Project included portions of the San Francisco Estuary that are downstream of the Sacramento-San Joaquin Delta. These include San Pablo Bay.

Working to achieve the defined Goals would improve the Bay’s natural filtering system and enhance water quality, increase primary productivity of the aquatic ecosystem, and reduce the need for flood control and channel dredging. Enhancing diked wetlands would increase the regional and subregional support of migratory birds. Restoring vernal pools and other seasonal wetlands would reverse declines of unique plant and animal communities. Restoring riparian corridors would benefit many species of amphibians, mammals, and birds.

The report contained specific recommendations for the North Marin region. It identified this segment as an opportunity area to restore marsh/upland transitions, expand and reintroduce populations of rare plant and animal species expansion. Though largely focused on habitat, it specifically called out the opportunity for tidal marsh restoration projects to enhance flood protection in the Novato Creek area by expanding tidal prism to maintain and enhance the existing channel. It also identified the opportunity for treated wastewater to be used to develop freshwater managed wetlands for waterfowl, and enhance stream and riparian habitat.
The Baylands System Habitat Goals project recommended restoring a wide, continuous band of tidal marsh along the bayfront between Black Point and Gallinas Creek, and along Gallinas Creek and Novato Creek, ensuring a natural transition to uplands throughout and providing an upland buffer outside the baylands boundary, protecting oak woodlands and mixed evergreen forest along the entire ridge and hillslopes from Black Point to Rush Creek, protecting the ecotone at the base of those slopes, and the oak woodlands at Deer Island and Hanna Ranch.

Restoring tidal marshes on the bayshore and along lower reaches of streams would expand suitable habitat for many tidal marsh species, particularly California clapper rail. Providing wide transitions between these marshes and adjacent uplands would benefit many rare plant species. Restoring and improving tidal marsh along Novato Creek would improve flood protection and expand habitat for sensitive tidal marsh species. Protecting oak woodlands and mixed evergreen forest would ensure habitat for the many species of wildlife that utilize these areas and the adjacent baylands.

The Goals were presented at three levels of specificity: region, by subregion, and by segment. **The Goals recommendations were founded on one important premise:**

- There should be no additional loss of wetlands within the baylands ecosystem. Furthermore, as filled or developed areas within the baylands become available, their potential for restoration to fish and wildlife habitat should be fully considered.

This was written for the public rather than for a scientific or technical audience. Making the habitat changes envisioned in this report was acknowledged to require a better scientific understanding of bayland processes and of the effects of habitat conversion. It also recognized the need for closer coordination among many public and private interests.

The overall goal for the North Bay subregion was to restore large areas of tidal marsh and to enhance seasonal wetlands. Tributary streams and riparian vegetation should be protected and enhanced, and shallow subtidal habitats should be preserved or restored.

Seasonal wetlands should be improved in the areas managed as agricultural baylands. All remaining seasonal wetlands in the uplands adjacent to the baylands should be protected and enhanced.

In 2000, a related report, *Baylands Ecosystem Species and Community Profiles*, was released. It provided scientific information on the environmental needs of the San Francisco Bay estuary’s plants and animals.

### 2.12 San Francisco Bay Area Wetlands Ecosystem Goals

**Baylands Ecosystem Goals**

The San Francisco Bay Area Wetlands Ecosystem Goals Project began in 1995 as a cooperative effort among nine State and Federal agencies and nearly 100 Bay Area scientists. The Project’s purpose was to develop a vision of the kinds, amounts, and distribution of habitats needed to sustain healthy populations of fish and wildlife in and around San Francisco Bay. It also facilitated the development of more balanced and diverse habitat recommendations.

This document served as the biological foundation of the aforementioned Baylands Ecosystem Habitat Goals and was a scientific document intended to lead to the improvement of habitat conditions and water quality throughout the Bay and along its tributaries. This report was not considered a complete treatise but as a reference and a starting point for determining the
kinds, amounts, and distribution of habitats needed to sustain healthy populations of fish and wildlife in and around San Francisco Bay.

The Goals organized available information regarding each species’ historic and modern distribution, use of habitats, migration, relationship and interaction with other species, conservation and management issues, and research needs. When time and data were available, additional information on life history and other relevant topics was included.

**The report included sections focused on the following:**

- Plants of Shallow Subtidal Habitat and Tidal Flats (with an emphasis on eelgrass);
- Tidal Marsh Plants;
- Diked Baylands;
- Estuarine Fish and Associated Invertebrates;
- Invertebrates;
- Amphibians and Reptiles;
- Waterfowl and Shorebirds;
- Other Birds of the Baylands Ecosystem

Census data showed the lowest number of birds and species observed in the summer, with the greatest number observed during fall, winter, and spring.

It recommended that diked wetlands considered for conversion to other marsh types, such as tidal wetlands, should be studied individually for site-specific floristic values, particularly for potential functions as refugia for species displaced from historic seasonal wetlands and tidal marsh ecotones. Diked wetlands should not be assumed to have uniformly low native wetland plant species diversity or “ruderal” status. In areas where restoration of seasonal fresh wetland systems (e.g. vernal pools, alkali basins, alluvial marsh, etc.) was precluded by development, some diked wetlands could be designed for modification and management to maintain regionally scarce plant communities.

Generally, priority should be assigned to restore peripheral estuarine plant communities in their proper original soils and topographic position. Where diked wetlands support regionally rare plant populations, they should be given interim conservation priority until suitable population restoration sites get established in more natural or restored habitats. Existing diked marshes should be managed to minimize impacts of exotic invasive plants on adjacent managed or natural tidal marshes. Dike maintenance should include best management practices which favor recolonization of disturbed dike surfaces by native vegetation and suppress re-invasion by exotic species.

### 2.13 Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California

US Fish and Wildlife Service (2013)

This recovery plan is an expansion and revision of The California Clapper Rail and Salt Marsh Harvest Mouse Recovery Plan (US Fish and Wildlife Service 1984).

The Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California features five endangered species: two endangered animals, *California clapper*
rail and salt marsh harvest mouse, and three endangered plants, Suisun thistle, soft bird’s beak, and California sea-blite. The biology of these species is at the core of the recovery plan, but the goal of this effort was the comprehensive restoration and management of tidal marsh ecosystems.

The Recovery Plan’s ultimate goal is to recover all focal listed species so they can be delisted. The interim goal is to recover all endangered species to the point that they can be downlisted from endangered to threatened status.

**It identified key actions needed:**

- Acquire existing, historic, and restorable tidal marsh habitat to promote the recovery of listed species and the long-term conservation of species of concern and other tidal marsh species;
- Manage, restore, and monitor tidal marsh habitat to promote the recovery of listed species and the long-term conservation of species of concern and other tidal marsh species;
- Improve coordination, participation, and outreach activities to achieve recovery of listed species and long-term conservation of species of concern.

The San Pablo Bay recovery unit encompasses San Pablo Bay populations and is separated from adjacent recovery units by gaps in populations and habitat for most covered species. The unit includes tideland habitats in Marin County. Population dynamics of covered species in this unit are likely decoupled from adjacent units because of low dispersal relative to local recruitment. Limited populations of California clapper rail and salt marsh harvest mouse exist within the San Pablo Bay recovery unit. This recovery unit is less altered by development at higher elevations than the Central/South San Francisco Bay recovery unit and in many places has high sediment concentrations, so accommodation of rising sea level can be more readily achieved here. Accompanying increased salinity may enhance habitat conditions for the covered species.

### 2.14 Adapting to Sea Level Rise Along the Northbay Shoreline NBWA (2013)

In 2013, the North Bay Watershed Association (NBWA) commissioned PRBO Conservation Science environmental consultants to prepare *Adapting to Sea Level Rise Along the North Bay Shoreline*. The purpose of the Report was to demonstrate how the PRBO planning tool could be used by agencies responsible for coastal areas in North San Francisco Bay to develop adaptive management plans. While not a regulatory agency, the NBWA is a membership group of 16 regional and local public agencies located throughout Marin, Sonoma, and Napa counties, and includes the City of Novato (Associate Member), the North Marin Water District (NMWD), and the Novato Sanitary District. NBWA is committed to crafting a set of regional approaches to the problems and issues associated with managing the North Bay watersheds. The mission of NBWA is to facilitate partnerships across political boundaries that promote stewardship of the North Bay watershed resources.

**Key study findings include:**

- 90% of the sites examined in the North Bay are projected to maintain or increase the amount of vegetated marsh they contain under scenarios of high sedimentation, even when faced with high sea-level rise;
- The ability of marshes to buffer incoming waves is highly dependent on the width of their vegetated area and the ability of marshes to keep pace with sea level rise;
There are substantial differences among regions of the San Francisco Bay Estuary in the population responses of tidal marsh birds to sea level rise, so adaptation plans require strategies tailored for specific regions of the estuary.

In the Novato Creek watershed, there are opportunities for tidal marsh restoration which could be resilient to high rates of sea level rise with adaptation actions. Initial elevations of restoration projects within the watershed should be raised to allow the marshes a better chance of keeping pace with sea level rise.

2.15 The Baylands and Climate Change
California State Coastal Conservancy (2015)

The California State Coastal Conservancy follow-up report recognizes that climate-change science has advanced greatly since the 1999 Baylands Ecosystem Habitat Goals were developed, spurring the need for a technical synthesis of climate-change projections and updated recommendations. This science update documents and celebrates the remarkable progress made toward achieving the 1999 report’s goals. It advocates a nonregulatory, voluntary effort to point the Bay Area toward a more resilient future, with strategies that were developed over several years by several hundred experts and practitioners in the region. The findings of this science update indicate clearly that restoring a vibrant and functioning baylands ecosystem will make our future shorelines more resilient to climate change stresses.

Climate change is altering the natural world at an accelerating pace, particularly in low-lying coastal areas like San Francisco Bay. Today management of the Bay’s shores must account for a future of rising sea levels and more extreme weather events while continuing to address the challenges posed by the demands of a growing urban population. The updated report, however, highlights many unmet needs in achieving such an effective alignment. The scope and pace of scientific experimentation and monitoring must increase, relevant policies and regulations must support innovative strategies, and efficient and cost-effective paths to implementation are critical.

As human communities are threatened by climate change, so are the baylands and their wildlife. In the absence of mitigating human action, rising bay waters, reduced sediment supplies, warmer temperatures, lower freshwater inputs, more intense storms, and other changes are likely to cause significant loss of the baylands and their wildlife.

The following five highlights are the most critical overarching ideas from the recommendations:

- Restore estuary–watershed connections that nourish the baylands with sediment and freshwater;
- Design complexity and connectivity into the baylands landscape at various spatial scales;
- Increase coordination among baylands stakeholder organizations to promote the successful implementation of the recommendations in this report;
- Create plans that factor in ecological outcomes after extreme events and other disasters;
- Engage the citizenry in stewardship of the baylands.

The report states that the Marin County portion of Segment A provides a unique opportunity to enhance tidal marsh in areas where natural terrestrial transition zones exist. In addition, transition zones could be secured in areas of low-intensity development because these zones will become the platform for tidal marshes by the late 21st century.
Environmental Studies

The upper edges of transition zones could provide the foundation for limited high-marsh and brackish-marsh zones. Furthermore, riparian and tidal restoration along Novato Creek could enhance tributary streams for fish and amphibians.

Historically, this segment supported large areas of tidal marsh that were bordered by the widest mudflats in San Pablo Bay. The most extensive marshes lay between Novato and Gallinas Creeks and were exposed to significant wave action due to the orientation of the shoreline. Marsh berms formed along the shoreline, and ponds were abundant within the marsh plain as a result of the minimal internal drainage. The marshes north and south of Novato Creek were more sheltered from wave action and formed well-drained plains with complex, sinuous channels. While Novato and Gallinas Creeks were the largest of the streams that flowed into and through the marshes, numerous ephemeral streams draining smaller watersheds flowed into the back of tidal marshes. Large freshwater emergent marshes are found along the western side of Novato Creek north of State Route 37 and at the Pacheco Pond.

Novato Creek has significant opportunities to connect the baylands to its watersheds and manage the fringing marsh bordering northern San Pablo Bay to sustain high marsh as sea levels rise by minimizing artificial drainage obstructions and maximizing wave processes that deposit coarser sediment. Large areas of public lands could be restored to a combination of tidal, seasonal, and riparian wetlands to create a mosaic of habitat types, including a large transition zone and a mix of fluvial–tidal habitats. This restoration would expand the tidal prism and reduce the need for dredging to maintain flood-channel capacity. Restoring tidal marsh would provide opportunities to expand and reintroduce populations of rare plant species, such as northern salt marsh bird’s-beak and salt marsh owl’s-clover. Ridgway’s rail could also expand into wide marshes remote from predator outposts and corridors.

The upper edges of transition zones could provide the foundation for limited high-marsh and brackish-marsh zones. Furthermore, riparian and tidal restoration along Novato Creek could enhance tributary streams for fish and amphibians. Large freshwater marshes along the western side of Novato Creek north of SR-37 and at the Pacheco Pond could also be enhanced as transition zone features.

Riparian corridors, including floodplains, could connect the baylands to the lower watersheds. Wet meadows, vernal pools, and swales in the lowlands could be protected by increasing their connectivity to the baylands. Willing sellers should be sought to conserve valleys and plains with low-intensity agriculture adjacent to tidal areas for future marsh and transition zone migration.

Similarly, treated wastewater and stormwater discharges might be realigned for diffuse discharge along wide, sloping engineered terraces on flood control levees to provide some surrogate transition zone biogeochemical functions (nutrient transformation, sequestration, etc.).

Achieving the North Bay vision would be subject to significant infrastructure constraints. Private landowners and public entities will need to be willing to retrofit infrastructure like SR-37 and SMART rail lines in keeping with ecosystem health and to conserve and restore lowland migration space for the baylands. The report’s recommendation to achieve this objective is
to “elevate Highway 37 and modify or realign rail lines and other infrastructure to allow the full passage of water, sediment and wildlife” (Goals Project 2015a, page 139).

Simmons Slough baylands (Atherton), currently managed as nontidal seasonal wetlands, could be hydrologically modified to restore tidal flows and establish brackish marshes influenced by wastewater discharge if upgrades are made to SR-37. Reengineering levees to create gently sloping transition zones could buffer storm-wave runup and erosion, and lower the flood risk as well as facilitate landward migration of the marsh. Other concerns include the presence of invasive species, extensive subsidence in potential tidal marsh restoration areas (and the subsequent need for significant amounts of sediment to raise elevations), and the need to address flood management issues for adjacent lands. Control of pepperweed, Pacific bentgrass, and stinkwort are of particular concern in the North Bay.

2.16 San Pablo Bay National Wildlife Refuge Climate Adaptation Plan US Fish and Wildlife Service (2016)

The purpose of this climate adaptation project is to use the best available information to identify a suite of actions with the highest likelihood of achieving refuge goals that are feasible and contribute to larger landscape conservation.

Future climate change is expected to cause dramatic changes in the physical and biological environment of the San Pablo Bay National Wildlife Refuge (Refuge). To effectively plan for an uncertain future, managers and decision makers considered a range of future scenarios using tools and decision support frame-works that could incorporate uncertainty. It stated that successful strategies will be those that are robust to uncertainty and are likely to provide benefits across a range of scenarios.

The report stated that transition zone habitat and restoration often occurs on the slopes of flood control levees.


This plan is the third in a series, updating 1992 and 2007 plans. It was prepared by the San Francisco Estuary Partnership. The San Francisco Estuary Partnership was established in 1988 by the State of California and the US Environmental Protection Agency under the Clean Water Act’s National Estuary Program when the San Francisco Estuary was designated as an estuary of national significance.

This update addresses current concerns and future uncertainties ranging from rising sea levels to drought, habitat loss, and failing fish and wildlife and provides restoration partners with the following priorities for 2016-2021:

- Sustain and improve the estuary’s habitats and living resources;
- Bolster resilience of the estuary’s ecosystem, shorelines and communities to climate change;
- Improve the quality and quantity of fresh water available to the estuary;
- Champion the Estuary

More than 70 organizations reached collaborative agreement on four long-term goals and thirty-two
actions to be taken over the next five years to protect, restore, and sustain the San Francisco Estuary.

**2.18 Bel Marin Keys Wetland Restoration Project Preliminary Design Report** State Coastal Conservancy (Ongoing)

The Bel Marin Keys Unit V (BMKV) site is owned in fee by the California State Coastal Conservancy (SCC) and consists of diked historic tidelands that are currently either dominated by annual grassland or utilized to grow organic oat hay. The SCC is leading the effort to restore the 1600 acre property, plus 200 acres of adjacent State Lands Commission land to a mosaic of tidal, seasonal, and transitional habitat on the site by constructing flood control features, placing dredged material to elevate the diked, subsided baylands, and reintroducing tidal waters to bayside portions of the site. A seasonal wetland will provide valuable habitat for migratory waterfowl and shorebirds on the Pacific Flyway, as well as high tide refugia for listed tidal marsh species, including the endangered Ridgeway’s Rail. The project will be resilient to sea level rise, as the overall project includes an extensive tidal marsh restoration made possible by the construction of a setback levee.

In 2002, a flooding and drainage agreement for the BMKV site was made between the SCC, County of Marin, and City of Novato. Main points agreed upon in the document are that the Corps and SCC are undertaking wetland restoration activities that have potential impacts to City and County flood zone easements per existing flooding and drainage agreements. All parties accepted that a performance-based criteria or standard to evaluate impacts of the proposed restoration would be used.

In 2003, The US Army Corps of Engineers (ACOE) analyzed the BMKV site as a possible expansion of the Hamilton Wetlands Restoration Project (HWRP). Combined work on the former Hamilton airfield runway site, Bel Marin Keys property, and an adjacent antenna field will total 2,500 acres — the largest wetlands restoration project on the West Coast.

Numerous alternatives for restoration of the BMKV site were considered before an alternative was selected that provided a mix of tidal and non-tidal wetland habitat, anticipating a combination of dredged material reuse and natural sedimentation to raise grade within the site. A timeframe of 50 years after construction was assumed for design and planning purposes, and the sea level rise associated with this timeframe was set at between 24 and 36 inches. In partnership with the SCC and BCDC, the ACOE prepared a Supplemental Environmental Impact Report, and in 2018, the project received approvals from ACOE, CDFW, RWQCB, and BCDC.

The SCC will begin construction of a multi-phased tidal BMKV Wetland Restoration project in 2019. Phase 1 includes the construction of a new Bayfront Levee landward of the existing one and the creation of a small amount of seasonal brackish wetlands. There will be 1.3 MCY of fill for the Phase 1 levee, coming from onsite sources. Vegetated ecotone slopes will be a minimum of 10H:1V and up to 15H:1V to accommodate the retreat of transitional habitat as the sea level rises, constructed on top of the base protection levee. The Novato Sanitary District’s treated effluent will serve as a freshwater source to the marsh.

Future phases will include dredged material placement for creation of tidal and seasonal wetlands, and breaching of the existing bayfront levee to reintroduce tidal waters to the site. Although the design effort for this project is currently focused only on Phase 1, the...
design for Phase 1 is being developed to ensure that future work in subsequent phases remain feasible.

2.19 San Pablo Baylands: Ensuring a Resilient Shoreline Baylands Group (2017)

The SR-37 - Baylands Group is comprised of North Bay wetland land managers, ecological restoration practitioners, and other stakeholders who have a long-term interest in the conservation and restoration of the tidal wetlands at the edge of the San Pablo Baylands. This white paper was prepared in response to the (SR-37) redesign effort led by the MTC and the transportation authorities of Marin, Sonoma, Napa, and Solano counties. It demonstrates the consensus around the critical importance of protecting, enhancing, and restoring the tidal wetlands, natural resources, ecosystem services, and habitats of the San Pablo Baylands.

The paper advocates that the redesign of SR-37 must be guided by principles that protect the values and services that the natural and agricultural lands provide and increase their resilience in the future. It suggests that the redesign of SR-37 provides an unprecedented opportunity for collaboration between transportation agencies and groups who have spent decades rebuilding the Bay’s system of marshes, creating a mosaic of dynamic, diverse, and connected habitats from the bay to its watersheds.

Beginning in the mid-1800s, 75% of San Pablo Bay’s tidal wetlands were diked, drained, and disconnected from the estuary for urban development, agriculture, salt ponds, and infrastructure such as SR-37 and rail lines. SR-37 and the SMART line pass through the very heart of the San Pablo Bayland’s remaining historical tidal wetlands. The segments of SR-37 and the SMART rail that were constructed in subsided areas are vulnerable to flooding and dependent on the aging system of berms and pumps that will be under increasing pressure as sea level rises.

Improvements to the SR-37 corridor should be integrated with the continued implementation of existing habitat goals and the extensive ecological planning for this region that has already occurred, to ensure ecosystem function and landscape resiliency into the future.

A key recommendation in the paper is to elevate SR-37 and modify or realign rail lines and other infrastructure to allow the unimpeded passage of water, sediment, and wildlife. To ensure that the design is aligned with conservation and restoration goals for the region, MTC has formed an Environmental Working Group, which includes representatives of the SR-37 - Baylands Group, environmental regulatory agencies, and transportation agencies.

Approximately $600 million has been invested in the conservation and restoration of these baylands as private, local, state, and federal agencies work to strengthen and improve habitat for threatened and endangered species.

The paper addresses equity issues as well, suggesting that the SR-37 redesign should seek opportunities to minimize financial impacts to disadvantaged drivers and include opportunities for multi-modal transportation such as passenger rail, ferries, and bike paths, as well as the Bay Trail.
2.20 Novato General Plan Update (1998)

This Plan was initially adopted in 1998 and is intended to be a dynamic document, providing guidance on major policy issues, while remaining flexible enough to allow amendment from time to time. It has been revised more than two dozen times since adoption to address a range of topics, including specific land use matters, the Bay Trail, housing, and transportation.

A number of environmental, transportation, economic, land use, and community service policies are set forth in the Plan.

The Transportation Chapter is based on several underlying themes and findings:

- Transportation is both a local and a regional problem;
- Effective improvements to the transportation system depend on the cooperative effort of other agencies such as the State of California, County of Marin, adjacent cities and counties, the Metropolitan Transportation Commission, and public transit districts;
- Land use and transportation are inextricably connected. They must be coordinated so that future development and transportation will be balanced with each other. The land use and growth management policies in this Plan reflect this relationship;
- Transportation facilities must serve all sectors of the community – seniors, children, the disabled and those who depend on public transportation;
- Future improvements to the transportation system must complement and support the other goals and objectives of the General Plan;
- Providing efficient routes for transit service, emergency and other service vehicles continues to be a high priority for the City;
- Local streets and roads generally remain at acceptable levels of service during the peak hours. The exceptions include Bel Marin Keys Boulevard. It recommends a connector to SR-37;
- Traffic congestion will continue to worsen as more development occurs in Marin and Sonoma Counties. In response, Novato is working to adopt innovative measures to reduce impacts of Highway 101 traffic on City streets, implement growth management programs, and emphasize alternatives to the single-occupant vehicle;
- Review proposed transportation improvements so that measures will be implemented to protect important open space lands, environmental resources, recreational facilities, and neighborhood integrity;
- Help alleviate congestion on major thoroughfares
such as US Hwy 101 and SR-37 by encouraging use of public transit in other locations and ways, including but not limited to park and ride lots, van pooling, bus shelters, convenient schedules and reasonable fares;

- Work with the Marin County Open Space District, the Association of Bay Area Governments, and other regional, state and federal agencies to implement the trail system as described in the Hamilton Bay Trail Public Access Plan, Marin County-wide Plan and ABAG Bay Trail Project.

- Establish a comprehensive and safe system of bicycle routes that connects all parts of the City;

- Traffic is the most significant source of noise in Novato. US Hwy 101 and SR-37 are the loudest sources;

- The City commits to hold public meetings on proposed transportation plans and improvements.

**Environmental Chapters includes the following policies:**

- Preserve, protect and enhance the natural setting throughout the community, including creeks, hillsides, ridgelines, woodlands, wildlife, native plants, wetlands and open space;

- Preserve bayfront lands and diked wetlands for agriculture, resource restoration, conservation and recreation. Preserve, protect, and enhance streams and other bodies of water;

- Require mitigation for loss of riparian vegetation. On-site mitigation is preferred wherever possible;

- Endeavor to preserve and enhance wildlife habitat areas in watercourse areas and control human use of these areas as necessary to protect them;

- Restore damaged portions of riparian areas to their natural state, wherever feasible;

- Prohibit further degradation and require restoration of previously-degraded riparian areas as a condition of development approval when restoration is feasible, taking into account the project’s size and cumulative impacts;

- Manage public access to watercourses in a manner that will not degrade the habitat. Use of vegetated buffer areas, rather than fences, to separate watercourses from paths will be considered. Bridges, increased access points and additional paths will be considered in watercourse corridors;

- Require development plans to avoid wetlands to the maximum extent feasible. If development is permitted within wetlands, require mitigation at 2:1 replacement to provide wetland habitat of the same type as the lost habitat. Require off-site mitigation of wetlands impacts in cases where on-site mitigation is not possible. Off-site mitigation sites should be as close to the project site as possible;

- Regulate development in the Bayland Overlay Zone so that it does not encroach into wetlands or sensitive wildlife habitats, provided that this regulation does not prevent all use of a property;

- Cooperate with State and Federal agencies to ensure that areas subject to tidal action remain in their natural state;

- Encourage the continuation of agricultural uses in Bayland Areas that do not adversely affect wetlands or sensitive wildlife habitats and do not damage fish habitat;

- Support measures to manage, protect and increase the floodwater storage capacity where appropriate;
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- Continue to work with the County of Marin Public Works Department to minimize negative impacts of storm runoff;

- Work with the County Flood Control and Water Conservation District to prepare a plan for responding to a potential rise in sea level. Consider developing flood control projects and modifying the City’s land use regulations for areas subject to increased flooding from sea level rise;

- Because of the conservation and restoration of the North Bay region’s wetland areas, opportunities exist for the City and Novato businesses to benefit from ecotourism to these areas.

2.21 **Novato Bicycle & Pedestrian Plan** (1998)

The SMART path is a major North-South route planned to be a Class 1 bikeway along the SMART rail line. Olive Avenue is listed as a Class 2 bikeway with a planned extension identified that nearly connects with Atherton Avenue. A Class 1 path is also identified as planned along the future Bay Trail alignment.

2.22 **Novato Sanitary Strategic Plan Update** Novato Sanitary District (2016)

Since 1925, the Novato Sanitary District has been chartered. It provides wastewater and solid waste resource management. Its primary treatment facilities were upgraded in 2011. The District discharges secondary-treated effluent into San Pablo Bay via a 54-inch diameter reinforced concrete pipe outfall operating under pressure. Currently the District is only allowed to discharge to San Pablo Bay during the wet season. During summer months, the District routes its secondary treated and disinfected wastewater to two onsite storage ponds (totaling up to 170 million gallons) to be used for irrigation on two adjacent pasturelands.

Within the BMKV project limits, the outfall alignment runs generally parallel to, and north of, the Pacheco Pond levee, and extends approximately 950 feet beyond the existing Bayfront levee.

In 2017, winter storms required the District to bypass 350,000 gallons of secondary-treated effluent to Novato Creek. Secondary-treated effluent overtopped from onsite storage (the District’s dedicated land disposal basin) into an adjacent irrigation pasture before the District pumped the effluent to Novato Creek.

In 2015, Novato Sanitary obtained a new NPDES permit that allows for future discharge into the restored BMKV brackish marsh. This change will allow the District to relocate the discharge point from San Pablo Bay to the restored tidal wetland and abandon a large portion of the existing outfall. It also will eliminate the need for irrigated pastureland in summer months. The initial location of the enclosing levee was modified. The new location is longer, avoids PG&E’s electrical transmission facilities, preserves their access, and allows immediate completion of the new levee.

The District participated in NBWRA Project Phase 2 Feasibility Study. The District is working on long-term options for treatment plant operations with a 20 year planning horizon. It also continues to collaborate with the NBWRA in designing the expansion of its Recycled Water Facility to increase production and produce up to 1.7 million gallons per day of tertiary recycled water. Currently, 400 million gallons of secondary recycled water are dispersed in the summer months through pasture irrigation. The District’s long-term
goal is to actively pursue opportunities to expand recycled water production and use, and maximize its value to the community through avenues such as potable water offsets, environmental restoration, etc.

2.23 **Black Point Community Plan (1998)**
The community plan for Black Point focuses mostly on local issues, but also includes some transportation related policies in the plan. It encourages consideration of connections to existing commuter bus and rail services, and improved bicycle and pedestrian facilities to connect neighborhoods with recreational opportunities, surrounding open space, and each other. It notes however, that development of public facilities should be limited within the Day Island State Wildlife Area.

2.24 **Green Point Community Plan (1998)**
The community plan for Green Point focuses mostly on local issues, though it also includes some transportation related policies in the plan. It encourages connections to be made between Atherton Avenue and Crest Road for improved access and fire safety. It also includes a policy promoting improved bicycle and pedestrian connections to recreation, open space, and other areas within the community, and consideration of pathways for bicyclists and pedestrians on key neighborhood roads, including but not limited to Atherton and Olive Avenues, Crest Road, School Road, and Harbor Drive.

2.25 **Novato Community Base Transportation Plan (2015)**
This Plan documents the efforts and results of Novato’s community-based transportation planning process. It includes information on demographics and travel characteristics of the community, transportation issues, outreach techniques, and solutions to address the transportation gaps identified as well as considerations for implementation, potential funding sources and next steps. Though the plan was largely focused on other travel needs, SR-37 traffic congestion was noted in the survey results.

2.26 **North Bay Water Reuse Program Final EIR/EIS NBWRA (2018)**
North Bay Water Reuse Authority (NBWRA) is exploring the feasibility of coordinating inter-agency efforts to expand the beneficial use of recycled water in the North Bay region thereby promoting the conservation of limited surface water and groundwater resources. The basic purpose of the North Bay Water Reuse Program (NBWRP) Phase 1 was to provide recycled water for agricultural, urban, and environmental uses. Phase 2 seeks to continue expanding the use of recycled water by reusing water that would otherwise be discharged into San Pablo Bay and its tributaries, and is planned to run through 2023. Pipeline and pumping facilities would be installed within or along existing roadways. Treatment and storage facilities would be located at or near existing wastewater treatment plants.

NBWRA was established under a Memorandum of Understanding (MOU) in August 2005 and most recently amended November 2017, and is comprised of 11 wastewater and potable water utilities as Member Agencies – the Las Gallinas Valley Sanitary District (LGVSD), the Novato Sanitary District, the Sonoma Valley County Sanitation District (SVCSD), the Napa Sanitation District, the North Marin Water District (NMWD), the County of Marin (associate membership), the County of Napa, the Marin Municipal Water District (MMWD), the City of American Canyon, the City of Petaluma, and the Sonoma County Water...
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Agency (SCWA). NBWRA Cooperating Agencies include the Central Marin Sanitation Agency (CMSA). SCWA is also acting as the administrative agency.

2.27 Novato Creek EIR Comments (1984)

This collection of feedback on the EIR for dredging Novato Creek defined the current management plans. It called for a V shaped channel to be maintained by dredging every 2-5 years, and the use of Deer Island Detention Basin as a mitigation for loss of riparian habitat due to dredging and concrete channelization in portions of the creek system.

Flooding risk in the Scottsdale pond area and overtopping of the banks of Novato Creek were acknowledged by the document. The creek is thought to be protected from 50 year flooding events, but 100 year flood protection was found not to be cost effective.

2.28 Hydraulic Assessment of Existing Conditions Novato Creek Watershed Project Kamman Hydrology & Engineering (2014)

The County of Marin Department of Public Work’s Watershed Program engaged Kamman Hydrology & Engineering to study feasible alternatives to reduce flood hazards and on-going long-term sediment management efforts/costs on Novato Creek, the largest watershed in the County that drains to San Francisco Bay. It encompasses a 44 square mile drainage which flows eastward from relatively steep, predominantly undeveloped, convex hill slopes, across a suburban valley bottom (the City of Novato) and an expansive leveed intertidal Bayland (Novato Baylands) to San Pablo Bay. This study integrates four different numerical models to characterize hydrology and hydraulics in the Novato Creek watershed, including Novato Creek and major tributaries, storm drain modeling from the Nave Gardens neighborhood to Scottsdale Marsh, tidal exchange modeling of tidal Baylands, and evaluate both existing conditions and the effects of 16” and 36” of sea level rise.

Through the Novato Creek Watershed Hydraulic Study, MCDPW identifies and evaluates alternatives to improve:

- flood protection (currently estimated at a 50-year return interval);
- the dynamic equilibrium of natural sediment transport;
- sediment management efficiency (currently encompassing dredging the lower creek on a 4 year cycle); and
- in-stream habitat for species of interest (particularly steelhead and clapper rail) within the Novato Creek watershed.

The study determines that restoring tidal influence to the Upper Baylands would lead to multiple positive changes, including: increased tidal prism in and downstream of the breach; increased channel geometry (width, depth and area); increased conveyance capacity, and maintaining a navigable Lower Bayland Reach channel. Over the long term, Bayland basins that are reconnected to Novato Creek and San Pablo Bay are expected to evolve towards mature marsh. However, the study notes that SR-37 is at intertidal elevations, and if adjacent parcels were restored to full tidal exchange, the roadway would be subject to monthly inundation during larger spring tide events.
The study also finds that Novato Creek and Warner Creek do not have the capacity to convey the 100-year or 50-year storm event peak flows in several locations. Predicted flooding in lower Novato Watershed is a product of the confluence of upstream inflows and high tides, which reduce the capacity for drainage in both the channel and storm drain systems. Floodwaters travel via streets and storm drains to Scottsdale Pond, then via open conduits to Lynwood basin where water is pumped to Novato Creek within the tidal Baylands. Reduction in flood risks can be accomplished via improved engineering of overbank flows, diversion of upstream inflows, and spilling of flood peaks into the expansive tidal baylands downstream.

Creek flow between the SMART Bridge and SR-37 (the Upper Baylands) strongly influence flood water levels and sediment transport upstream. This un-dredged reach has a smaller flow area and higher bed elevations which slow flows from upstream, increasing sediment deposition during both flood recession and more typical high flow conditions. Maintenance dredging has not been permitted in the Upper Bayland reach because the channel and associated high marsh support clapper rail and salt marsh harvest mouse. Levee overtopping occurs upstream of these bridges during both the Q50 and Q100 storm events. Modification of these structures or breaching of adjacent levees can be expected to alter flow dynamics both locally and regionally. Increasing conveyance capacity in the upper Bayland will likely increase upstream flood conveyance and sediment transport capacity.

Several locations have potential for floodwater detention:

- North of Novato Creek in the Upper Baylands
- Novato Creek & SoDIB) the most viable sites for re-operation to improve flood and sediment management in the area. Marin County Flood Control has historically breached levees to alleviate impacts from floodwaters in Novato. To the north and east of the Deer Island basins (north of SR-37), Novato Sanitary District operates wastewater facilities including two treatment ponds, a solids disposal area and irrigated pasture in the North Basin. This is the primary constraint on reoperation of the basins for flood control and habitat enhancement.

- Northeast of Deer Island, Marin Audubon Society owns and manages several contiguous Bayland parcels collectively referred to as the Simmons Slough Seasonal Wetland Enhancement Project. Simmons Slough flows to a Marin County Flood Control pump/outfall to Novato Creek. The slough isolates the eastern quarter of the parcel, which is a US Department of Fish and Wildlife upland mitigation site for the District.

- To the southwest of Novato Creek, Flood Control operates the 278 acre Lynwood Basin complex on State of California Department of Fish and Wildlife lands. The complex consists of three sub-units. An interior levee constructed by Marin County Flood Control created two smaller wildlife ponds, Duckbill Pond and Heron’s Beak Pond. The agency constructed this setback levee one to two feet higher than the opposite levee adjacent to the right bank of Novato Creek. This higher levee is now the primary flood protection structure on this segment of Novato Creek. The SMART right-of-way which extends south along the southwestern perimeter of the basin is seven feet lower than the levees adjacent to the creek, limiting the maximum water level and storage capacity. When nec-
necessary water is pumped from the central portion of Lynwood basin. In the southern portion of the basin, culverts discharge to the Cheda drainage and pump station when water levels rise within Lynwood Basin. The Lynwood/Cheda basins are the primary storage area for storm water draining from “West Side” drainages in the Novato Creek watershed upstream of SR-37. Though Scottsdale Pond is overwhelmed in the 50-year storm event, Lynwood Basin has significant available capacity to store additional flows.

**The study includes a comprehensive analysis of historic and current hydrologic conditions at key locations surrounding SR-37.**

- SR-37 marks the downstream limit of the Upper Baylands Reach, and bisects the Baylands at elevations near Mean Higher High Water (MHHW). The road is protected from tidal inundation by Novato Creek’s left bank levees. Elevated creek banks at the bridge over Novato Creek create a perpendicular levee and flood corridor for the creek, though low chord elevations on the SR-37 Bridge are lower than typical grades for adjacent upstream levees, and in flood conditions result in overbank flows to SoDIB and adjacent parcels to the east and west.

- The Lower Bayland Reach extends East of SR-37 to the marsh limit in San Pablo Bay. Novato Sanitary District’s primary outfall line cross Novato Creek from east to west just bayward of SR-37. The easement traverses a large privately owned parcel adjacent to the right bank of Novato Creek until it cross the outlet of Pacheco Pond en route south to San Pablo Bay.

- Pacheco Pond, which receives waters from the Arroyo San Jose and Pacheco Creek drainages, discharges along the right bank into Novato Creek approximately 3000 feet downstream of SR-37. Marin County Flood Control operates the 118 acre Pacheco Pond for the dual benefit of flood control and wildlife habitat. Tide gates at the Pacheco Pond outfall only permit outflows to Novato Creek. The gates also limit brackish tidal incursions into this predominantly freshwater pond, and preserve Pacheco Pond storage to accommodate creek flows that cannot drain against Novato Creek high tides. Pacheco pond outflows are limited by water levels in Novato Creek. Larger storm events generate reduced outflows from Pacheco Pond, which fills and overtops to adjacent parcels during 50-yr and 100-yr storm events.

- East of Pacheco Pond and along the right bank of Novato Creek, the Bel Marin Keys Community Service District (BMKCSD) residences occupy a set of peninsular islands within two tidal basins called North and South Lagoons. BMKCSD actively manages these two interior lagoons, which are connected to Novato Creek by two hydraulic locks to regulate water levels, tidal exchange and circulation within the lagoon. The locks also provide recreational boat access to Novato Creek. To maintain navigable depths in the channel, BMKCSD has conducted approximately decadal maintenance dredging in Lower Novato Creek. The BMKCSD manages tidal exchange in the lagoon and conducts routing flushing to maintain water quality and reduce sedimentation. BMKCSD operates the locks to maintain water quality and flush sediments from the lagoon. Lagoon operations have been optimized and are reported to maintain downstream channel conveyance.
land use in the Bayland requires maintenance of existing levels of flood protection and recreational boat passage for BMKCSD.

- Adjacent to left bank and north of lower Novato Creek between SR-37 and San Pablo Bay, the Sanitation District manages Flood Control’s West Basin and East Basin parcels as irrigated pasture. The Novato Creek north levee provides inland flood protection for the West Basin, SR-37/SMART and adjacent Sanitation District irrigated pasture facilities. The East Basin contains a State-owned parcel with a former federal radio station facility, which would require removal and potentially remediation prior to wetland conversion. Simmons Slough separates West Basin from East Basin. Along the northern (interior) perimeter of the East Basin, Stonetree Golf Course and Day Island are protected by 7 foot berms. The adjacent run of SR-37/SMART is lowest at the eastern side. It relies on Novato Creek levees for flood protection.

- Generally, Novato Creek’s right bank levees are lower than the adjacent left bank levees, so flooding is expected first on parcels south of Novato Creek. Typical right bank levee crest elevations range from 8 to 10 feet over the length of the reach. A private levee along the southern bank of Novato Creek protects private lands between SR-37 and Pacheco Pond. Between the levees, the creek and marsh plain are elevated above the adjacent agricultural parcels, which have subsided to within the low intertidal range.

- In the Lower Bayland (downstream of SR-37) current peak floods (Q50/100) are predicted to overtop right and left bank levees in the vicinity of SR-37, and inundate BMKCSD homes along Monte Key. Existing Lower Bayland levees reduce flood wave attenuation, and extend the period of upstream flood recession. Removal of Lower Bayland levees is likely to hasten Novato Creek flood recession. The resulting Increases in tidal prism in the reach (further compounded by wetland restoration in the Upper Baylands, if implemented) would increase channel geometry and conveyance capacity and help maintain a navigable Lower Novato Bayland channel. The addition of tidal prism would also help to sustain tidal wetland conveyance during low flow and lower magnitude storm events.

- Drawing on the 2005 hydrologic study Noble Consultants produced for ACOE, the study illuminates how historic land use decisions have dramatically reduced tidal prism in the study reach. As a result, channel capacity has declined dramatically since the mid 1800s, resulting in overall narrowing and shallowing of Novato Creek. Based on review of historical maps it has been estimated that the 1854 channel width was 900 feet wide at the historic mouth and 300 feet wide at the SR-37 crossing. The most significant reduction in the tidal prism, and channel adjustment, occurred between 1850 and 1920, when the majority of marshlands were leveed, drained, and reclaimed for agricultural land uses. More recent, but less significant, factors contributing to the reduction in channel capacity include changes in upstream basin hydrology and sediment transport (Collins, 1998 ), installation of boat locks at the Bel Marin Keys lagoons, development of Pacheco Pond as a flood detention system, rerouting of drainage channels, levee improvements, and the installation of flap gates on Simmons Slough and Pacheco
Pond. Channel dredging has been conducted in the study reach since at least the mid-1960s to increase channel capacity for flood control and navigation purposes.

In 2013, the environmental firm ESA-PWA completed an analysis of the costs and benefits of using tidal marsh restoration as a sea level rise adaptation strategy in San Francisco Bay, and found that by combining current regional marsh restoration and regional flood risk management planning into a new shoreline management approach, costs could be significantly reduced while providing equivalent levels of protection.

2.29 Pacheco Pond Water Management Plan (2014)

Pacheco Pond was created in 1980 as a mitigation for creation of the adjacent industrial park, replacing a slough that drained Pacheco Creek. It is maintained by Marin County Flood Zone District 1 (MCFCWCD) and the Department of Fish and Wildlife (DFW) as a flood control basin and freshwater wildlife habitat.

Since 1980 the pond has faced management issues such as fish kills, low amounts of dissolved oxygen, high temperatures, mosquito infestation and the presence of West Nile Virus, sewage spills and run-off from historic agricultural activities, odorous anaerobic processes, and invasive plant proliferation. Seasonal opening of the tide gates to introduce salt water has improved many of these issues while allowing for continued use of the pond as a flood control basin in the rainy season.

2.30 Flood Control 2.0 Novato Baylands Vision San Francisco Estuary Institute, et. al (2015)

Project partners in Flood Control 2.0 were San Francisco Estuary Institute (SFEI), San Francisco Bay Joint Venture, Bay Area Flood Protection Agencies Association, Bay Conservation and Development Commission, and the Marin County Flood Control and Water Conservation District. The lower Novato Creek Baylands was chosen as one of three focus areas around San Francisco Bay, for inclusion in the Flood Control 2.0 program. The program was a regional effort funded by the US EPA San Francisco Bay Water Quality Improvement Fund and led by scientists from the San Francisco Estuary Institute in cooperation with the Marin County Flood Control Division. Flood Control 2.0 proposed to re-direct flood protection strategies from more traditional hard engineering solutions to those that work with natural processes. The project aimed to increase flood protection while restoring stream and wetland habitats, improving water quality, and adapting to sea level rise around San Francisco Bay.

Through an interdisciplinary team linking regional science expertise with on-the-ground flood control agencies, the project advanced channel redesign to restore wetland habitat, water quality, and shoreline resilience through demonstration projects, such as the Novato Baylands projects.

Concepts from Flood Control 2.0 work products, including the Novato Creek Baylands Historical Ecology Study and Novato Creek Baylands Vision Plan, have been incorporated into the development of potential projects. Participation in Flood Control 2.0 also provided information about the Novato Watershed Program to a regional audience of scientists and grant funding agencies.

The Novato Creek Baylands Vision makes the case that integrating ecological functions into flood risk management on lower Novato creek can improve flood protection while restoring tidal landscapes which
sustain native ecosystems, and shows that there is an economic advantage to these management practices.

The report documents the history of change in the Bay and the challenge presented by climate change, sea level rise and increasingly intense storm events. The historic management techniques have had a negative impact on flood safety and the ecology of the baylands. Levees disconnect marshlands from tidal action and reduce sediment deposition, causing decomposition of peat soils and subsidence to occur. Reduced mud flats and natural berms diminish flood protection and habitat area.

The analysis presents several multi-beneficial management strategies that diminish impacts from flooding while expanding habitat. Removing levees along lower Novato Creek, and reestablishing tidal inundation within the historical tidal marsh would increase tidal prism and scour lower Novato Creek, thereby increasing floodwater conveyance when the tidal elevation is low. Reusing treated wastewater could create brackish to freshwater transitions and expand marsh habitat. These methods reduce long-term costs of sediment dredging, alleviate coastal flooding and erosion of levees, and elevate subsided baylands through sediment nourishment.

CHALLENGES
- Sediment accumulation within lower Novato creek that reduces in-channel flood capacity
- High maintenance costs and regulatory restrictions for continued sediment dredging
- Increased flood risk from subsidence adjacent to the channel
- Localized flooding of downtown Novato under current conditions
- Increasing marsh and levee erosion (along bay shore) and flood risk from accelerated sea level rise
- Risk of marsh loss or functional change with increasing sea level rise
- Loss of extreme high tide refuge for bayland species
- Limited habitat for native wildlife, including endangered species
- Lack of watershed sediment supply to support baylands under a rising sea level
- Land constraints and availability adjacent to Novato creek (e.g., SR-37, infrastructure, private lands)

OPPORTUNITIES
- Provide expansive area for flood water inundation and potential flood stage reduction
- Increase coastal flood protection through tidal marsh wave reduction
- Improve sediment management by using local sediment supply to increase marsh elevations and create topographic complexity
- Increase tidal prism to maintain flood conveyance and promote sedimentation on the marsh plain
- Enhance freshwater connections to create much needed brackish wetlands
- Re-use treated wastewater for creating brackish to salt marsh transitions
- Restore tidal wetlands with a range of salinity gradients

2.31 Novato Creek Hydraulic Alternatives Analysis (2016)

This analysis builds on existing efforts to improve flood protection efficiencies and reduce the ecological impacts of flood and sediment management. It
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identifies the most significant opportunities for improvement in Novato Baylands where MCDPW owns and manages both flood protection levees and most of the adjacent undeveloped bayland basin.

Several near term projects are identified that would reduce highway flooding issues by increasing upstream floodplain area, widening creek channels to improve flow, and expanding areas under tidal influence to reduce the need for dredging. Widening of the creek at SR-37 within the existing ROW is identified as important, as it constrains the benefit of work in the channel above and below that point. Establishing conduit from S. DIB to West Basin to increase SR-37 peak flood conveyance was identified but not selected as a project due to the challenge of crossing both the highway and rail right-of-way.

In the mid and long term more significant levee work is proposed around Deer Island Basin eventually completely opening the area to tidal interchange.

2.32 Novato Creek Economic Analysis (2016)

In 2015 an economic benefit/costs analysis was conducted for the Novato Creek project area to assist managers in prioritizing and planning flood protection and sea level rise resiliency projects. The economic study compared the benefits and costs of two alternatives, Flood Control 1.0, the more traditional flood control method of maintaining, rehabilitating, and replacing existing levees, pump stations, and tide gates to retain their functionality; keeping the same management approach and maintaining the 50-year flood protection including sea level rise via flood water conveyance; and Flood Control 2.0, the new approach that incorporates tidal wetland restoration in order to increase tidal marsh habitat and environmental benefits, wastewater assimilation, recreation, and aesthetics to provide a 50-year flood protection level and resiliency to sea level rise as detailed in Novato Creek Baylands Vision (Integrative Economics, 2015). The results of these analyses indicated that Flood Control 2.0 performed better in general economic terms. It was noted, though, that costs are closely linked to project design as well as the time period projected for project completion, and that multi-benefit approaches such as Flood Control 2.0 have more variety in their benefit/costs and should be submitted to more thorough economic analysis.

2.33 Novato Creek Flood Protection and Watershed Program (2016)

Following damaging storms in 2006, the County of Marin Department of Public Works initiated the Novato Watershed Program with its partners the County of Marin, Marin County Flood Control District Zone No. 1, North Marin Water District, City of Novato, and Novato Sanitary District. The group has undertaken several studies to identify activities necessary to achieve and maintain the 50-year flood protection levels of Novato Creek. This case study builds on the 2014 Kamman Hydrology & Engineering Study and the Baylands Vision and details the hydrology, man-
agement, and history of Novato Creek and the Novato Flood Protection and Watershed Program. The Novato Watershed Program identifies opportunities to integrate flood protection goals with creek and wetland restorations elements. The study contains an extensive history, hydrological analysis, and summary of other studies pertaining to Novato Creek, as well as documentation of regulatory authority and permitting required for short, medium and long term projects.

This watershed program covers all major developed watersheds in Marin including the Novato Creek and Rush Creek watersheds. The goals of this program are as follows:

- Partner with local municipalities, agencies and non-profits;
- System-wide analysis of flood protection options;
- Identify multi-benefit type projects;
- Protect, enhance and restore habitat and water quality;
- Improve efficiency of flood control maintenance operations;
- Evaluate the beneficial re-use of dredged material;
- Identify sea level rise adaptation strategies;
- Work with the natural watershed processes

In the near term the study recommends levee setbacks and floodplain restoration to improve drainage, sediment management, and reduce flood risk. In the medium term the study focuses on increased storage in Stafford Lake and detention basins by Scottsdale Marsh, in addition to restoring tidal exchange in basins near Deer Island. In the longer term it emphasizes the importance of marsh plain and stream sediment management, reconnecting marshlands to adjacent areas, building wide sloping levees, dispersing wastewater on horizontal levees, rerouting creeks to support seasonal wetland habitat with freshwater and sediment inflow, significant work around Bel Marin Keys to elevate levees, establish tidal channels, and protect freshwater marshland with new levees, and elevating SR-37 and the SMART rail line to allow for tidal flows to reach historic extents.

Project permitting, implementation, mitigation requirements and related studies can be very time consuming, costly and difficult for local agencies to address in a timely manner. Costs of obtaining regulatory permits and the required mitigation has at times limited the amount of work flood channel and infrastructure maintenance the County Public Works Department could complete at one time. This has led to deferred maintenance of Novato Creek levees and weirs which in turn led to unplanned costly emergency breaches and repairs. The Novato Creek 50-year flood level improvements, which started in 1985, took 20 years to complete. This long project time was due mainly to complications and delays in permitting. By considering the regulatory aspects of a project early on in the planning process, the supporting studies can better reflect potential regulations applying to the proposal. As SMART and the MCFWCD move toward a new approach to channel maintenance and flood protection the proposed steps necessary to accomplish their goals will need to adhere to regulations and resource agency policies.

The projects defined in these studies are dependent on obtaining funds for their design, permitting and construction. Funding sources so far have included grants, tax assessments and annual department budgets. The total cost for the future work outlined in the studies was estimated at $25-35 million for short-term projects, with costs for the medium and long-term projects estimated at $60-90 million (KHE, 2016).
### 2.34 North Deer Island Flood Diversion Weir and Detention Basin and Novato Creek Corridor Widening Restoration Projects

**Marin County Flood Control and Water Conservation District (2017)**

The Marin County Flood Control District managed this study. Novato Creek is the largest watershed in eastern Marin County at 44 square miles, with overflows from Novato Creek being a primary flood hazard to the City of Novato. This report documents the results of the hydraulic and geotechnical analyses for a preliminary design of the flood flow diversion weir structure into North Deer Island Basin.

In 2012, the Marin County Watershed Program began the Novato Creek Hydraulic Study, which was completed by Kamman Hydrology and Engineering, Inc. (KHE) in 2016. The study identified a number of flood reduction projects that maintain 50-year flood protection along the Novato Creek corridor while also maximizing habitat values, improving sediment transport, and reducing creek dredging.

Two projects identified in this hydraulic study as short-term priority projects are the North Deer Island Flood Diversion Weir and Detention Basin and the Novato Creek Corridor Widening Restoration projects. The Novato Creek Corridor Widening Restoration project is also identified in the San Francisco Estuary Institute Vision Plan as part of the Flood Control 2.0 program, which works to redirect flood protection strategies from more traditional hard engineering solutions to those that work with natural processes.

The Novato Creek Corridor Widening Restoration projects would remove approximately 4,100 linear feet of existing flood control levees and restore up to 3.8 acres of tidal and seasonal wetland while improving the natural processes that transport sediment in Novato Creek. The North Deer Island Flood Diversion Weir and Detention Basin would meet both the Q50 flood protection goals for Novato Creek as well as address regulatory concerns over impacts, including the stranding of juvenile fish and salmonids in the basin. The proposed North Deer Island Weir and Basin project would not result in any change to regulatory flood hazard mapping.

This report documents the results of the hydraulic and geotechnical analyses for a preliminary design of the North Island Flood Diversion Weir and Detention Basin and an environmental analysis of the removal of a levee at Herons Beak Island. Finally, a preliminary cost analysis of the project is presented and the cost-effectiveness of the project evaluated.

A variety of weir elevations and lengths were considered and evaluated in detail. Establishing a weir below elevation 11 feet NAVD was not found to provide further improvements in upstream flood protection. With a weir elevation of 11 feet NAVD (or lower), the number of finished floor elevations (FFEs) impacted in the Nave Gardens neighborhood during a 50-year storm could be reduced, but it would trigger the need for a fish deterrent structure because 11 feet NAVD is below the 10-year Novato Creek water surface elevation of 13 feet NAVD. Based on the evaluation, preliminary design moved forward with a weir elevation of 11 feet NAVD and a weir length of 1,100 feet. Protective setback levees would be located 50 feet from the adjacent SMART right-of-way and 30 feet each from the City of Novato Corporation Yard, adjacent residential areas, and Novato Sanitary District sewer force main.

This geotechnical analysis added a number of significant additional constraints to the project design. The
North Deer Island Basin is underlain by San Francisco Bay Mud, which is a very compressible deposit. The Bay Mud layer is estimated to vary in thickness between 8 and 29 feet throughout the proposed project site area. Given the presence of the Bay Mud layer, considerable subsidence is expected due to the loads imposed by the proposed new levees; as much as two feet.

To protect the new levees from seepage, no pipes would penetrate it, requiring a pumping facility to drain flood waters in a reasonable time period.

Herons Beak Pond levee removal was chosen as the preferred restoration alternative due to its ability to meet long term restoration goals including high habitat value. This restoration alternative would create approximately 3.8 acres of wetlands within and adjacent to Herons Beak Pond, and would enhance the habitat value of Herons Beak Pond for birds. The preliminary project construction cost was estimated to be $7.9 million. This was more than three times available grant funding of $2.5 million, making the project not cost-effective for the relatively limited upstream flood hazard mitigation and other project objectives. However, preliminary analyses indicated that the more complete removal of Deer Island Levees along Novato Creek may eliminate some of the constraints of the proposed preliminary design, such as the cost of levee and pump station construction and fish deterrence.

2.35 Deer Island Basin Tidal Wetlands Restoration Project SF Bay Restoration Authority (Current) & Deer Island Basin Wetlands Restoration Project (Ongoing)

North Deer Island Basins (NoDIB) and South Deer Island Basins (SoDIB) are the most viable sites for re-operation to improve flood and sediment management in the area. The primary constraints on reoperation of the basins for flood control and habitat enhancement are the Novato Sanitary District facilities.

Marin County Flood Control District began conceptual design for this project in 2012, developing a comprehensive evaluation of multi-objective projects in the Novato watershed under the County of Marin Watershed Program. The Novato Creek Hydraulic Study, which involved multiple partner agencies and stakeholders, was conducted to identify and evaluate a suite of feasible alternatives to reduce Novato Creek flood hazards and on-going sediment management effort and costs. Restoring the Deer Island Tidal Basin was identified during that process.

The project will contribute to restoration of one of the most extensive remaining and important reaches of San Pablo Bay of tidal wetlands that arcs across three North Bay counties. Connecting these bay wetlands is critically important for biological diversity and will restore habitat connectivity for the many critically threatened and endangered species that use these areas. The lower Novato Creek baylands, which include the Deer Island Tidal Basin and Bel Marin Keys, are a keystone piece in this landscape scale wetland restoration both now and under sea level rise conditions since much of the lower watershed is still undeveloped.

Deer Island Tidal Basin sits at the critical physical habitat junction where fresh flows from Novato Creek enter the mixed salinity flow regime in San Pablo Bay. The project site is one of only a handful of locations in the Bay where potential remains to restore tidal marsh within this mixing zone. This project is an important
step towards reconnecting natural watershed sediment transport processes in lower Novato Creek, and providing habitat for a variety of threatened and endangered species. Restoration of the Deer Island Tidal Basin will allow for tidal channel development which is critical for the endangered Ridgeway’s Rail’s foraging and nesting habitats. In the current hydrological regime, the basin is largely flooded for approximately half of each year.

Restoration plans include restoring tidal fluctuation to the basin and creating transitional habitat areas that are necessary for the endangered salt marsh harvest mouse. Tidal and freshwater mixing zones such as those that occur at the project area are critical for rearing of out-migrating juvenile steelhead. The stretch of Novato Creek within the project area is also a migratory corridor for steelhead and has been designated by USFWS NOAA as critical habitat for that species. Restoration of the natural floodplain would also enhance foraging opportunities for waterfowl and introduction of transition zones and the creation of high tide nesting islands would improve nesting habitat for a wide range of bird species.

The project will also serve as a multi-benefit project by combining urban flood protection with shoreline and habitat restoration. The project is intended to provide flood protection to critical local and regional transportation and housing infrastructure including the sections of SR-37 that experienced significant flooding in 2016. It also provides increased protection for the adjacent Novato Sanitary District treatment facilities.

The project fits the combined restoration and sea level rise adaptation vision for the transportation corridor developed by the Highway 37 Baylands Group, a consortium of environmental groups, wetlands scientists, and landowners. On the local scale, the project is expected to reduce water levels in areas of the City of Novato that experience flooding during events below the 100-year flood flows.

The project design will include the construction of approximately 4,500 linear feet of new set-back levees designed to create ecotone transition habitats with room for sea level rise adaptation and habitat migration.

During the project design work, Marin County Flood Control and Water Conservation District will evaluate all opportunities for including public access in the restoration project, including opportunities to connect the restored area to existing public trails on Deer Island Preserve (which is owned and managed by Marin County Parks and Open Space), as well as opportunities for improving informal trails along existing levees and constructing formal overlooks and interpretative areas. The project designs will incorporate all such feasible opportunities.

Design studies will be completed for the restoration of approximately 194 acres of tidal baylands. Of that 194 acres, approximately 120 acres of diked baylands will be restored to tidal marsh in the ecologically significant freshwater-saltwater mixing zone, 36 acres will receive full or muted tidal restoration, and 38 acres of flood ponds will be restored to tidal ponds with specific habitat enhancements for birds, especially waterfowl. Restoration plans will address designs for high-flow refugia for migrating steelhead, and rearing habitat for juvenile steelhead, including creating return channels within breached areas.

The requested funding will support preparation of designs, environmental review, and permit applications.
for the breaching and removal of the existing channel-confining levee around the creek and restoring natural fluvial-tidal action and processes within this restored basin along Novato Creek.

This project meets all the goals and requirements of the Coastal Conservancy’s San Francisco Bay Area Conservancy Program. It also meets the San Francisco Bay Joint Venture’s (SFBJV) implementation strategy criteria and is included on the SFBJV’s priority projects list due to its explicit focus on restoring tidal wetland habitat.

2.36 Simmons Slough Drainage System Improvements Project Marin County Flood Control District (2018)

The County of Marin Flood Control and Water Conservation District is managing this project. The Simmons Slough watershed is located in the City of Novato, Marin County, CA and is bisected by Highway 37 (see Figure 1). The watershed consists of approximately 1,837 acres (2.9 square miles) and is comprised of agricultural lands bounded by small field dikes. The nature of field drainage flow is predominantly shallow flow, which drains to pumping facilities through small channels such as Simmons Slough. The watershed is currently drained by the Remote Pump Facility, operated by the Novato Sanitary District, and a rented portable pump operated by the Flood Control. The District studied the existing hydraulic performance of the Simmons Slough drainage system and analyzed feasible water management improvements. The study recommended the following improvements:

- Culvert improvements at several locations, including (6) 48” RCPs at various locations in the Simmons Slough area surrounding SR-37;
- The clearing of sediment in the SR-37 crossing, and;
- An increase in pump capacity from 38 cfs to approximately 40 cfs (18,000 gpm). The increased pump capacity can be achieved by adding additional pumps to the existing pumps at the Sanitation District’s remote pump facility, modifying the existing pumps at the facility, replacing the existing pumps at the NSD Remote Pump Facility with new pumps with more capacity, or constructing a new higher capacity remote pump facility.

The project began with a field visits conducted by Novato Sanitary District, the County of Marin Public Works Department, Wood Rodgers, and WRA on February 28, 2018 to assess alternative culvert locations, the existing Novato Sanitary District pump station conditions, and the new pump location to replace the existing one. The 40 feet long 48” corrugated HPDE culvert across railroad crossing was found to be relatively new, filled with light sediment, and constructed higher than the connecting channel bottoms. The connecting upstream and downstream channels were heavily vegetated with cattails and filled with shallow standing water. The crossing collects flows from SR-37 crossing and discharge them to the channel running southeast to the District’s pump station. Numerous access road crossings need culvert replacements. The pump station discharge pipes, and supporting piles were found to be in good condition. The cast iron flap gates are found to be corroded and will benefit from installing a cathodic protection system to prolong the useful life. Overall, the pumps appear to be in good condition and have another 10 to 20 years of remaining useful life.

The pump station structure was constructed in 1983 and is 35 years old. With some structural improve-
Marin County Flood Control

ments, it has another 20 years of remaining useful life. The channel connecting the Novato Sanitary District pump station and the malfunctioning Flood Control District Station was found to be mostly dry and heavily vegetated with cattails in the channel and woody bushes along the channel slopes.

The dirt access road separating the channel from Novato Creek was built up overtime with dredged mud mixed with gravel. The road is also serving as a levee system protecting the tides and flood water from Novato Creek. The road can be impassable during wet session because of the soft soil condition.

Per Caltrans’ plans (Contract No. 04-128284 dated 8/4/1992), the SR-37 culvert crossing at Simmons Slough consists of two 10 foot wide by six foot tall culverts. The crossing is adequately sized and was found to be in a good condition.

Immediately north of the SR-37 drainage ditch, there is a flow control junction box, a sluice gate to the front and a corroding 36-inch CMP that connects a drainage ditch to Simmons Slough. The drainage ditch collects substantial flows from the hills north of Atherton Avenue.

There is a 48-inch HDPE pipe at the access road crossing at the upstream end of Simmons Slough. The crossing is the only existing Audubon wetland connection to Simmons Slough drainage system. The crossing was found to be in a good condition. A tide gate or similar level control structure is proposed to maintain the Audubon wetland water level and prevent excessive flooding that endanger the adjacent properties.

Three alternatives for the pump station were reviewed in the past and more recently discussed with the District. This study confirms that the replacement pump-

“the project is expected to reduce water levels in areas of the City of Novato that experience flooding during events below the 100-year flood flows
Sea Level Rise Studies

2.37 Sea Level Rise & Adaptation White Paper City of Novato (2015)

This white paper was prepared as part of the City of Novato 2035 General Plan, and as a ‘first step’ in responding to the City of Novato Climate Change Action Plan, adopted in 2009. The white paper sought to:

• Identify the key agencies that have been involved in studying and planning for this topic;
• Present the most current information and studies on sea level rise, particularly in the Bay Area;
• Identifies potential funding sources to pursue for next steps;
• Summarize the studies underway in Marin and the North Bay;
• Describe techniques and tools that have been developed for adaptation;
• Identify the City of Novato’s shoreline and levees areas to study, as well as potential opportunity areas for studying adaptation;
• Present suggestions for next steps in moving forward with preparing a vulnerability assessment and long-term adaptation strategies for sea level rise.

The paper identifies the US Hwy101 / SR-37 Interchange and other locations where infrastructure will be at risk due to sea level rise and notes the extensive system of unengineered levees and significant vulnerability of the road system over the course of the next century. Ignacio Boulevard, low-lying agricultural lands, and the Hamilton flats are also at risk. It stresses the importance of regional partnerships in addressing these issues, and suggests that further vulnerability assessment incorporating citizen engagement is crucial. Given the expanse of area that would be affected by predicted sea level rise, the number of stakeholders is substantial.

Additionally, it identifies a number of general strategies and next steps to take in understanding and addressing vulnerability to sea level rise. In the area of Novato Creek east of Rowland Plaza, it suggested that conversion of diked areas to tidal marsh should be studied.

One of the biggest challenges to assessing and planning for sea level rise is funding. Funding sources and grant opportunities for studies include, among others: Government Issue (GI) bonds, FEMA, the California Emergency Management Agency (CalEMA), and the California State Coastal Conservancy. Funding sources for construction (e.g., adaptation) include the ACOE Engineers (funding shoreline restoration projects), the SCC and the North Bay Watershed Association. The major take-away regarding the availability of grants is that the City must have a current, adopted Multi-Hazard Mitigation Plan. These plans are required to be updated every five years. The City’s current Multi-Hazard Mitigation Plan was last updated in 2011.

2.38 Sea Level Rise Policy Guidance California Coastal Commission (2016)

The California Coastal Commission’s (CCC) policy guidance document lays out guiding principles for sea level rise planning including: using science to guide decisions, minimizing coastal hazards through planning and development standards, maximizing protection of public access, recreation, sensitive coastal resources, agency coordination and public partici-
Sea Level Rise Studies

pation. It provides an in depth analysis of the science and impacts of sea level rise. It also catalogs considerations related to local coastal program updates and coastal development permits, as well as general and specific adaptation strategies for a range of coastal resources.

2.39 Marin County BayWAVE: Marin Shoreline Vulnerability Assessment
County of Marin Department of Public Works and Community Development Agency (2017)

The County of Marin Department of Public Works and Community Development Agency are the project leads for the Bay Waterfront Adaptation & Vulnerability Evaluation (BayWAVE) program. The program began in September 2015 with funding from County of Marin and additional financial support from the California State Coastal Conservancy. The Vulnerability Assessment is an initial effort to identify the risks and exposure from sea level rise. Future tasks could include development of an adaptation report and may occur at different jurisdictions: local municipalities, service districts, and County of Marin could update general plans, master plans, capital improvement plans, hazard mitigation plans, and other relevant plans and procedures in the near future.

Sea level in the San Francisco Bay Area has risen eight inches in the past century and could rise up to 70” by the end of the century, as reported in, *Sea-Level Rise for the Coasts of California, Oregon and Washington: Past, Present and Future*, authored by the National Research Council (NRC), in 2012.

The Plan identifies that much of the community is fronted by unincorporated areas and County-managed stormwater, agricultural, utility, and marsh lands.

These lands could buffer Novato from the bay for several decades, thus, the majority of assets may not experience saltwater flooding until the end of the century. The Vintage Oaks Shopping Center could anticipate storm surge impacts in the medium-term and tidal impacts in the long-term. Tidal and storm surge flooding could impair travel on US Hwy 101 in the long-term. SMART rail tracks could be vulnerable in the near-term. Train cars could also be damaged by salt water exposure. The Novato Sanitary District wastewater treatment could expect long-term impacts to several critical buildings.

Marsh lands are vulnerable in Hamilton, Deer Island and the surrounding diked baylands, and Bahia.

In the near-term scenario 1,426 acres, or 4 percent of Novato's land area, could be exposed to sea level rise. An additional 100-year storm surge could flood a total of 1,336 acres, or 14 percent of Novato’s land area. This acreage could flood tidally by the medium-term, and more than twice this amount could face storm-surge flooding. **It includes identification of two key transportation facilities that are vulnerable to sea level rise:**

1. State Route 37 between Atherton Avenue and US Hwy 101 This stretch of SR-37 is protected by unengineered levees that have a history of overtopping with combined high tides and Novato Creek flows.

2. US Hwy 101 at the Route 101/37 Interchange, Novato This vulnerable 3,100-foot stretch is protected by levees and pumps operated by others.

It also acknowledges that impacts to transit can have disproportionate impacts to households without vehicles and low income household that depend on transit. The study notes the vulnerability of Novato's
Corporation Yard and wastewater treatment facilities, and specifically mentions that State Route 37 between Atherton Avenue and US Hwy 101 is protected by un-engineered levees that have a history of overtopping with combined high tides and Novato Creek flows.

2.40 Rising Seas in California Ocean Protection Council (2018)

This comprehensive analysis of the science of sea level rise offers 7 key findings:

1. Scientific understanding of sea-level rise is advancing at a rapid pace;
2. The direction of sea level change is clear;
3. The rate of ice loss from the Greenland and Antarctic Ice Sheets is increasing;
4. New scientific evidence has highlighted the potential for extreme sea-level rise;
5. Probabilities of specific sea-level increases can inform decisions;
6. Current policy decisions are shaping our coastal future;
7. Waiting for scientific certainty is neither a safe nor prudent option

The report details the historic course of sea level rise on the planet, proposing that the rate of sea level rise was roughly 45” per century since the last ice age, from roughly 18,000 to 8,000 years ago, but that in the last 8,000 years the rate dropped to a tenth of that until recently. The rate of sea level rise has doubled since 1990 and is accelerating.

The Ocean Protection Council’s report breaks down probable amounts of sea level rise heights for low and high emission scenarios, and offers numbers to use in planning based on risk aversion. For critical infrastructure it is recommended that numbers on the upper end of the spectrum are considered. For the San Francisco Bay Area, those numbers range from 2’ in 2050 to 7’ by 2100, though it is more likely that sea level rise will not exceed 1 foot by mid-century and 3.5 feet by 2100. In the most extreme scenarios the Bay Area could see a nearly 3 foot rise by 2050 and more than 10 feet by the end of the century.


The State’s most recent guidance document on sea level rise builds upon the latest research from the Ocean Protection Council, currently the most referenced data on sea level rise projections. This report thoroughly explains the latest science around sea level rise, provides a framework for evaluating adaptation projects, and offers preferred approaches. It recommends that projects pick appropriate sea level rise projections based on location and risk tolerance, then develop adaptation pathways that increase resiliency to sea level rise and include contingency plans if projections are exceeded.

Key principles in coastal adaptation planning identified in the report reflect:

- Adaptation strategies should prioritize protection of vulnerable communities and take into consideration social equity and environmental justice;
Sea Level Rise Studies

- Coastal habitats and public access should be protected and preserved;
- Adaptation strategies should consider the unique characteristics, constraints and values of water-dependent infrastructure, ports and Public Trust uses;
- Acute increases in sea-level rise caused by storm surges, El Niño events, king tides, or large waves should be considered. These events could produce significantly higher water levels than sea level rise alone and will likely be the drivers of the strongest impacts to coastal communities, ecosystems, and infrastructure;
- Cross-jurisdictional coordination and consistency among permitting entities should be sought in selecting sea-level rise projections. These entities should also prioritize implementation of consistent or complementary adaptation strategies;
- Local conditions, including the diversity of shoreline types, natural conditions, and community characteristics, should be evaluated to inform risk tolerance and adaptation decisions;
- Adaptive capacity should be built into project design and planning;
- Risk assessment and adaptation planning efforts should be conducted at community and regional levels, when possible.

2.42 Paying For Climate Adaptation In California: A Primer for Practitioners
AECOM (2018)

This report catalogs resources for state and local leaders to address the challenge of securing funding and financing required to maintain critical infrastructure in California and develop new projects that address climate change and sea level rise. It defines key terms, catalogs important laws and existing sources of funding, describes challenges, and sets forth equity principles that should underpin all adaptation and resilience investments. It also gives policymakers clear recommendations for overcoming the challenges that discourage cities, counties, water districts, utilities, state agencies, private companies, and other entities from making essential investments. Key recommendations include:

- Integrate resilience requirements and design principles into all infrastructure-related policies, programs, and investment decision;
- Adopt disclosure requirements that will steer investors toward projects and institutions exposed to less climate (and thus financial) risk;
- Increase market incentives (such as insurance discounts) for projects that increase resilience;
- Develop more and better data about climate risk and share data and adaptation lessons learned in accessible formats;
- Invest in cost-benefit analyses to demonstrate what we already know: The cost of doing nothing is more expensive than paying for adaptation;
- Make sure the funding and financing for resilience projects includes all phases, from predevelopment to maintenance and renewal;
- Coordinate adaptation across jurisdictions to achieve efficiency of scale;
- Pursue multi-function projects that qualify for a wide range of funding sources;
- Engage communities early, often, and always to deliver projects that communities need and support;
• Encourage private sector participation in projects but include requirements and metrics to ensure the private sector role advances public goals.

2.43 The Governance of Sea Level Rise in the San Francisco Bay Area University of California, Davis (2019)

Building on a collaborative research project from UC Berkeley and UC Davis in 2017, this document investigates the hurdles to effective governance of regional efforts to address climate change and sea level rise. A wide range of stakeholders were surveyed about their perceptions of the state of sea level rise governance, necessary actions to address the issue, and their collaborative activities on the issue. Improved collaboration between organizations that are active in addressing sea level rise was identified as the most pressing issue to address. Other key findings from the paper include:

• Most San Francisco Bay Area stakeholders address sea level rise as only part of their work, with a smaller core group having sea level rise as their major focus;
• Most San Francisco Bay Area stakeholders work at the local level, with a smaller number working across the entire region;
• Transportation, storm water, and wastewater infrastructure, along with disadvantaged communities, are perceived to be the most vulnerable to sea level rise;
• There is a relatively high level of agreement on perceived risks, but much lower level of agreement on appropriate infrastructure and governance actions;
• The largest barriers to collaboration, as perceived by respondents, are lack of an overall sea level rise adaptation plan, insufficient political leadership, funding gaps, and low levels of public support. Lack of scientific information is NOT perceived as a major barrier;
• While stakeholders desire an overall climate adaptation plan that identifies an appropriate mix of “gray” and “green” infrastructure, there is an aversion to creating any new regional authority; assigning responsibility to an existing agency receives lukewarm support;
• Most collaborative activities are at an early stage of the policy process, and comprise sharing information, joint planning, public outreach, funding applications, and research;
• There are some clear differences among some of the most popular collaborative initiatives in terms of their perceived cooperation, fairness and challenges;
• The most valuable collaboration partners are reputable organizations with financial and information resources.

2.44 Living with a Rising Bay BCDC (2011)

In 2011, BCDC published Living with a Rising Bay, which presented the results of an initial vulnerability assessment of the Bay Area using two sea level rise projections: 16” (40 centimeters) by mid-century and 55” (140 centimeters) by the end of the century. The assessment was focused on three planning areas: shoreline development, the Bay ecosystem, and governance. Conclusions and recommendations focused on several areas that could be strongly affected by sea level rise, including the San Francisco and Oakland Airports, critical natural habitats that need preservation, and the change in jurisdictional boundaries as sea level rise progresses.
### 2.45 Addressing Social Equity White Paper BCDC (2012)

This white paper highlights links between adaptation planning and efforts to address equity issues. It helps to define key terms in the discussion around resilience, and through surveys identified ways that a diverse range of practitioners define resilience in the context of equity, specific equity concerns in analyzing and adapting to sea level rise, barriers to integrating equity into adaptation; and major success stories that can be built upon for future sea level rise planning efforts.

The paper includes an extensive list of factors contributing to vulnerability for individuals and communities and provides a framework for integrating socio-economic analysis of vulnerable communities and historic exposure to hazards into an understanding of community needs, resources and opportunities for cross-jurisdictional cooperation. The paper emphasizes the importance of obtaining sufficient funding to meaningfully engage the community in planning processes.

### 2.46 Levee Ownership Survey Memorandum Metropolitan Transportation Commission (2017)

This memo was produced as part of MTC’s design alternatives assessment for SR-37. The memo notes that most levees in the area were built for purposes other than highway protection. Most levees in the Marin segment of SR-37 are County or State owned, with the exception of one privately owned levee on the west side of Novato Creek just south of SR-37, and two levees on land owned by SMART. It identifies the segment of SR-37 from Novato Creek to Atherton Avenue is relatively low-lying (approximately 4 to 6 feet NAVD88) and protected by the Novato Creek levees which range in elevation from approximately 10 to 13 feet NAVD88.

### 2.47 Grand Bayway Common Ground (2018)

This project was created by Common Ground, a multi-disciplinary team commissioned by regional planning agencies as one of ten efforts in a competition known as the Resilient by Design Challenge. The project considers a new future for SR-37 as an elevated scenic byway, creating an iconic “front door” to a vast ecological open space previously known to few. Accessible to cyclists, runners, kayakers, campers, and fishermen, the Grand Bayway is envisioned as a Central Park with more 21st century sensibilities for rapidly expanding North Bay communities.

Carrying forward explorations from the research phase, the proposal explores ways that the communities around San Pablo Bay could share and steward environmental resources while having more diverse means to connect with each other for work, recreation, food and health, and cultural ties.

The team acknowledged that the area is already impacted by flooding due to incremental sea level rise as well as the certainty of instantaneous dike failure from seismic liquefaction. In addition, approximately 2/3 of all trips on SR-37 are made by those earning at/below the median income, which should be given consideration when developing a financing plan for improvements.
References


References


County of Marin Community Development Agency. May 2013. *Green Point Community Plan*.  

County of Marin, Marin County Flood Control and Water Conservation District. 2014. *Pacheco Pond Water Management Plan*.

County of Marin, Marin County Flood Control and Water Conservation District. 2018. *Simmons Slough Drainage System Improvements Project*.


Fehr and Peers. February 2015. *Novato Community-Based Transportation Plan*.  
https://novato.org/home/showdocument?id=13632


References


References

Road Ecology Center, University of California, Davis. 2013. *State Highway Corridor Planning California Case Study.* 


SchAAF & Wheeler. 2017. *North Deer Island Flood Diversion Weir and Detention Basin and Novato Creek Corridor Widening Restoration Projects.*


Deer Island

SMART RR
Novato Sanitary District
Treatment Plant
Bel Marin Keys
Olive Ave
Rowland Blvd
S Novato Blvd
Atherton Ave
Novato Creek
San Pablo Bay

Extent of Tidal Flooding
with Sea Level Rise -
Novato (north area)

60 inch Sea Level Rise*

Novato Watershed Program, August, 2017

Data Sources:
- Our Coast Our Future (OCOF)
- MarinMap Consortium of Public Agencies
- Marin County Community Development Agency

Disclaimer: Marin County, and data providers herein, make no warranties of the accuracy or completeness of maps and data. Map is representational and subject to future revision.

* corresponds to Scenario 5 in Marin Shoreline Sea Level Rise Vulnerability Assessment, BayWAVE, 2017 [marinslr.org]