State Route 37 Ultimate Sea Level Rise Resilience Design Alternatives Assessment Marin–Sonoma (US 101 – SR 121)
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<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AB</td>
<td>Assembly Bill</td>
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<tr>
<td>BATA</td>
<td>Bay Area Transportation Authority</td>
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<td>Baylands</td>
<td>San Pablo Bay tidal marshlands</td>
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<tr>
<td>Caltrans</td>
<td>California Department of Transportation</td>
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<tr>
<td>CDFW</td>
<td>California Department of Fish and Wildlife</td>
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<td>County Transportation Agencies</td>
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<td>DAA</td>
<td>Design Alternatives Assessment</td>
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<td>DSCM</td>
<td>deep soil cement mixing</td>
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<td>ETWG</td>
<td>Environmental Technical Working Group</td>
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<td>Executive Steering Committee</td>
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<td>FHWA</td>
<td>Federal Highway Administration</td>
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<td>GIS</td>
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<td>Interstate 80</td>
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<td>LOS</td>
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<td>MHHW</td>
<td>mean higher high water</td>
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<tr>
<td>MLLW</td>
<td>mean lower low water</td>
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<td>RCIS</td>
<td>Regional Conservation Investment Strategy</td>
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<td>USDOT</td>
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<tr>
<td>VMT</td>
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1. Introduction

State Route (SR) 37 is a major transportation facility linking the four northern San Francisco Bay Area (Bay Area) counties: Marin, Sonoma, Napa, and Solano. Population distribution and commerce needs in the broader Bay Area make this an indispensable regional corridor. This 21-mile corridor, which extends from U. S. Highway 101 (US 101) to Interstate 80 (I-80) (Exhibit 1-1), provides both a west-east connection between US 101 and I-80 as well as north-south linkages (combining SR 37 with Lakeville Highway and SR 121) for commuters, tourists, and goods movement traveling throughout northern California and the San Francisco Bay Area. In addition, SR 37 is identified as a State Recovery Route. Such routes are deemed critical and thus have priority in recovery and restoration to facilitate continued movement of goods and services after major incidents or disasters.

However, due to sea level rise and the increased frequency of flood events along major portions of SR 37, it is a vulnerable facility. Flooding closes SR 37, which leads to traffic diversion onto alternate roadways, in turn severely affecting traffic circulation that can become gridlock on alternate roadways. Added congestion leads to increased greenhouse gas emissions, transportation inequities, and jeopardizing safety as SR 37 is the primary west-east evacuation route for major population centers in northern Bay Area counties.

The SR 37 corridor connects from US 101 to I-80. A previous Design Alternatives Assessment (DAA) to study the ultimate solutions for sea level rise was prepared for the geography between SR 121 and Mare Island, and now this DAA will build upon the previous DAA for the geography between US 101 and SR 121. These and the portion from Mare Island to I-80 are illustrated in Exhibit 1-1.

Exhibit 1-1: SR 37 Corridor Geographies
The SR 37 corridor and the sensitive ecological setting has been the focus of a multitude of studies that range from implications of sea level rise, traffic operations, transit feasibility, wetland and sensitive habitat restoration, to recreational studies. In 2019, the Transportation Authority of Marin (TAM) and Marin County commissioned a summary of technical data and alternatives considered in the *SR 37 Corridor Adaptation Study: Segment A-1 Adaptation Strategies* (TAM and Marin County 2020). This report summarized the findings and approaches from 47 other studies on subjects concerning transportation studies, trail plans, environmental issues facing the San Pablo Bay tidal marshlands (Baylands) and adaptation efforts, Novato-specific plans, Marin County flood control projects, sea level rise for California and the Bay Area, and social equity and property ownership-related issues. This foundation of issues, among other reports and alternatives analyses, served as the basis for this *State Route 37 Ultimate Sea Level Rise Resilience Design Alternatives Assessment, US 101 – SR 121* (DAA US 101 – SR 121).

This current study, which is funded by California Department of Transportation (Caltrans) Adaptation Planning Grant and Metropolitan Transportation Commission (MTC)/Bay Area Transportation Authority (BATA) funding, focuses on the DAA US 101 – SR 121 transportation needs between I-80 with SR 121. This DAA US 101 – SR 121 study, which is a component of the overall SR 37 corridor, continues to build upon previous data and insights by contributing additional geotechnical and environmental insights to inform feasible alternatives development.

1.1 Process Overview

To advance a full range of possible solutions, MTC engaged and directed a team of planning, environmental, and engineering consultants (study team) to consider the unique transportation needs and environmental characteristics of US 101 – SR 121; develop a feasible and practical range of alternatives; and provide comparative assessment of these alternatives. MTC sought an inclusive and collaborative approach through consulting with Caltrans and the four-county North Bay county transportation authorities (CTAs), including Marin, Sonoma, Napa, and Solano, and a process that engaged a range of vested stakeholders as well as public input.

The range of alternatives for the SR 37 transportation corridor between US 101 and SR 121 were developed with logical connections to previously evaluated alternatives in DAA SR 121 – Mare Island using SR 121 as the key junction between the two reaches (MTC 2019). While both DAA US 101 – SR 121 and DAA SR 121 – Mare Island are unique, they have overlapping issues concerning projected flooding and are highly interdependent. Because the Mare Island to I-80 section of SR 37 does not directly influence the DAA US 101 to SR 121 alternatives, no further discussion is provided about Mare Island to I-80 in this study.

This DAA US 101 – SR 121 study does not attempt to revisit development of the DAA SR 121 – Mare Island range of alternatives (as detailed in *SR 37 Alternatives Assessment Report for the Ultimate Project, SR 37 from SR 121 to the Mare Island Interchange* [MTC 2019]). However, this study does build upon and update the engineering approach and assessment data for the DAA SR 121 - Mare Island to ensure consistency in the assessment between the two studies. This study remains focused on DAA US 101 – SR 121, but Section 6.2, DAA SR 121 – Mare Island Evaluation Results, provides updates to the DAA SR 121 – Mare Island alternatives without offering new conclusions. Together, these studies are intended to be forwarded for consideration into the Planning and Environmental Linkage (PEL) Process, which will be conducting the alternatives assessment for the comprehensive SR 37 transportation corridor between US 101 and I-80.
Caltrans is leading the PEL on behalf of the Federal Highway Administration (FHWA) in cooperation with MTC and the CTAs within the four North Bay counties that SR 37 traverses. Subsequent to Caltrans completing the PEL, funding would need to be identified to conduct the environmental documentation (both federal and state processes), design, and—when the SR 37 ultimate solution(s) is/are approved—a phased corridor construction will also be dependent on funding availability. The comprehensive process is displayed below in Exhibit 1-2; the first three arrows (through the PEL) in this exhibit are anticipated to be complete by fall of 2022. The subsequent phases are funding-dependent, but if funding is secured, project approval and environmental documentation (PA/ED) could be accomplished by late 2025. This study assumes a possible start of construction in 2030, which allows enough time for final design.

**DAA US 101 – SR 121,** which extends approximately 7.3 miles from US 101 in Marin County to the SR 121 junction in Sonoma County, is a four-lane roadway (two general purpose lanes in each direction) with a median and controlled stops at Lakeville Highway and SR 121 and an interchange at US 101 and Black Point/Atherton Avenue. This portion of the corridor traverses several drainages (Novato Creek, Simmons Slough, and Petaluma Creek), several residential communities (Novato, Atherton/Black Point, and Bel Marin Keys), a defunct marina, and some farmlands. Many of the lands along SR 37 are prone to flooding and vulnerable to sea level rise. There are numerous different groups interested in the SR 37 design development because of how this roadway might interact or affect other key objectives for the San Pablo Baylands, such as flood risk reduction, tidal marsh restoration, recreational access, and long-term railroad service options.

Much of US 101 to SR 121 is relatively low-lying subsided former tidal marsh (0- to 3-feet NAVD 88; see the insert box above for NAVD definition) for most of its length as it skirts along San Pablo Bay. In the late 1800s, levees were built by farmers to reclaim the marshes for farming, and, later, for residential areas. After being disconnected from the Bay, the soils dried, and the land subsided up to 7 feet below sea level. An extensive system of levees and pumps, primarily managed by private landowners and wildlife agencies,

**North American Vertical Datum of 1988 (NAVD 88) is...**

...the national standard vertical datum base measurement point from which elevations are determined. The National Geodetic Survey determines this datum by measuring the earth’s shape, referred to as the “geoid.” Coincidentally, in San Francisco Bay, the mean lower low water (MLLW) is close to 0-foot mean lower low water (NAVD) 88 (0.06 foot to be exact). Other San Francisco Bay tidal elevations in NAVD 88 can be found on NOAA’s *Tides and Currents* website at:

https://tidesandcurrents.noaa.gov/datums.html?datum=NAVD88&units=0&epoch=0&id=9414290&name=San+Francisco&state=CA
is now required to drain excess water, and prevent daily flooding of SR 37 and other nearby roads, railroads, farms, and residences.

An existing railroad owned by the Sonoma-Marin Area Rail Transportation Authority (SMART) that is actively being used for freight transport, with future plans for commuter traffic, is built on a low-lying embankment parallel to, and often adjacent to, SR 37. The levees along Novato Creek, Petaluma River, and the railroad embankment were never designed to protect important infrastructure such as SR 37. These levees range in elevation from approximately 10- to 13-feet NAVD 88.

Since the 1980s, many organizations and agencies have actively implemented land acquisition and habitat restoration projects, and significant progress has been made toward meeting restoration goals for the San Pablo Baylands region. Approximately $600 million has been invested in the conservation and restoration of these Baylands, thereby improving habitat for threatened and endangered species. Restoration of thousands of acres of tidal wetlands not only supports a return of the native ecology but provides estuarine floodplains that can accommodate San Pablo Bay and creek floodwaters and reduce flood risk for developed areas along the margin of the bay. SR 37 and the rail corridor that parallels SR 37 to the south are barriers for future restoration efforts.
2. SR 37 DAA US 101 – SR 121 Project
Needs and Purpose Statement

Every project has a reason for being initiated and a record of needs that drive the purpose for expending public funds. It is common that during a project development study, additional project need topics and critical issues can arise, which requires that need statements evolve and become more defined; the project’s purpose is born from these needs. The purpose statement provides the parameters that project alternatives must meet. Goals and objectives are also valuable to establish performance of the alternatives against community and environmental values. The DAA US 101 – SR 121 need statements and purpose statement are outlined below. Chapter 4, Assessment Process, expands on the use of objectives in this study.

2.1 Needs Statements

The needs for the SR 37 corridor have been documented through numerous studies over the past 20 years. The study team collected SR 37 corridor-specific studies and other studies pertinent to US 101 to SR 121 and extrapolated the dominant concerns and supporting facts. Each of the following need themes and statements listed below are supported with data and records found in these past studies. Appendix A, Project Purpose, Needs, and Supporting Data Sources, records the referenced data and original source materials for the DAA US 101 – SR 121 needs.

- Increasing frequency in flooding events closes SR 37 roadway more often and with increasing durations:
  - There is a higher probability of increased flood frequency, and eventually, permanent inundation along SR 37 due to sea level rise, more frequent extreme rainfall events, and storm surges.
  - SR 37 roadway bed and levees have a high degree of settlement due to San Pablo Bay mud (bay mud) layer which then makes the road more susceptible to flooding and more likely to overtop levees.

- Indirect effects of floods on SR 37 cause further congestion and impede climate change adaptation:
  - Flooding of SR 37 leads to traffic diversion onto alternate roadways, in turn affecting circulation, commutes, and operations on alternate roadways.
  - Currently, SR 37 impedes tidal marsh restoration efforts and disrupts hydrologic and habitat connectivity between the Baylands and the bay, which affects flood management, adaptation to sea level rise, and the success of present and planned habitats that support a range of fish and wildlife species, including federal and state protected (listed and species of concern) species.

- SR 37 is a critical regional transportation corridor:
SR 37 is a critical economic link for goods and services (commercial truck traffic and commute traffic), and it is the most direct connection between areas with affordable housing in Solano County to jobs in Marin and Sonoma counties.

SR 37 is a vital evacuation route because it is the most direct east-west corridor in north of San Pablo Bay. SR 37 is identified as a State Recovery Route by Caltrans. Such routes have priority in recovery and restoration to continue the movement of goods and services after major incidents or disasters.

SR 37 is a vital regional corridor for movements of goods and people passing southwest to northeast and well as the southeast to northwest directions.

- Multimodal options are not currently available on SR 37:
  
  - There are no high-occupancy vehicle (HOV) lanes or viable transit options that can encourage higher occupancy travel and transit options to minimize vehicle and greenhouse gas emissions.
  
  - Designated pedestrian and bicycle options are non-existent on or parallel to SR 37; although bicycling is legal, the conditions are inhospitable.
  
  - SR 37 does not currently respond to the state and regional rail plans to preserve and plan for rail opportunities; the existing rail line is in threat of being flooded and further deterioration from more frequent extreme weather events, high tide events, and potential failures of third-party levees or pumps.
  
  - Transportation plans must be consistent with Assembly Bill (AB) 32, the California Global Warming Solutions Act of 2006, to reduce greenhouse gas emissions, and transportation analysis must be completed consistent with California Senate Bill (SB) 743, which requires agencies to analyze transportation impacts using vehicle miles traveled (VMT) instead of level of service (LOS).

These needs have not only attracted the attention of transportation agencies but the environmental community as well. The SR 37Baylands Group is composed of North Bay wetland land managers, ecological restoration practitioners, and other stakeholders interested in the conservation and restoration of the San Pablo Baylands. Established in 2017 and led by the California State Coastal Conservancy, the group reached consensus that the redesign of SR 37 represents both a major opportunity and potential threat to North Bay ecosystems, particularly considering future sea level rise. The SR 37 Baylands Group’s purpose is to ensure that the redesign of SR 37 is compatible with and advances the ecological restoration and conservation goals for the San Pablo Baylands and improves the climate resilience of both the built infrastructure and natural ecosystems. This is encapsulated in its vision statement:

Integrate infrastructure improvements for SR 37 with existing and future habitat planning, conservation and restoration to ensure healthy ecosystem function and resilience to landscape scale change of the San Pablo Bay (SFEI 2015a).

The current practice of raising the roadway on additional fill has resulted in uneven settlement of the road and further pressures on flooding and adjacent ecosystems/habitat areas. The interconnection of the roadway with the surrounding landscape is driving a unique partnership between environmental stakeholders and transportation planners, where the roadway solutions can be a part of the solution to adaptation as well as maintaining regional transportation needs. Additionally, interests extend beyond maintaining the transportation corridor and restoring the historic San Pablo Baylands; designing SR 37 to
allow bay waters to expand into the North Bay can reduce flooding in developed areas around the bay by up 0.5 foot (Hummel and Stacey 2021, Nederhoff et al. 2021).

2.2 Purpose Statement
Based on the range of needs identified, the purpose of the DAA US 101 – SR 121 is to provide a transportation corridor that:

- Preserves a critical regional transportation corridor that is resilient to extreme events, while integrating ecological resiliency which facilitates adaptation to sea level rise
- Provides reliable travel time and increases in average vehicle occupancy
- Provides safe mobility for bicyclists and pedestrians
- Maintains and enhances public access, including to recreational areas
- Provides equitable transit and multimodal transportation solutions that improve access for and provide meaningful benefits to all users of SR 37, with special consideration of underserved communities

This purpose statement is the culmination of input from many stakeholder groups, jurisdictions with authority, resource agencies, and a series of refinements over time. DAA US 101 – SR 121 collaborated with the Caltrans SR 37 PEL team and the four CTAs to refine one purpose statement for both efforts. The process and key participants involved in the SR 37 DAA US 101 – SR 121 are outlined in Chapter 3, Collaborative Engagement Process.
3. Collaborative Engagement Process

Successful projects are a result of a collaborative process that integrate environmental, community, and economic goals through defensible quantitative and professional analysis conducted through a transparent process, whereby stakeholders see their input matters and can ultimately support the alternatives that result from this process. The DAA US 101 – SR 121 was structured to achieve the following objectives:

- Develop a draft purpose and need statement from which to base the development and screening of alternatives.
- Engage key stakeholders and regulatory agencies in the development and analysis process.
- Engage federal agency oversight as represented by Caltrans acting on behalf of FHWA.
- Develop a full range of alternatives.
- Evaluate and screen alternatives using evaluation criteria that represent the environmental, community, and economic objectives.
- Engage public input at key milestones.
- Make the documentation accessible for public review and comment.

These objectives outline many engagement activities involving many entities. Representatives for each entity were identified and invited to participate in the DAA US 101 – SR 121 and evaluation process. The remainder of this section defines the stakeholder groups, their roles, and the flow of information and input received to meet the above objectives.

3.1 Committees and Key Stakeholders

This study had the advantage of many already-formed committees made up of key public agencies with jurisdiction over SR 37 (shown in Exhibit 3) to vet, report, and provide opportunities for public engagement. These committees are described below, and Exhibit 3-1 depicts the flow and order of information gathering and sharing among these committees.

Policy Committee (POLICY) is made up of three elected representatives from Marin, Sonoma, Napa, and Solano counties; the Director of Caltrans District 4; and the Executive Director of MTC to review SR 37-related progress within a public forum. The public is invited to listen and make comments at these meetings.

Executive Steering Committee (ESC) is made up of executive staff from Marin, Sonoma, Napa, and Solano counties; Caltrans, District 4; and MTC to review SR 37 work efforts and approve agenda items for the Policy Committee meetings.

Project Leadership Team (PLT) are transportation-focused staff members who lead SR 37 work efforts, make recommendations, and suggest discussion items to the ESC.

The DAA US 101 – SR 121 seeks to collect input from a broad range of stakeholders who are vested in the SR 37 outcome beyond merely the
transportation elements. The study team worked in collaboration with the PLT to identify and invite the input from the following three stakeholder groups, as defined below and shown in Exhibit 3-2.

**Environmental Technical Working Group (ETWG)** are a group of environmental technical experts (subject matter experts in geomorphology, wetland restoration, biology, wildlife refuge resources and other specialties) with knowledge of the North Bay area who provide input into the development and evaluation of a range of alternatives.

**Stakeholder Workshop Group (SWG)** includes members of the ETWG, agencies with jurisdiction over SR 37, and other stakeholders, such as SMART, non-profit organizations (such as Sierra Club, Greenbelt Alliance, Bay Trail, and bicycle coalitions) and sanitary and flood control districts who review, vet, and contribute to alternatives development and evaluation.

**Resource Agency Partners (RAP)** is made up of representatives from the state, and federal agencies that have a role in the environmental review process for infrastructure projects in the Bay Area. This RAP was formed by Caltrans, who invited the DAA US 101 – SR 121 study team to present information at key milestones to receive feedback on the draft purpose and need statement and evaluation process, with the intent of advancing the alternatives consistent with regulatory requirements.

Many of the ETWG, RAP, SWG meetings and public outreach were held in collaboration with the PEL team. The full list of members for the ETWG, SWG, and RAP are in Appendix B, ETWG, SWG, and RAP Members.

In addition, a critical element of transportation planning processes is engaging the public early and often to align on critical issues, uncover undocumented information, and refine alternatives in response to public concerns. The public was engaged via multiple avenues, including broad announcements to attend public meetings, provide input via surveys or comments via email, review website-posted materials, and provide feedback at POLICY meetings at key milestones. See Section 3.2, Public Engagement Summary, to learn more about how the public was engaged.

The study team organized a series of stakeholder workshops where the alternatives analysis process could be developed in collaboration with ETWG, SWG, and RAP groups, each adding their perspective and knowledge. The purpose of the DAA US 101 – SR 121 Stakeholder Workshops were as follows:

- Provide a forum for receiving input from stakeholders that can inform the design alternative assessment process, particularly input on environmental considerations.
- Provide DAA study information to stakeholders to increase understanding.
- Solicit and receive input from stakeholders to inform the development, screening, and evaluation of alternatives, including input on stakeholder values.
• Facilitate collaboration regarding on-the-ground conditions and potential environmental opportunities and constraints.
• Establish a platform for future project review and development.

Exhibit 3-3 illustrates how the DAA US 101 – SR 121 incorporated input and feedback through the public agencies, committees, stakeholder groups, and the public throughout the development of the DAA US 101 – SR 121 and how this information will be brought forward into subsequent SR 37 Corridor-wide Project development stages.

Exhibit 3-3: Roles and Process for Incorporating Input into the DAA and the SR 37 Ultimate Sea level Rise Project

Exhibit 3-4 lists the four key milestones in the DAA US 101 – SR 121 and how each of the stakeholder groups were consulted. The process is not limited to solving only the transportation needs. While all alternatives must meet the DAA US 101 – SR 121 project purpose, not all alternatives that meet the project purpose are ultimately carried into federal and state environmental evaluation process. The objective is to develop a breadth of alternatives, then compare how they perform based on evaluation criteria measuring both positive and negative effects of the alternatives on the surrounding built and natural environment. To be transparent about this second level of evaluation, the DAA US 101 – SR 121 includes objectives developed with the input of the stakeholder groups. These objectives go beyond the project purpose and are important in helping narrow the range of alternatives under consideration. From these objectives, evaluation criteria were developed to measure how alternatives perform relative to the objectives.

Alternatives were advanced by successfully meeting the project purpose and performing well against the evaluation criteria that are developed to reflect issues that the stakeholders care about. Ultimately, the study is a consensus building process. The results born from this dynamic process incorporate the checks
and balances necessary to reach broad consensus through a defensible process. The workshops were structured to walk through these process steps as set forth in Exhibit 3-4.

Exhibit 3-4: DAA US 101 – SR 121 Stakeholder Group Workshop Milestones

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<tr>
<th>DAA US 110 -SR 121 Steps And Associated Stakeholder Group Involvement</th>
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<tr>
<td><strong>Draft Purpose and Need, Project Objectives, Criteria, Collect Baseline Landscape Scenarios</strong></td>
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<tr>
<td>Environmental Technical Working Group Meeting #1</td>
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<tr>
<td>Stakeholder Workshop Meeting #1</td>
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<tr>
<td>Regulatory Agency Partnership Check-in #1</td>
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<tr>
<td><strong>Review Criteria Evaluation Methodologies, Develop a Range of Transportation Elements and Alignments</strong></td>
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<td>Environmental Technical Working Group Meeting #2</td>
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<td><strong>Review and Refine Project Alternatives (or Packages)</strong></td>
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<td><strong>Assessment and Evaluation Results</strong></td>
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<tr>
<td>Public Outreach &amp; Input</td>
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3.2 Public Engagement Summary

Over the course of the DAA US 101 – SR 121, parallel SR 37-related planning efforts have been underway. These include interim project designs to address near-term flooding and congestion, Comprehensive Management Congestion Plan development, and the corridor-wide PEL study. All these studies are being developed through the PLT and shared with the ESC and the Policy Committee (see Exhibit 3-3). To reduce confusion and align messages, these planning efforts jointly sought public input during spring of 2021. Public input has been collected and distributed through the following means:

- Virtual public meetings
- Public Notifications
- Project information via
  - Websites: Resilient37.org
  - Social Media: SR 37 on Facebook and Twitter
- Questionnaire via SurveyMonkey Platform
- Interactive Map
- Soliciting written input via: StateRoute37@dot.ca.gov
- Public Information Line for verbal comments: (510) 286-1204
As needed or requested, the public has been provided translated materials and, at public meetings, translators have been made available upon request. Public input was collected through two public meetings (spring of 2021: a ‘Highway 37 Town Hall’ hosted by State Senators McGuire and Dobbs on April 15, 2021, and a PEL-focused public meeting held on May 26, 2021). The public was asked to fill out the SR 37 questionnaire that was advertised on various websites, social media postings, and the Sears Point Raceway electronic messaging sign (see Exhibit 3-5) as well as distributed via email to those who expressed interest or was part of one of the SR 37 partner-agency email distribution lists.

Presenters at both public meetings described the collective planning efforts and included requests to seek input on long-range plan objectives and prioritization. During both meetings, attendees were able to email comments, questions, and inquiries in advance as well as throughout the meetings. The Highway 37 Townhall continues to be available via YouTube at https://youtu.be/wZ1IPmamOWA.

Key subjects raised by the public involved congestion relief, need to decrease VMT and greenhouse gas emissions, sensitivity for the natural wetland environment, threats of future flood waters overtopping SR 37, desire for rail transit within the corridor, understanding of the housing-job imbalance between Solano and Marin counties and the need for equitable solutions, and funding constraints. A frequent recurring theme throughout the discussion included accelerating project solutions. Appendix C, Public Engagement Summary, provides additional details of the public engagement and input received for the DAA US 101 – SR 121.
4. Assessment Process

4.1 Alternatives Assessment Process

When the range of alternatives were developed, the process for assessing the full range of alternatives to determine which alternatives to be carried forward followed primarily the three steps shown in Exhibit 4-1.

Exhibit 4-1: Alternatives Assessment Process Steps

**Step 1:** Test if the alternative meets the Purpose and Need or results in strong environmental consequences without providing equivalent advantages.

**Step 2:** Measure how the alternatives perform against key Project objectives relative to each other (Collect available resource data, measure relative impacts and compare).

**Step 3:** Build Consensus through engaging professionals, stakeholders and the public in assessing the comparative results.

**Step 1:** This step is an early screening based primarily on a series of yes and no questions on whether the alternative would meet the purpose statement (see Section 2.2, Synthesized Need Issues into Purpose Statement) and/or whether there is a major conflict while not providing additional transportation advantages over other alternatives under review. The DAA US 101 – SR 121 purpose statement includes several elements that are purposefully engineered into each alternative. For example, all alternatives meet the purpose statement of “Provides equitable transit and multimodal transportation solutions that improves access for, and provides meaningful benefits to all users of SR 37, with special consideration of underserved communities” and “Provides safe mobility for bicyclists and pedestrians” because the cross section includes a high-occupancy vehicle lane in either direction, and similarly, the cross section includes a Class I bicycle and pedestrian path that ensures all alternatives will meet the statement. Step 1 is recorded in Section 5.2.3, Range of Alternative Routes.

**Step 2:** In this step, the alternatives were assessed based on a range of criteria measuring their relative effects on environmental, built, transportation, social, economic, and fiscal issues. These measures addressed operation and construction of the alternatives and evaluated both adverse and beneficial effects.
Criteria are the tools for assessing and comparing the relative effects/performance of each alternative. The criteria measures were developed with input from ETWG, SWG, and RAP and shared with the public as well. These are described below in Section 4.2, Criteria and Methodologies.

Step 3: When the criteria measures were assembled and normalized into an easily comparable format, the study team sought input from the ETWG, SWG, and RAP to discuss the implications of the assessment results. This input is recorded herein and provided to the PEL for consideration into the broader corridor assessment process.

The results from Steps 2 and 3 are presented in Chapter 6, Summary of Assessment by Alternative.

4.2 Criteria and Methodologies

This DAA US 101 – SR 121 study builds from insights gained during the previous study (MTC 2019) conducted and completed in 2019 for the DAA SR 121 - Mare Island. Many of the stakeholders who participated in this previous study continued to be involved in the DAA US 101 – SR 121. During the EWTG meeting in November 2020 and the SWG in December 2020, a range of objectives and criteria for evaluating and comparing the range of alternatives were reviewed and input was provided. The DAA objectives and criteria are divided into five categories and listed in Exhibit 4-2:

- Transportation
- Natural Resources
- Built Environment
- Social Equity
- Fiscal Feasibility

The study team subject specialists developed the criteria methodologies and measures based on publicly available data. This preliminary planning phase did not include field verifications. The methodologies provide information about the analyst’s credentials, definition of the criteria measurement, and the following:

- Data sources
- Methods for measurements
- Range of potential outcomes
- Elements of professional data interpretation
- How results could be normalized into a common scale with other criteria results

Exhibit 4-2: DAA US 101 – SR 121 Project Objectives and Supporting Criteria

<table>
<thead>
<tr>
<th>Category and Objectives</th>
<th>Measurable Criteria to Support the Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRANSPORTATION</td>
<td></td>
</tr>
<tr>
<td><strong>Objective 1:</strong> Provide a resilient and reliable transportation corridor that accommodates all planned modes for safe movement of goods and people through 2100.</td>
<td>• Traffic Operations</td>
</tr>
<tr>
<td><strong>Objective 2:</strong> Maintain and enhance accessibility (parks, public and private land ownership, and inclusive of ped and bicycle access).</td>
<td>• Vehicle Miles Traveled</td>
</tr>
<tr>
<td></td>
<td>• Change of Access</td>
</tr>
<tr>
<td></td>
<td>• Multimodal opportunities</td>
</tr>
</tbody>
</table>
### Category and Objectives

<table>
<thead>
<tr>
<th>Category and Objectives</th>
<th>Measurable Criteria to Support the Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NATURAL RESOURCES</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Objective 1</strong>: Minimize impacts to existing natural resources and preserve potential for future conservation and ecological restoration.</td>
<td>• Non-tidal Marshlands  &lt;br&gt; • Tidal Wetlands  &lt;br&gt; • Waters of the US/Critical Habitat &lt;br&gt; • Special-status Species with Potential to Occur  &lt;br&gt; • Ecological Connectivity  &lt;br&gt; • Accommodate Future Tidal Habitats  &lt;br&gt; • Future Tidal and Transition Zone Habitat  &lt;br&gt; • Future Bird Habitat  &lt;br&gt; • Future Ecological Connectivity</td>
</tr>
<tr>
<td><strong>Objective 2</strong>: Prioritize ecological connectivity in roadway design.</td>
<td></td>
</tr>
<tr>
<td><strong>Objective 3</strong>: Facilitate ecosystem adaptation to sea level rise.</td>
<td></td>
</tr>
<tr>
<td><strong>BUILT ENVIRONMENT</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Objective 1</strong>: Maintain consistency with existing and future plans.</td>
<td>• Noise/Vibration  &lt;br&gt; • Visual  &lt;br&gt; • Hazardous Materials  &lt;br&gt; • Conversion of Land Use  &lt;br&gt; • Community Compatibility  &lt;br&gt; • Cultural Resources (archaeological and historic)  &lt;br&gt; • Air Quality  &lt;br&gt; • Park, Recreational, and Refugee Resources</td>
</tr>
<tr>
<td><strong>Objective 2</strong>: Avoid the roadway affecting changes to existing land use designations.</td>
<td></td>
</tr>
<tr>
<td><strong>SOCIAL EQUITY</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Objective 1</strong>: Provide an equitable transportation solution for all populations regardless of age, ability, race, ethnicity, or income to secure access to jobs, services, and recreation for populations with fewer transportation choices.</td>
<td>• Multimodal opportunities &lt;br&gt; • Vehicle Miles Traveled &lt;br&gt; • Change of Access &lt;br&gt; • Noise/Vibration &lt;br&gt; • Visual  &lt;br&gt; • Community Compatibility  &lt;br&gt; • Air Quality</td>
</tr>
<tr>
<td><strong>Objective 2</strong>: Avoid the roadway affecting changes to existing land use designations.</td>
<td></td>
</tr>
</tbody>
</table>

*All Social Equity Criteria overlap with other categories. However, it is important to collect and comprehend the relative performance of the alternatives relative to social equity in meeting both transportation needs and minimizing disproportionate impacts on disadvantaged communities.*

<table>
<thead>
<tr>
<th><strong>FISCAL FEASIBILITY</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective 1</strong>: The alternatives need to be fiscally feasible with consideration for lifecycle costs (minimizes capital, construction, and annual maintenance costs).</td>
<td>• Capital costs  &lt;br&gt; • Lifecycle Cost</td>
</tr>
</tbody>
</table>

Appendix D, DAA US 101 – SR 121 Objectives and Evaluation Criteria, includes the compilation of objectives and criteria complete with a standard methodology for each of the 23 criteria.

To compare the performance for the vast amount of data collected and measured for each alternative, the results were normalized to facilitate viewing many criteria at once. This required each analyst to interpret the measurements and construct a standard scale to convert the measurements into a performance rating. Some criteria offered the possibility of both beneficial and adverse effects, while most criteria measurements only resulted in an increasing level of adverse effect.

The data were converted into normalized performance ratings (a scale of 1 through 5) and to further simplify, the numbers were converted into a color scale described and illustrated in Exhibit 4-3. On the color scale, the greens are more positive, and the reds represent less desirable performance. This scale is also described using the following five terms: most desirable performance, good performance, moderate
performance, poor performance, and worst performance. For most criteria, the performance rating of an alternative is relative to an established scale for each criterion rather than a relative comparison. In other words, in one criterion, all the alternatives have the same chance at receiving a green, yellow, or red rating.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOST DESIRABLE</td>
<td>Scores most desirable / highest when compared to other alternatives; net benefit or minimal negative effect</td>
</tr>
<tr>
<td>GOOD</td>
<td>In-between highest desirable and moderate effects</td>
</tr>
<tr>
<td>MODERATE</td>
<td>Moderate effects when compared to other alternatives</td>
</tr>
<tr>
<td>POOR</td>
<td>In-between moderate and substantial adverse effects</td>
</tr>
<tr>
<td>LEAST DESIRABLE</td>
<td>Scores least desirable when compared to other alternatives; notable or substantial adverse effects</td>
</tr>
</tbody>
</table>

Exhibit 4-3: The DAA US 101 – SR 121 Normalized Performance Rating Scale Used to Simplify the Evaluation Data

The color-coded ratings are intended to provide an easy and transparent tool for identifying where alternatives perform similarly and where there are trade-offs. Not all criteria are valued equally by stakeholders, so the ratings are not averaged or weighted. A red score for one criterion does not cancel out a green score for another criterion.

To summarize, the resource analysts completed the following steps for each evaluation criterion:

1. Determine what readily available data and unit of measurement could provide a planning-level assessment of effects from the construction and operation of each alternative.
2. Using professional judgement, determine how the results could be assessed given the sensitivity of the resource, the likelihood of effects, potential for avoidance, and the potential for beneficial effects.
3. Assign a normalized scale that could be reviewed in parallel with results from other criteria measures.
4. Associate the normalized scale with the color codes shown in Exhibit 4-3.

The results provide a planning-level comparison among alternatives that are defensibly based in measured data and best professional judgement. This planning level assessment considers only major differences among the alternatives and are intended to inform the discussion for narrowing the range of alternatives being carried forward for a more in-depth evaluation.
5. Alternatives Development

The criteria were developed prior to the development of alternatives and were therefore unbiased. After criteria development, the study team initiated the development of alternatives. The initial set of alternatives were guided by the following engineering principles for the DAA US 101 – SR 121:

- Review all existing/previously developed alignments.
- Meet current applicable state design criteria to achieve expressway standards of service.
- Minimize distance over the projected floodplain to the extent possible.
- Avoid built environments and existing public assets and infrastructure.
- Take advantage of existing right-of-way where possible to minimize acreage needed and reduce effects on natural ecosystems.
- Attempt to minimize effects on existing restoration and sensitive habitat areas.

This section outlines the study area parameters and engineering considerations for the development of the alternatives for the DAA US 101 – SR 121.

5.1 Study Parameters

Study Area: The east and west limits of the DAA US 101 – SR 121 study area extends from US 101 to the Sears Point intersection of SR 121. The study team reviewed the regional traffic model and public input\(^1\) on alternative routes used when SR 37 has been inundated to define the north-south limits of the study area. During previous SR 37 road closures, travelers diverted to routes in the north beginning in Petaluma using the combination of Lakeville Highway/SR 116 to SR 121 and SR 12 and to the southernmost route using I-580/I-80 (including the San Rafael-Richmond Bridge). Exhibit 5-1 demonstrates the extent of the SR 37 study area. The map also illustrates the extent of potential flooding as sea level rises, thereby demonstrating which routes serve as retreat routes.

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\(^1\) Public input was collected in spring of 2021 via public survey and a review of previous public survey data collected during the development of DAA SR 121 – Mare Island.
Exhibit 5-1: SR 37 Extent of Traffic Diversion and DAA US 101 – SR 121 Study Area

Planning Horizon: Typically, transportation planning relies on the definition of a foreseeable future planning horizon, which can range from 20 years to 40 years, depending on the project type and context. However, the concern over sea level rise and the understanding that a 21-mile corridor long-term solution constitutes a mega-project of significant fiscal investment, a planning horizon of 100 years guides the DAA US 101 – SR 121 development of alternatives. This planning horizon establishes the engineering design-life for the project as well. The planning horizon year 2130 was agreed upon, with the understanding that construction would not be possible to begin for a minimum of 8 years to 10 years from the time of this study (2021/2022); therefore, the 100-year period would extend from 2030 through 2130.
5.2 Definition of an Alternative

The definition of an alternative is purposefully organized from general planning level decisions to an incrementally more detailed design development. A transportation alternative consists of the following:

- **Mode** (roadway for motorized vehicles, transit corridor for bus, rail or ferry and/or bicycles, and pedestrian facilities)
- **Cross-section** (number of lanes, shoulders, paths, barriers)
- **Alignments** (route placed horizontally on the ground)
- **Profile** (vertical elements, e.g., causeway or bridge, embankment or retained-fill and at-grade)
- **Connection points with adjoining roadways or access points** (e.g., interchange, intersection)

The discussion below walks through the above elements of the DAA US 101 – SR 121 alternatives.

5.2.1 Mode

The DAA US 101 – SR 121 relies upon findings of previous studies, and for modal decisions, the SR 37 Travel Behavior & Transit Feasibility Study (Fehr & Peers 2019) provides a recent assessment of a variety of modes in the SR 37 corridor. This study concluded that low-density land use and low potential passenger ridership in the SR 37 corridor would not support substantial rail service investment for the foreseeable future (20- to 40-year period). SMART is currently allowing use of the SR 37 parallel rail line for freight service and is considering a passenger rail line. And, the California State legislation actively promotes methods for reducing VMT and greenhouse gases, which requires that projects do not add single-occupancy vehicle capacity but rather find opportunities to promote transit and HOV lanes.

However, among the public and the DAA US 101 – SR 121 stakeholder groups, there is strong support for inclusion of commuter rail in the SR 37 corridor. While the fundability is premature (Fehr & Peers 2019), the study team did make sure that each alternative accommodates the potential for and does not preclude rail development for future planning purposes. Additionally, the purpose and need statements (see Chapter 2) underscore the need to incorporate transit as well as facilitating bicycle and pedestrian

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2 Executive Order S-3-05 – Requires continued reduction of transportation-related greenhouse gas emissions to a new standard of 80 percent below 1990 levels by 2050. Assembly Bill 32 – California’s landmark Global Warming Solution Act of 2006 requires reducing the state’s greenhouse gas emissions to 1990 levels by 2020, and continued reductions beyond 2020. Senate Bill 743 requires agencies to analyze the transportation impacts of new projects using VMT as the metric instead of LOS. VMT is already used to determine potential greenhouse gas emissions impacts, and the use of VMT for transportation projects would measure how much actual vehicle miles driven a proposed project would create on roadways and the changes in other air pollutant emissions, water quality, and traffic congestion as well as improvements in safety and health.

3 Although not discussed within the stakeholder groups, ferry service was eliminated from discussion early on by the study team for the following reasoning: One lane of expressway can carry an average of 3,400 vehicles per hour at average of 55 miles per hour (mph), whereas the largest pedestrian on board ferryboat in Washington state can carry 200 vehicles for the same distance at half the speed. Therefore, it would take a ferryboat 18 trips to accommodate the same travel as one expressway lane of traffic does in one hour. Pedestrian ferry boats can carry more persons, but this corridor does not support dense land use destinations whereby pedestrians or active transit can facilitate the final origin and destination objectives without additional transportation support services. The route between Mare Island to Novato is approximately 14 miles straight across. A comparable ferry route is the 17-mile ferry service between Victoria, British Columbia, Canada and Port Angeles, Washington, where the travel time takes an hour, not including loading and unloading, which is not competitive against a 20- to 25-minute drive across SR 37. Finally, ferry boats are beginning to use alternative fuels, but they are not advancing clean energy as efficiently as personal and other transit vehicles. Ferry service was not considered further since this mode would not meet the DAA US 101 – SR 121 need to “Preserving a critical regional transportation corridor...”
accessibility. Therefore, the DAA US 101 – SR 121 design parameters for all alternatives include (see Exhibit 5-2 below) the following:

- One general purpose lane for motorized vehicles within each direction
- One HOV lane in each direction for transit and higher occupancy travel options
- Class 1 bicycle and pedestrian pathway as a separated pathway from the motorized vehicles
- Commuter-rail compatible gradient design to preserve opportunity for rail transport when it can be supported

### 5.2.2 Proposed Cross Section

Based on the mode decisions and a review of traffic projections modeled as part of the Final Plan Bay Area 2050 (MTC 2021), the study team proposed a planning-level cross section of approximately 100 feet wide to include one general purpose lane and one HOV lane in each direction and a Class I bicycle/pedestrian path (Class I is defined as facilities with exclusive right of way), as shown below in Exhibit 5-2. This cross section is merely a planning-level concept applied consistently among the alternatives under consideration in DAA US 101 – SR 121 and DAA SR 121 – Mare Island and does not represent a final decision.

*Exhibit 5-2: Proposed DAA US 101 – SR 121 Cross Section Consistent among Alternatives

*Dimensions could vary*

### 5.2.3 Range of Alternative Routes

In February 2021, the study team, with input from the ETWG, explored the potential for alternative routes within the confines of US 101 and SR 121 with connections to previously developed alternatives for the DAA SR 121 – Mare Island between SR 121 and Mare Island (MTC 2019). Although numerous routes were discussed, the discussion and Exhibit 5-3 below are organized around the following five themes, numbered as 1 through 5 on the exhibit. In the following discussion, each theme can represent more than one roadway alignment.
1. Retreat routes
2A and 2B. Minimized floodplain routes
3. Immediately Offshore routes
4. On-alignment routes
5. Overbay routes

Exhibit 5-3: Varying Route Themes Explored for SR 37 between US 101 and SR 121
1. **Retreat Routes that remain out of the floodplain** (orange swath). Retreat routes (routes that remain out of the floodplain) were identified along the SR 116 and SR 121/21 corridors and could include, with some minor improvements, Lakeview Highway. Together, these roadways provide alternatives that are not in jeopardy of being flooded from sea level rise within the planning horizon. These retreat routes travel approximately 4 to 5 miles north and parallel to SR 37 beginning from Petaluma at US 101 and eastward to SR 121. Based on input collected for this study, cautions were raised that if northern routes were considered, routes should take advantage of existing roadways and avoid impacting undisturbed natural areas, such as Tolay Regional Park and Cougar Mountain.

2. **Minimized Floodplain Routes through shorter distances of the floodplain** (yellow swaths). Themes 2A and 2B mid-way between existing SR 37 and Petaluma would avoid the Novato Creek floodplain and cross a shorter distance of the Petaluma River floodplain. While these routes cross a narrower portion of the projected floodplain than current SR 37, it is impossible to avoid impacting existing undisturbed and restored marshlands of significant ecological value. Considerations include the need to avoid conflicts with the Gnoss Airport flight approach and descent zone, crossing the north-south SMART railroad, and potential effects to existing and/or restored protected marshland areas. Routes to the north of Gnoss Airport might impact Petaluma Marsh, the largest remaining mature salt marsh in San Francisco Bay. Routes to the south of Gnoss Airport might impact some of the few remaining oak savannas, the Bahia marsh restoration areas, and the Rush Creek Open Space Preserve.

3. **Immediately Offshore Routes that follow offshore of the marshland linking to US 101 south of Novato** (green swath). This theme of routes would be over mudflats and cross over tidal marshlands to connect with the land side roadways. Since the concept would have to be a causeway facility over the San Pablo Bay, hydrologic connectivity would be unencumbered. Due to lack of connection opportunities between US 101 to this route until south Novato, travelers are likely to disperse on other routes, thus cause longer VMT, increase vehicle emissions, and result in longer travel times for routine commuters (Appendix E, Transportation Technical Memorandum). In addition, this route would bifurcate the San Pablo Bay National Refuge with the connection to SR 121 as well as the San Pablo Bay Wildlife Area just east of Marin County shoreline. This route could not be adjusted to avoid these resources and still meet the theme of this route.

4. **On-alignment Routes that use SR 37 and/or the nearby existing rail corridor** (blue swath). These routes benefit from availability of existing right-of-way and support the current travel pattern. This theme of routes has the highest potential to minimize or avoid effects on adjacent sensitive habitat areas and land use. This theme offers a convenient opportunity for co-locating rail and road. The design could include remedies for existing hydrologic constraints and may allow advancements in tidal restoration efforts. However, if the rail corridor were to move forward, the stretch within Sonoma County (east of Petaluma River) would result in exacerbating an existing division of the San Pablo Bay National Wildlife Refuge that lies on either side of the railroad.

5. **Overbay Routes across the San Pablo Bay between US 101 to Mare Island** (red swath). This theme of routes would be over the water as well as crossing over tidal marshlands to connect with the land side roadways. Since the concept would have to be a causeway facility over the San Pablo Bay, hydrologic connectivity would be unencumbered. Based on an MTC traffic study, approximately 30 percent of traffic movements at the intersections of SR 37 and Lakeville Highway or SR 121 involve coming or going from those north-south routes, which indicates the importance
of maintaining the north-south connection (MTC 2021a). Therefore, these routes would require a connecting leg across the marshlands of Tolay Creek to reach SR 121, making this route the longest of the proposed routes in DAA US 101 – SR 121 for travel to Sears Point and northward. Like Theme #3, this theme would bifurcate the San Pablo Bay National Refuge with the connection to SR 121 as well as the San Pablo Bay Wildlife Area just east of Marin County shoreline. However, this effect could be confined to the edges of these sensitive areas with proper alignment adjustments.

The following describes why some themes of routes were removed from further consideration:

The Theme #1 Retreat Routes (orange swath) conflict with the purpose statement of “preserves the critical regional transportation corridor” by inducing higher VMT. The Retreat Routes were identified to follow or slightly modify SR 116 and SR 121/21 roadways and possibly Lakeview Highway. These routes do not fulfill the dominant traffic patterns that SR 37 currently serves, which means that many travelers might be inclined to use other routes and add congestion to those routes, which would cause higher VMT, increased vehicle emissions, and longer travel times for travelers. A high-level review of the top 10 origin and destination pairs using SR 37 demonstrates that if current and projected 2040 traffic were to use the retreat routes compared to the existing SR 37, VMT could increase approximately 18 percent (see Appendix E). This conflicts with the California Transportation Plan 2050 objective for reducing greenhouse gas (Caltrans 2021). Routes that followed the orange swath, labeled as Theme #1 in Exhibit 5-3, were removed from further review.

The Theme #3 Immediately Offshore Routes (green swath) and Theme #4 On-alignment Routes (blue swath), specifically those along the railroad corridor, would result in substantial and unavoidable effects that would bifurcate regional and federal wildlife refuges. Within the range of alternatives considered, those routes that would result in substantial bifurcation of existing wildlife refuges and not offer enhanced transportation benefits beyond existing routes under consideration were removed from further consideration. Specifically, Theme #3 Immediately Offshore routes (green swath) would result in direct effects on both the San Pablo Bay National Wildlife Refuge and San Pablo Bay Wildlife Area along the Marin County San Pablo Bay shoreline without resulting in improved transportation access found in other less impactful routes. In addition, a potential alignment following the railroad east of the Petaluma River within the Theme #4 swath would expand an existing division in the San Pablo National Wildlife Refuge. Because the SR 37 alignment is nearby and has substantial available right-of-way and the rail corridor does not provide additional transportation advantages, the rail corridor was removed from further consideration. This issue was also discussed for Theme #5 (red swath) for the portion that extends north-south to connect with SR 121. Upon further review, this portion of the route could be re-aligned to avoid bifurcating the refuge and only touch the eastern edge of the San Pablo National Wildlife Refuge; therefore, the Overbay Route (Theme #5) was adjusted to avoid impacts and carried forward into this alternatives assessment.
The study team reviewed the routes that remained and worked with the ETWG to develop and refine alignments to best optimize and minimize effects on known sensitive areas and land uses. Exhibit 5-4 illustrates the four routes carried forward:

1. On-SR 37 Alignment route
2. Overbay route
3. Bahia/Atherton route
4. The Burdell/Hog Island route

5.2.4 Profile and Engineering Considerations and Profile Types
The study team applied state and federal design standard specifications consistently throughout all four alternatives. In addition, the study team developed preliminary engineering design details to address resilience to sea level rise through 2130. The following lists the primary engineering criteria applied:

- Expressway design standards for upwards of 65 miles per hour (mph) that require horizontal curves of 3,000-foot radius
- Design standards to meet an approximate 100-year lifecycle (2030 to 2130)
- Resilience to extreme events, including specifications to counter effects of earthquake, king tides and strong sea wave action through 2130 considering the 100-year flood events with projected sea level rise
- Meet hydrologic connectivity demands of more extreme weather and rising bay waters
- Roadway grade slopes vary between 0.3 to 4 percent, except for short distances up to 6 percent for hilly terrain
- To accommodate railway opportunities, the roadway gradient would not exceed 0 to 3 percent grades with only slight divergence of a maximum of 4 percent grade

To design for resilience to extreme events, the study team collaborated with Caltrans to align on sea level rise projections for the year 2110, based on greenhouse gas emission expectations and within a conservative flood risk tolerance. Additionally, the team investigated geotechnical approaches to counter
bay mud conditions, and modeled channel openings for bridge designs to achieve hydrologic conveyance needed through the next 100 years. The profile of the roadway must be passable above the 100-year floodplain, together with sea level rise and the resulting waves and debris that can confront a roadway during extreme events. The sea level rise projections influence the height that the roadway would need to be raised when crossing the floodplain; it affects the projections for hydrology conveyance needs; and it directs the range of profiles for crossing these waters. These elements are described below.

**Projecting Sea Level Rise through 2130**

The current SR 37 roadway elevation in the low-lying areas is approximately 0–3 feet NAVD 88 (see inset box on page 1-3). To understand how high the roadway would have to be raised to accommodate sea level rise through 2130, the DAA US 101 – SR 121 relied on the California Ocean Protection Council Guidance (California Ocean Protection Council 2018). Exhibit 5-5 provides the most current sea level rise projections. The Sea-level Rise Risk Analysis and Decision Framework (California Ocean Protection Council 2018) follows the steps listed below:

1. Evaluate sea level rise projections for the Project area: San Pablo Bay north shoreline.
2. Determine lifespan of project: 100 years.
3. Determine flood risk tolerance: Study team followed a risk probability range of 5 percent to 0.5 percent probability.
4. Determine emission scenario: Study team used both low and high emission scenarios due to the long lifespan of the project.
5. Develop adaptation pathways and contingency plans if the design sea level rise amount were to be exceeded after construction.

As shown in Exhibit 5-5, according to the State of California Sea Level Rise Guidance (California Ocean Protection Council 2018), the sea level rise expected between 2000 and 2130 ranges from 4.4 feet to 10.0 feet, depending on the greenhouse gas emission scenario and the risk tolerance. This rise is added to the Federal Emergency Management Agency 100-year flood plain elevation. This range was adopted for use in the DAA US 101 – SR 121 and is used in the subsequent development of the roadway profiles.
Exhibit 5-5: California Ocean Protection Resource Sea Level Rise Projection based on Flood Risk Probability

Source: California Ocean Protection Council 2018

Exhibits 5-6.a and 5-6.b demonstrate how the sea level projection determine how high to raise the roadway over low-lying areas (shown for an embankment in 5.6a and a causeway profile in 5.6b) in order to meet the 100-year design life of the Project.
Hydrologic Conveyance

Three creek channels cross perpendicular to the proposed DAA US 101 – SR 121 alignments – Novato Creek, Simmons Slough, and the Petaluma River. These waterways provide important flood conveyance for watershed runoff to reach San Pablo Bay and provide important connectivity for tidal waters, sediments, nutrients, and biota between the bay and areas landward. Given the importance of this hydrologic connectivity, the study team projected hydrologic design standards to be used on all alternatives as a baseline expectation where alternatives would cross the channels.

Bridges for each of the creek crossings are designed to be high enough to accommodate future sea level rise and long enough to span the projected future width of each creek plus bands of fringing marsh along the channel. This sizing is expected to be sufficient to carry flood flows from watershed runoff as well. Channels are dynamic systems, and channel width can change over time. Historically, the three main channels were much larger than they are today. As late as the mid-1800s, large expanses of tidal Baylands drained through the creeks, carving out deep and wide channels. As the tidal Baylands were diked, drained, and converted to other land uses, tidal flows decreased, and the creeks filled with sediments, resulting in the landscape we see today.
In the future, the creeks have the potential to deepen and widen again from the restoration of tidal action to diked Baylands. With sea level rise, low-lying historical Baylands will be increasingly difficult to keep dry. Groundwater levels will rise, making existing land uses more difficult and costly. Some levees might breach and remain unrepaired. Other levees might be breached intentionally for tidal wetland restoration. With sea level rise and additional tidally flooded areas, creek channels have the potential to be much wider than they are today and wider than they were historically (Williams et al. 2002). Current, historical, and potential future channel widths are shown in Exhibits 5-7 and 5-8.

### Exhibit 5-7: Current, Historical, and Potential Future Petaluma River Channel Width at SR 37

<table>
<thead>
<tr>
<th>Petaluma River</th>
<th>Novato Creek</th>
<th>Simmons Slough</th>
<th>Sources:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current</strong></td>
<td>790</td>
<td>50</td>
<td>150</td>
</tr>
<tr>
<td><strong>Future – 2130</strong></td>
<td>2,220</td>
<td>650</td>
<td>560</td>
</tr>
</tbody>
</table>

### Exhibit 5-8: Current, Historical, and Potential Future Channel Width for Creeks in the Study Area

<table>
<thead>
<tr>
<th>Channel Top Width (feet)</th>
<th>Petaluma River</th>
<th>Novato Creek</th>
<th>Simmons Slough</th>
<th>Sources:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current</strong></td>
<td>790</td>
<td>50</td>
<td>150</td>
<td><strong>Current Data:</strong> Google Earth for Petaluma River and Simmons Slough. Novato Creek width from HEC-RAS Deer River modeling</td>
</tr>
<tr>
<td><strong>Future – 2130</strong></td>
<td>2,220</td>
<td>650</td>
<td>560</td>
<td><strong>Future Projection:</strong> Channel dimensions are estimated for the “Future full tidal scenario” from potential tidal prism; Figure 6 in Williams et al. 2002. ESA. 2021.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Max Depth Below MHHW (feet)</th>
<th>Petaluma River</th>
<th>Novato Creek</th>
<th>Simmons Slough</th>
<th>Sources:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Historic</strong></td>
<td>44</td>
<td>NA</td>
<td>NA</td>
<td><strong>Historic Data:</strong> H-sheet for Petaluma River</td>
</tr>
<tr>
<td><strong>Current</strong></td>
<td>26</td>
<td>7</td>
<td>NA</td>
<td><strong>Current Data:</strong> Petaluma River from USACE dredge survey report (USACE 2000); original depth with respect to MLLW (-20 foot) converted to depth below MHHW. Novato Creek depth from HEC-RAS Deer River modeling.</td>
</tr>
<tr>
<td><strong>Future – 2130</strong></td>
<td>33</td>
<td>20</td>
<td>19</td>
<td><strong>Future Projection:</strong> Williams et al. 2002., ESA. 2021.</td>
</tr>
</tbody>
</table>

**Proposed Width of Bridge Spans With 500-foot Buffer on Either Side (feet)**

| Bridge width | 3,220 | 1,650 | 1,560 |

MHHW = mean higher high water; MLLW = mean lower low water; NA = not available; USACE = U.S. Army Corps of Engineers
Design bridge lengths were calculated using empirical “hydraulic geometry” relationships developed for San Francisco Bay (Williams et al. 2002). Hydraulic geometry provides an estimate of creek width based on the amount of tidal flow through the channel. The calculations use a long-term “full tidal” scenario in which the low lying Baylands are assumed to be tidally flooded. As noted above, this scenario might occur intentionally through restoration or unintentionally through unrepaired levee breaches and become more likely over time with sea level rise. This scenario is used to anticipate needed bridge width. For each creek crossing, the study team estimated the channel width with the future full tidal scenario and allowed room for a 500-foot marsh buffer on either side of the channel, as recommended by the ETWG.

Profile (Vertical Elements)
To cross areas prone to flooding, the roadbed needs to be above the design water levels. Where the terrain will remain higher than the 2130 projected floodplain, the roadway can remain at-grade. Three types of roadway profile were considered in the development of the alternatives: at-grade, embankment, and causeway (viaduct), which are defined below:

- **At-grade.** This profile would be designed to be built on or slightly above the existing terrain for drainage purposes. For DAA US 101 – SR 121, this profile would be employed where the alignment would cross terrain above the projected extreme water levels (20 to 24 feet NAVD 88). Construction could be accomplished within the proposed roadway except for bridges, where an extra 50 to 75 feet on either side would be necessary, resulting in a temporary footprint of 200 to 250 feet.

- **Embankment.** This profile would raise the roadway to an elevation of 20 to 24 feet NAVD 88 on an embankment of engineered fill. An embankment can appear much like a levee (a rhombus shape), meaning that the mound of fill is supported by 4:1 side slope extending outward such that the base for a 100-foot-wide roadway could be as wide as 250 feet. Techniques to tighten the slopes could include retaining walls up to 20 feet high before the wall should be stepped back. This can reduce the footprint, but due to the bay mud conditions and potential for a vertical wall to reflect waves and cause erosion, a retaining wall might be limited in application. Construction could be accomplished within the proposed footprint of the embankment.

- **Causeway.** A roadway that is raised on pile-supported columns is a causeway (also referred to as a viaduct). The DAA US 101 – SR 121 causeways are proposed as an elevation of 28 to 35 feet NAVD 88. The height difference compared with the embankment includes an allowance (of an additional 9 feet) to accommodate the structure depth above the wave and freeboard clearance. Sets of pile-supported columns are anticipated to be placed every 120 to 150 feet apart. But unlike the embankment, the column...
supports would allow water and wildlife to move freely beneath the structure. The causeway would be higher, but the footprint would remain within the 100-foot-wide cross section. Construction of the causeway would require an extra 50 to 75 feet on either side, which would result in a temporary footprint of 200 to 250 feet.

The difference in embankment and causeway cross-sections results in different footprint widths on the ground. Exhibit 5-9 illustrates the difference in the permanent footprints.

Exhibit 5-9: Comparison of Footprint Width of Embankment versus Causeway Profile

An overview of engineering and construction considerations to support resiliency in the alternatives by profile are presented below.

At-grade
At-grade profile was assumed where the proposed alignment could remain above the projected extreme water levels (20 to 24 feet NAVD 88) using the existing ground elevation. In these situations, the conditions are suitable for the relatively easy construction methods; therefore, no additional geotechnical or engineering efforts were expended. For alternatives using the SR 37 alignment on areas that can remain at-grade, the alternatives do include updates to the expressway, such as an interchange and the Class I bikeway and pedestrian path. No additional special considerations were explored for the at-grade profile conditions, and no further discussion is provided for this profile.
Embankment

Embankment is typically presumed to be a relatively conventional and cost-effective method for raising roadways above floodplains. Many portions of the current SR 37 are already supported on some fill material. Experiences with fill material supporting SR 37 in the bay mud has resulted in the roadway cracking and sinking from differential displacement, thus leading to heavy maintenance and repairs. To provide realistic preliminary designs and more fully understand the cost elements for a resilient embankment profile, the study team explored geotechnical considerations for supporting large quantities of soil (up to the 20 to 24 feet NAVD 88) and necessary construction phasing strategies for the embankment profile. The following outlines these efforts and findings.

Geotechnical Considerations for Embankment Profile

To raise the roadway approximately 20 to 24 feet on an embankment profile would require large sums of fill material (see inset box). To properly plan for a resilient roadway, the study team sought geotechnical insights on design options for constructing on the bay mud. This included collecting and analyzing depth to solid geologic substrate and the settlement potential under varying loads. The surficial soils along the SR 37 corridor have been mapped by the United States Department of Agriculture (USDA) National Resource Conservation Service and USDA Soil Conservation Service (NRCS 2021). Details of the preliminary geotechnical findings are recorded in Appendix F, Geotechnical Memorandum. The geotechnical memorandum summarizes the anticipated depths of bay mud along the existing SR 37 alignment, summarizes preliminary settlement potential under different loads using different fill materials and provides preliminary recommendations. Based on the data reviewed (see Appendix F), the conditions can be summarized as follows:

- The present pavement section and a thin layer of fill overlie compressible bay mud. The existing roadway fill is on the order of 2 to 14 feet thick.
- There is varying thickness of soft, compressible bay mud. On the Marin County side, the bay mud varies between 20 to 65 feet thick. On the Sonoma County side, the bay mud is between 5 to 110+ feet thick.
- Alluvial soils generally underlie the bay mud and overlie the bedrock in low-lying areas and are exposed at the surface in upland areas. Alluvial soil thicknesses vary from about 25 to 55 feet thick on the Marin County side to about 30 to 60+ feet thick on the Sonoma County side.
- Bedrock is generally encountered at depths greater than 100 feet below existing grade. The depth to bedrock is expected to be deeper on the Sonoma County side of SR 37 compared to Marin County.
- Conglomerate material is assumed to be a structurally supportive material.

The geotechnical assessment reviewed the following methods to counter the effects of the bay mud and tendency for movement, liquefaction, and settlement of the roadway:

| Truck Volumes needed for 1 mile of Embankment (approximately 20 feet high by 250 feet wide at base): |
| Fill volume: 782,000 cubic yards of engineered soil fill or an estimate of 52,000 to 78,000 dump truck loads. |
| Soil spoils from deep soil cement mixing (average 60 feet deep): 704,000 cubic yards of soil requiring an estimate of 47,000 to 70,400 dump truck loads. |
• Reducing embankment loads with geofoam blocks
• Increasing height of the embankment to accommodate settlement
• Structurally supporting the underlayment material with deep soil cement mixing (DSCM) techniques

The analysis of the first two techniques did not meet the 100-year resilience design criteria outlined in the introduction of this section. Based on readily available data, including recent and past geotechnical borings, the preliminary recommendation to effectively minimize settlement issues for the proposed embankment profile involves DSCM, which involves mixing in cement with the soil in deep linear columns that stiffens the bay mud to resist compression. The recommendation outlines that DSCM would need to displace 30 percent of the bay mud beneath the embankment prism, which would result in large amounts of spoils that could not be used for embankment building material (see inset box on page 2-15). Exhibit 5-10 illustrates the augering technique and machinery associated with DSCM. The spoils from DSCM would need to be transported offsite or, if opportunities allow, may be used in restoration efforts nearby. The DSCM depth would be dictated by the depth of the bay mud to reach bedrock or conglomerate soil structure. In discussions with DSCM contractors, it was advised to limit DSCM to areas not deeper than 80 feet of bay mud, after which the cost and risks associated are less reliable (Strandgaard 2021).

Finally, boulder riprap would cover the side slopes to protect the embankment from erosive wave action. Another more costly method to protect the side slopes would include mechanically stabilized earth walls, which might be necessary in areas to reduce the footprint width. In addition to the bridge designs described under Hydrologic Conveyance above, additional hydrologic connectivity across the embankment would be provided by culverts to maximize the absorption of rising waters into the floodplains and reduce tidal surges pressure through the bridge openings.
A more gently sloped embankment (e.g., 10:1 or 20:1 side slopes) was initially considered to provide a wide marsh-to-upland transition zone. This type of transition zone is considered valuable for marsh species in the right context and provides room for marsh migration with sea level rise. However, it was the opinion of the ETWG that a transition zone immediately adjacent to SR 37 would be of limited ecological value and may be detrimental. In addition, there was no desire to fill existing wetlands to create a SR 37 transition zone and concerns about the additional amount of fill and associated costs that would be needed to create gentler slopes.

Construction Sequencing for Embankment Profile

Study team construction experts determined that an embankment could be built in a linear fashion and result in the same footprint for both operational (permanent) and construction (temporary) effects. Where new alignments are concerned, the embankment could be built in one continual process of clearing the land, conducting DSCM, and then immediately building the embankment.

For the approximately 100-foot-wide cross section, the embankment that would rise above the projected 2130 sea level rise is anticipated to result in a footprint approximately 220 to 250 feet wide, where the current elevation begins at 0 to 3 feet NAVD 88. Where alternatives are proposed on the existing SR 37 alignment, this would maximize the use of the available right-of-way. Therefore, a phased approach would be required to maintain existing traffic movement while under construction. Under this scenario, traffic lanes would be shifted close together and, to the opposite side, one-half of the embankment would be built using a geotextile to stabilize the soil into a near-vertical support wall to protect the adjacent traffic lanes. Upon thorough compaction and testing, and installing the roadbed on the new embankment, traffic could be shifted to the raised roadway while building the second half in Stage 2 (see Exhibit 5-11). The roadway would not have the shoulders and bikeway until Stage 2 is completed, when the roadway could be expanded to meet the full cross section.

Causeway

A causeway is much like a long bridge. In many situations, a causeway profile is presumed to be highly expensive and thus reserved for special situations, such as crossing large bodies of water. A causeway
provides many advantages, such as a narrow footprint, free movement underneath for wildlife and waterways, and columns engineered to withstand seismic events.

**Geotechnical Considerations for Causeway Profile**

Geotechnical research revealed the varying depth of the bay mud and determined the length of piles needed for the causeway profile. Piles might be the least-risk method for raising a roadway in areas where the bay mud is deeper than 90 feet. The causeway would require numerous pile-driven or augered pile-supported columns. The number and girth of the piles would be determined by the depth and seismic design criteria.

**Construction Sequencing for Causeway Profile**

The study team determined that a set of four columns of approximately 8 feet in diameter each would be appropriate for a causeway over the varying depth of bay mud. The set of columns would be joined with a concrete cap, upon which steel I-beams or precast substructure would be placed linking across column cap to column cap. When the roadway deck is poured, railings and barriers between lanes and the bikeway would be added.

Constructing the causeway would require areas on either side of the causeway or bridge structure for equipment movements alongside of the structure. Depending on the landscape, approximately 50 to 75 feet on either side of the causeway would be required during construction. The causeway operational footprint would only be 100 feet wide, but with the additional construction area needed, it would require an approximately 200- to 250-foot-wide temporary footprint.

Exhibit 5-12 shows examples of how the causeway could be built if located on SR 37. Stage 1 generally consists of shifting existing traffic close together and building half of the structure. The entire width of the causeway could be built in a linear fashion. Where alternatives are proposed on the existing SR 37 alignment, there is enough right-of-way to build the entire width of the causeway after shifting existing travel lanes together.

Exhibit 5-13 illustrates a longitudinal cross section of how the embankment would require DSCM as compared with the causeway profile supported on column supports every 150 feet on average. This
Exhibit 5-13: Longitudinal Cross Section illustrating Embankment and Causeway Profile

The exhibit also illustrates that where the two profiles are combined, there would be a sloped transition between the embankment and causeway profiles to account for the difference in the heights of the roadways. Even with DSCM, there is potential for settlement at the joint between these two profile types, which could result in a road bump for drivers.

Preserving Access

Another aspect of planning a roadway is considering how to preserve access to current adjacent land uses. To recognize the importance of property rights (see inset box to right), the DAA US 101 – SR 121 study alternatives were designed to maintain short-term (pre-flooding condition over next 20- to 30-year horizon) access to existing land uses. As necessary, the designed footprint of each alternative includes frontage roads or roadway crossings to preserve these existing access points.

However, this DAA also recognizes the long-term context as well as the short-term assessment. The long-term scenario includes the eventual potential for lands where the alternative crosses the 2130 projected floodplain to become flooded more frequently and, potentially, these lands would be purchased for conservation/restoration lands or merely deserted due to cost and loss of productivity or otherwise left fallow. As appropriate to the

The Law of Property Rights and Access Preservation

Property rights are protected through Common Law, state law, and the US Constitution— the rights of people to acquire, use, and dispose of property freely. The Constitution protects property rights through the Fifth and Fourteenth Amendments’ Due Process Clauses and, more directly, through the Fifth Amendment’s Takings Clause: “nor shall private property be taken for public use without just compensation.” State and federal laws protect the productive use of property by ensuring that it can’t be landlocked – that is, ‘denied access to a public road, or removing a roadway that renders access to be restricted from continued use of the land’. In other words, property cannot not be rendered idle due to lack of access. Access is protected unless by necessity an easement is provided, negotiated or purchased.
criterion, the assessment includes both a short-term and long-term evaluation (see Chapter 6, Summary of Assessment by Alternative).

5.3 Range of Alternatives under Evaluation

With the design criteria, profiles, and hydrologic needs defined, the study team developed engineered designs for each of the routes (see Section 5.2.3) and then collected further refinement input from the stakeholder groups during the workshop meetings. Both engineering considerations and input from these meetings were incorporated into the alternatives design development. Refinements included realignments to avoid sensitive habitats, avoid residential communities, and attempts to minimize traversing valuable wetlands.

Exhibit 5-14 is a conceptual illustration of the DAA US 101 – SR 121 alternatives. An engineered preliminary plan sheet for each alternative is provided in Appendix G, Preliminary Alternative Plans, that are evaluated and compared in the assessment recorded in Chapter 6. These alternatives include professional judgement on where causeway, at-grade, or embankment can be considered, as indicated in the Exhibit 5-8 legend of colors. However, two alternatives were developed for remaining On-SR 37: (1) both a Hybrid alternative (Alternative A1A), which emphasized embankment profile, except over water crossings or in locations where bay mud is particularly deep, and (2) a predominately causeway alternative (Alternative A1B).

Listed below are the DAA US 101 – SR 121 alternatives:

- Alternative A1A – On-SR 37 - Hybrid (predominately embankment)
- Alternative A1B – On-SR 37 - Causeway
- Alternative A2 – Over-Bay
- Alternative A3 – Bahia/Atherton
- Alternative A4 – Burdell/Hog Island

To properly align the DAA US 101 – SR 121 with the DAA SR 121 - Mare Island, Exhibit 5-14 reflects the logical connections with the alternatives in DAA SR 121 – Mare Island as shown in dashed lines. See Section 6.2 for more discussion on the DAA SR 121 – Mare Island alternatives listed below.

- Alternative B1A – On-SR 37 - Hybrid (predominately embankment)
- Alternative B1B – On-SR 37 - Causeway
- Alternative B2 – Over-Bay
Exhibit 5-14: Range of DAA US 101 – SR 121 Alternatives under Evaluation

Where the alternative would be located above the design floodplain elevation (with projected 2130 sea level rise), the roadway is planned to be at-grade (green lines in Exhibit 5-14). Embankment construction is indicated by the orange lines. Placing causeway or bridge structures over river crossings and in areas where embankment is not advisable is indicated with the blue lines. Exhibit 5-15 provides a summary description for each DAA US 101 – SR 121 alternative, and Appendix G provides the preliminary alternative plan sheets. Exhibit 5-16 provides the right-of-way needed and length of each profile type by alternative.
### Exhibit 5-15: DAA US 101 – SR 121 and DAA SR 121 – Mare Island Alternatives Summary Description

<table>
<thead>
<tr>
<th>Alternative General Description</th>
<th>Proposed Interchanges</th>
<th>Changes to Existing SR 37 Bridges</th>
<th>Changes to existing SR 37 roadway or not</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DAA US 101 – SR 121 ALTERNATIVES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| **On-SR 37 Alternative A1A – Hybrid Bridge/Causeway** | An interchange is proposed at:  
- US 101  
- Atherton Avenue  
- Lakeville Highway  
- Sears Point/ SR 121 | All existing bridges would be removed and replaced with bridges consistent with U.S. Coast Guard requirements when pertinent and meet the study’s design requirements to pass 2130 projected hydraulic flows (bridge height meets design elevations and bridge length provides room for potential long-term channel expansion plus a 500-foot buffer on either side of the channel to accommodate fringing tidal marsh). See Section 5.2.6). | The existing roadway would be almost completely removed and replaced. Small areas of roadway that are no longer needed would be removed and restored to appropriate habitat during construction. New frontage roads would be constructed in select locations as needed to preserve existing local access with access from planned interchanges. The new frontage roads would be constructed at-grade preserving (but not improving) the existing level of access. |
| **On-SR 37 Alternative A1B – Causeway** | An interchange is proposed at:  
- US 101  
- Atherton Avenue  
- Lakeville Highway  
- Sears Point/ SR 121 | Like A1A, all existing bridges would be removed and replaced consistent with U.S. Coast Guard requirements when pertinent and meet the Project’s design requirements as outlined above. | The roadway would be elevated but there would be adequate right-of-way to also maintain at-grade access to adjacent properties. Access to this roadway would be achieved at interchange locations. |
| **Over-Bay Alternative A2** | An interchange is proposed at:  
- US 101  
- Sears Point/ SR 121 | Novato Creek bridge is proposed to be removed and replaced with a bridge that meets the Project’s design requirements. All other existing bridges would remain in place because they are needed to preserve local access. | The assumption is that the remaining SR 37 bridges and roadway shall remain in use for continued access preservation until either the roadway is inundated and/or the bridge is no longer deemed safe. Alternative A2 would be designed to preserve existing access points or roadway crossings along the landside portions of the alignment. Additionally, boat navigation would be preserved over the waterbody, as dictated by the U.S. Coast Guard. |

A1A prioritizes remaining within existing SR 37 right-of-way and locations where ground is above projected floodplain. This alternative is a combination of long bridges, at-grade roadway where existing grade is high enough, embankment where feasible based on geology, and causeway in other locations.

Like A1A, A1B would remain predominantly within the SR 37 right-of-way and remain at-grade, when possible, but would be a predominantly a pile-supported causeway when crossing low-lying areas of the alignment.

A2 predominantly would be causeway as it crosses the bay from Novato to Mare Island, with a connecting leg to the interchange at SR 121 and existing SR 37. When not necessary to be on a bridge over creeks or causeway over bay waters and marshes, an embankment would be used to support the proposed expressway. This is the longest of the alternatives under evaluation.
<table>
<thead>
<tr>
<th>Alternative General Description</th>
<th>Proposed Interchanges</th>
<th>Changes to Existing SR 37 Bridges</th>
<th>Changes to existing SR 37 roadway or not</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bahia/Atherton Alternative A3</strong>&lt;br&gt;A3 would avoid the Novato Creek floodplain and skirt the northernmost and lower base of Atherton hillside with cut/fill to remain below the residential area and above the wetlands/floodplain where possible. It would result in a new crossing over the Petaluma River and is the shortest of the alternatives.</td>
<td>An interchange is proposed at:&lt;br&gt;- US 101&lt;br&gt;- Lakeville Highway&lt;br&gt;- Sears Point/ SR 121</td>
<td>All existing bridges would remain in place because they are needed to preserve local access.</td>
<td>The assumption is that the remaining SR 37 bridges and roadway shall remain in use for continued access preservation until either the roadway is inundated and/or the bridge is no longer deemed safe. Alternative A3 would be designed to preserve existing access points or roadway crossings along its alignment.</td>
</tr>
<tr>
<td><strong>Burdell/Hog Island Alternative A4</strong>&lt;br&gt;A4 would avoid the Novato Creek floodplain, skirt the southside of the landfill on Burdell Island, and add a new crossing of the Petaluma River eastward through a narrow portion of the floodplain before connecting to and heading south along Lakeville Highway to SR 37 and then east to the SR 121 interchange. This alternative would take advantage of the existing Lakeville Highway right-of-way but include the additional right-of-way acquisition to meet the expressway design standard for a 4-lane and Class I Bikeway facility.</td>
<td>An interchange is proposed at:&lt;br&gt;- US 101&lt;br&gt;- Lakeville Highway&lt;br&gt;- Sears Point/ SR 121</td>
<td>All existing bridges would remain in place because they are needed to preserve local access.</td>
<td>The assumption is that the remaining SR 37 bridges and roadway shall remain in use for continued access preservation until either the roadway is inundated and/or the bridge is no longer deemed safe. Alternative A3 would be designed to preserve existing access points or roadway crossings along its alignment.</td>
</tr>
</tbody>
</table>

**DAA SR 121 – MARE ISLAND ALTERNATIVES:**

<table>
<thead>
<tr>
<th>On-SR 37 Alternative B1A - Hybrid</th>
<th>Proposed Interchanges</th>
<th>Changes to Existing SR 37 Bridges</th>
<th>Changes to existing SR 37 roadway or not</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1A prioritizes remaining within existing SR 37 right-of-way and locations where ground is above projected floodplain. This alternative is a combination of long bridges, at-grade roadway where existing grade is high enough, embankment where feasible based on geology, and causeway in other locations. The embankment portion is limited to the first 2 miles east of Sears Point.</td>
<td>An interchange is proposed at:&lt;br&gt;- Mare Island (The Sears Point interchange is assumed in the DAA US 101 – SR 121 connecting alternative.)</td>
<td>Existing bridges would be removed and replaced with bridges that meet Project’s design requirements.</td>
<td>The existing roadway would be almost completely removed and replaced. Local access would be substantially removed unless accessible from Sears Point or Mare Island interchanges.</td>
</tr>
</tbody>
</table>
Alternative General Description

On-SR 37 Alternative B1B — Causeway
Like B1A, B1B would remain predominantly within the SR 37 right-of-way and remain at-grade, when possible, but is predominantly a pile-supported causeway when crossing low-lying areas of the alignment.

Proposed Interchanges
An interchange is proposed at:
- Mare Island (the Sears Point interchange is assumed in the DAA US 101 – SR 121 connecting alternative.)

Changes to Existing SR 37 Bridges
Existing bridges would be removed and replaced with bridges that meet the project’s design requirements.

Changes to existing SR 37 roadway or not
The existing roadway would be almost completely removed and replaced unless a local road could be accommodated under the causeway structure and accessible from Sears Point or Mare Island interchanges.

Over-Bay Alternative B2
B2 would predominantly be causeway and dependent on the connection from the DAA US 101 – SR 121 A2 and further west. It would not have independent utility without A2 or at minimum the leg connection to SR 121.

Proposed Interchanges
An interchange is proposed at:
- Mare Island (The Sears Point interchange is assumed in the DAA US 101 – SR 121 connecting alternative.)

Changes to Existing SR 37 Bridges
Existing bridges would remain in place because they are needed to preserve local access.

Changes to existing SR 37 roadway or not
The assumption is the remaining bridges and roadway shall remain in use until either the roadway is inundated and/or the bridge is no longer deemed safe.

Exhibit 5-16: Descriptive Elements Overview by Alternative

<table>
<thead>
<tr>
<th>Description Element</th>
<th>DAA US 101 – SR 121 Alternatives</th>
<th>DAA SR 121 – Mare Island Alternatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acres of New Right-of-Way Needed</td>
<td>23</td>
<td>9</td>
</tr>
<tr>
<td>Total Length in Miles (From US 101 to SR 121)</td>
<td>7.4</td>
<td>7.4</td>
</tr>
<tr>
<td>Length in miles of Causeway</td>
<td>1.9</td>
<td>5.9</td>
</tr>
<tr>
<td>Length in miles of Embankment</td>
<td>4.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Length in miles of At-grade</td>
<td>1.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>
6. Summary of Assessment by Alternative

The objective of this chapter is to provide the stakeholders and the public enough information to easily compare, contrast, and make informed opinions about the alternatives. Exhibit 6-1 provides the results for all 23 evaluation criteria in the form of color codes, where green scale indicates better performance, red shades indicate poor performance, and yellow indicates middle to moderate performance. The color code allows the eye to scan many variables quickly; however, to fully understand the scale behind the color code, Appendix H, Evaluation Measures, provides the measurements used for the assessment.

In addition, Appendix I, GIS Maps, includes geographic information system (GIS)-based maps of the spatial data for the Natural Resource criteria. Most of the criteria measurements evaluated direct effects of construction and the permanent Project footprint. However, for criteria labeled ‘Future’ that evaluated the habitat effects beyond the 40-year planning horizon, the assessment assumes that the existing SR 37 roadway and bridge infrastructure would be inundated and removed under all alternatives. These criteria, which are listed below, do not anticipate when this change would occur.

- Water Crossings Accommodating Future Tidal Waters
- Future Tidal and Transitional Zone Habitat
- Future Bird Habitat
- Future Ecological Connectivity.

While the Social Equity category is included in the overall rating table, that category duplicates the criteria results from other categories. Social Equity is considered an additional and separate assessment, even though the criteria overlap, because it provides insights on how impact may combine to affect disadvantaged populations.

6.1 DAA US 101 – SR 121 Evaluation Results

Some criteria did not differentiate between the alternatives and therefore are not elaborated upon in the comparative assessment. For example, DAA US 101 – SR 121 alternatives are designed to accommodate projected tidal flows in the rivers and creeks; therefore, all alternatives perform well for “water crossing accommodating future tidal flows.” Additionally, no known hazardous waste sites are recorded on available databases in the corridor, and therefore all alternatives are equally positive for this criterion. While there are some nuanced differences among the alternatives, all alternatives are considered to result in substantial visual change because they are designed to be raised to accommodate projected sea level rise through 2130. Because the alternatives are all located within areas associated with pre-historical uses, all the alternatives have the potential to adversely affect culturally sensitive resources. However, the use of DSCM has the potential of more lasting adverse effects of the unidentified pre-historical features than other construction types.

A one-page summary assessment of each alternative follows with information on the potential operation and construction effects that would be both positive and negative.
### Exhibit 6-1: SR 37 Ultimate Sea Level Rise Design Alternatives Assessment Summary Rating

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Transportation</td>
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Alternative A1A – On-SR 37 - Hybrid (Predominantly Embankment)

Alternative A1A – On-SR 37 - Hybrid Brief Description: A1A – Hybrid would be built upon embankment within SR 37 right-of-way, except for bridges at water crossings, and at-grade where topography is above the projected floodplain. It includes four interchanges (US 101, Atherton Avenue, Lakeville Highway, and SR 121) and frontage roads to maintain access to adjacent land uses where necessary and would result in replacing and enlarge bridges at Novato Creek, Simmons Slough, and Petaluma River.

Acres of New Right-of-way Needed: 23
Total Length in miles (From US 101 to SR 121): 7.4
Length in miles of Causeway: 1.9
Length in miles of Embankment: 4.1
Length in miles of At-grade: 1.5

Transportation: Performs above average as compared with most of the other DAA US 101 – SR 121 alternatives, except Alternative A1B – On-SR 37 - Causeway, which would also remain on SR 37. Change of access would be slightly less advantageous compared with the causeway (A1B). It would maintain current, if not slightly improved, traffic operations; not add VMT; and, generally, promote multimodal opportunities.

Natural Resources: Performs well compared with the other DAA US 101 – SR 121 alternatives on Natural Resources criteria, except when considering the future habitat scenarios. Under the future scenario, the embankment along substantial portions of the alignment would prevent the potential return to future tidal habitat, transition zone, and bird habitat and have less desirable ecological connectivity than other alternatives, with more causeway over the floodplain areas.

Built Environment: Performs above average as compared with the other DAA US 101 – SR 121 alternatives on Built Environmental criteria, except for cultural resources and air quality. Air quality during construction is viewed as the highest potential adverse effects among all the proposed alternatives with respect to volumes of cement and fill material required. This has the potential to result in high vehicle emissions. The construction technique of deep-soil mixing might be detrimental to cultural resources, if present, because of high cultural sensitivity in the area. This would slightly impact the San Pablo National Wildlife Refuge around the SR 37/ Lakeville Highway interchange.

Social Equity: Performs slightly above average when compared with the other DAA US 101 – SR 121 alternatives except for air quality effects, particularly during construction as noted under Built Environment. By remaining on the SR 37 alignment, it would maintain existing accessibility and enhanced multimodal opportunities. However, because it would continue near the developed areas, construction effects could be higher than those alternatives farther north (A3, A4) in the criteria of visual, air quality and noise effects.

Fiscal: In terms of capital cost, A1A is considered among the mid-range investment alternatives (approximately 12 percent more than the least costly A4) and a mid-range to more costly lifecycle cost.
Alternative A1B – On-SR 37 – Causeway

**Alternative A1B – On-SR 37 - Causeway Brief Description:** A1B – Causeway would be primarily causeway within SR 37 right-of-way, except for being at-grade where topography is above the projected floodplain. It includes four interchanges (US 101, Atherton Avenue, Lakeville Highway, and SR 121), and portions of the existing road could be used to maintain access to adjacent land uses where necessary. Bridges would be replaced and enlarged at Novato Creek, Simmons Slough, and Petaluma River.

- **Acres of New Right-of-Way Needed:** 9
- **Total Length in miles (From US 101 to SR 121):** 7.4
  - Length in miles of Causeway: 5.9
  - Length in miles of Embankment: 0.0
  - Length in miles of At-grade: 1.5

**Transportation:** Performs as good as, if not slightly better than, A1A enhanced accessibility criteria because the roadway would be raised and still leave areas under the causeway for enhanced or new access points, such as additional parking when inundation is not impacting the landscape. It would maintain current, if not slightly improved, traffic operations; not add VMT; and, generally, promote multimodal opportunities.

**Natural Resources:** Performs the best on Natural Resources criteria for both current and future criteria measures. Would remain on SR 37, but because it would be predominantly raised on columns, the waters, habitat, and hydrologic connectivity would be allowed to expand over time. The only alternative with potentially less area of wetland impacts is A4, Burdell/ Hog Island; however, A4 has additional wetland impact considerations not reflected in the area measurements.

**Built Environment:** Performs best compared with the other DAA US 101 – SR 121 alternatives on Built Environmental criteria, except noise effects during construction. It would result in potentially higher noise effects over A1A due to the pile-driving needed to build the columns supporting the causeway structure and visual effects due to its proximity to more developed areas. Both A1A and A1B would slightly impact the San Pablo National Wildlife Refuge around the SR 37/ Lakeville Highway interchange.

**Social Equity:** Performs the best when compared with the other DAA US 101 – SR 121 alternatives apart from noise, particularly during construction. By remaining on SR 37, it would maintain existing accessibility via a nearby interchange. It is designed to enhance multimodal opportunities and link to key destinations along the corridor where transit stations would likely be placed. However, because it would continue to be near developed areas, construction effects could be higher than alignments farther north (A3, A4) for the criteria of air quality and noise effects. Additionally, A1B is assessed to have slightly lower community compatibility when compared to A2.

**Fiscal:** In terms of capital cost, A1B is considered among the mid-range investment alternatives (approximately 30 percent more than the least costly A4). However, it also represents the lowest lifecycle cost than the other DAA US 101 – SR 121 alternatives.
Alternative A2 – Over-Bay

Brief Description: A2 would be built upon embankment south of SR 37 and before veering due east over the San Pablo Bay. It would replace a bridge at Novato Creek and add a new bridge over Simmons Slough, then transition to causeway over the bay. A2 would include a north-south leg to reach SR 121. It would include three interchanges (US 101, SR 121 (in Bay), and at existing SR 23/SR 121). Much of SR 37 would remain and continue to provide access to local land uses and would not assume replacing or enlarging existing bridge over the Petaluma River.

- Acres of New Right-of-way Needed: 161
- Total Length in miles (From US 101 to SR 121): 10.5
  - Length in miles of Causeway: 7.7
  - Length in miles of Embankment: 2.7
  - Length in miles of At-grade: 0.2

Transportation: Performs well on traffic operations and potentially slightly reduce VMT. However, A2 would also reduce opportunities for new access points and potentially discourage some pedestrian and bicycle use since it would be predominantly over water, with longer distances between access points.

Natural Resources: Performs the worst of DAA US 101 – SR 121 alternatives for most criteria. Would result in high wetland impacts where the highway enters and exits the Baylands and on waters in the San Pablo Bay, which also represents critical habitat for protected salmonid species; causeway construction in the bay might be detrimental to these species. The portion within Marin County would negatively affect ecological connectivity. In the long-term, A2 performs reasonably well and could be modified in subsequent planning and design to perform better by refining the reach through the Marin Baylands to include more causeway/less embankment. Ultimately, even with potential refinements, A2 would present a trade-off between disturbance to open water habitat and marsh habitat with the other alternatives.

Built Environment: Performs poorly on conversion of land use and recreational resources, and the introduction of a new infrastructure in the open bay waters would result in high visual effects. Most of the construction and operational noise effects would occur away from sensitive residential receptors; therefore, A2 would have the lowest noise impacts. However, like A1A, it would still result in large quantities of cement and fill material in Marin County and therefore result in substantial increased emissions. It is the only alternative that would directly impact the San Pablo Bay National Wildlife Refuge (with the north-south leg connecting to Sears Point) and the San Pablo Bay Wildlife Preserve (with the bay crossing).

Social Equity: Provides advantages for disadvantaged communities. For example, for many of the more frequent trip patterns (origin and destination pairs), it could result in fewer VMT, and operational/construction noise might affect fewer residents compared with alternatives remaining on SR 37. However, since A2 would be over water, with fewer opportunities to connect to destinations along its route, it may not encourage multimodal opportunities as well as other alternatives. It would have a visual impact on the bay setting.

Fiscal: In terms of capital cost, A2 is by far the costliest alternative (over 300 percent more than the least costly alternative), with moderate lifecycle cost over time compared with the other DAA US 101 – SR 121 alternatives.
Alternative A3 – Bahia/Atherton

**Brief Description:**
A3 would be at-grade along the base of Atherton Hill, causeway over the projected floodplain with a new bridge spanning the Petaluma River, and embankment over the existing farmland before joining with SR 37 to reach SR 121. It would include three interchanges (US 101, Lakeville Highway, and SR 121). SR 37 would remain as is, and A3 would not assume replacing or enlarging existing bridges at Novato Creek, Simmons Slough, and Petaluma River.

**Acres of New Right-of-way Needed:** 198

**Total Length in miles (From US 101 to SR 121):** 7.5
- Length in miles of Causeway: 3.1
- Length in miles of Embankment: 2.1
- Length in miles of At-grade: 2.4

**Transportation:**
Performs poorly compared with other DAA US 101 – SR 121 alternatives on transportation-related criteria. Although it would be a relatively short alignment, travelers would have to use US 101 to continue south, thereby potentially resulting in additional VMT. In addition, the interchange at Atherton may be difficult to reconcile with the existing interchange and topography.

**Natural Resources:**
Performs poorly for most Natural Resources criteria, except for waters and water crossing. A3 would have slightly less effects on existing tidal wetlands and ecological connectivity than A2, but on-SR 37 alternatives would perform better for both criteria. A3 would not provide clear advantages for future bird habitat criteria and ecological connectivity.

**Built Environment:**
Would introduce a new infrastructure through undisturbed wetlands and farmlands and result in substantial changes in land use and visual effects. It would result in higher construction-related pollutants than A1B and A5 (Burdell/Hog Island). Would relocate a recreational trail within the Rush Creek Open Space Preserve and impact an area of San Pablo National Wildlife Refuge at the Lakeville Highway interchange. Most of the pile-driving construction noise and long-term operations would occur away from sensitive receptors, except for the area adjacent to Atherton Avenue community. A3 would create visual effects along the base of the Atherton hillside, south of the Gnoss Airport at the Rush Creek Open Space Preserve. However, A3 would perform better on community compatibility when compared to A4 but less favorable than the other alternatives.

**Social Equity:**
On average, A3 performs poorly on social equity criteria. It would not perform well on multimodal opportunities, since it terminates further away from destinations or transit hubs than other alternatives. It may lead to higher VMT and does not support existing access points along SR 37.

**Fiscal:**
In terms of capital cost, A3 is considered among the mid-range investment alternatives (approximately 28 percent more than the least costly A4), with low-to-moderate lifecycle cost over time compared with the other DAA US 101 – SR 121 alternatives.
Alternative A4 – Burdell/Hog Island

Brief Description: A4 would be a causeway over the projected floodplain with a new bridge spanning the Petaluma River, then at-grade along Lakeville Highway to merge with SR 37 to reach SR 121. It would include three interchanges (US 101, Lakeville Highway, and SR 121). SR 37 would remain as is, and A3 would not assume replacing or enlarging existing bridges at Novato Creek, Simmons Slough, and Petaluma River.

Acres of New Right-of-way Needed: 263
Total Length in miles (From US 101 to SR 121): 8.2
- Length in miles of Causeway: 3.3
- Length in miles of Embankment: 0.9
- Length in miles of At-grade: 4.1

Transportation: Performs the worst on transportation-related criteria among the DAA US 101 – SR 121 alternatives. A4 may induce higher VMT and congestion rather than encourage multimodal opportunities as well as those that would remain on SR 37. It would not support existing access points or potential for new access opportunities.

Natural Resources: Does not perform well among natural resource categories. While it would affect the least area of waters and non-tidal wetlands, it would cross the Bay Area’s largest undisturbed ancient marsh. This is also reflected in comparatively worse ratings for effects to tidal wetlands and special status species that could potentially occur there. A4, together with A1A, performs worse than the other three alternatives for future conditions.

Built Environment: Performs the worst on visual effects and community compatibility than alternatives remaining on SR 37. The current design would convert the most acres of land use to transportation use, affecting 14 parcels and relocating one residence. The US 101 interchange could impact the Olompani State Historical Park, which is a recreational resource and important cultural and historic resource. By being the farthest from sensitive residential receptors, A4 would result in lower noise and air quality effects than most other DAA US 101 – SR 121 alternatives. A4 could remain at-grade along the Lakeville Highway right-of-way and result in lowest amount of borrow material and cement, resulting in the lowest construction-related emissions of all the alternatives.

Social Equity: A4 would not provide advantages for regular commuters nor perform well for multimodal opportunities as it would not link to urban centers or locations where transit transfers could easily occur. This could also disincentivize pedestrians and bicyclists and lead to higher VMT and not support existing access points along SR 37. Along Lakeville Highway, the low number of residences relatively close to the road could be directly impacted throughout construction and operation. Without relocation, operational noise could affect these sensitive receptors. However, pile-driving would not occur near residences. A4 would have lowest quantities of material import, which would result in a potentially shorter construction period compared with other DAA US 101 – SR 121 alternatives. The moderate rating for air quality considers the potential for nearby receptors along Lakeville Highway.

Fiscal: Least costly alternative because A4 would use Lakeville Highway for much of the alignment, which would be above the projected floodplain and thus require less structure to raise the roadway, with low-to-moderate lifecycle cost over time compared with the other DAA US 101 – SR 121 alternatives.
6.2 DAA SR 121 – Mare Island Evaluation Results

This section serves as an addendum to the previous DAA SR 121 - Mare Island (MTC 2019). Just as DAA US 101 – SR 121 benefited from insights developed during DAA SR 121 - Mare Island, this section updates a few additional findings for the range of alternatives advanced in DAA SR 121 – Mare Island. The additional elements consist of updating the engineering design to reflect current geotechnical findings and updating the evaluation measures so that the data and results remain consistent between the two reaches.

Exhibit 6-2 illustrates the three DAA SR 121 – Mare Island alternatives:

- On-SR 37 Alternative B1A – Hybrid (embankment limited to 2 miles)
- On-SR 37 Alternative B1B – Causeway
- Over-Bay Alternative B2

Exhibit 6-2: DAA SR 121 – Mare Island Alternatives Evaluated

The following paragraphs provide brief descriptions of the DAA SR 121 – Mare Island alternatives. Exhibit 6-3 provides information on new right-of-way and the length and profile type associated with these three alternatives. The alignments for each do not change from the original DAA SR 121 – Mare Island study (MTC 2019).

**On-SR 37 Alternative B1A – Hybrid**: Would remain on SR 37 for the entire length. Because SR 37 is only two lanes, to maintain the same cross section, this alternative would widen to the north for the first 3 miles from SR 121 eastward, then the alignment would transition to widening on the south side of SR 37. The alternative would begin as an embankment between Tolay Creek and Sonoma Creek and then due to the depth of bay mud, it would become causeway.
On-SR 37 Alternative B1B – Causeway: Would remain on SR 37 in a causeway profile for the entire length. It follows the same alignment and widening pattern as Alternative B1A.

Over-Bay Alternative B2: Would begin where Alternative A2 would end in the middle of the San Pablo Bay. (It would rely on Alternative A2 or the connecting roadway from SR 121 for traveling west of SR 121.) It would be entirely causeway profile and link into the existing SR 37 roadway at Mare Island.

Exhibit 6-3: Brief Description of DAA SR 121 – Mare Island Alternatives

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<th>DAA SR 121 – Mare Island Alternatives</th>
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<td>Total Length in miles</td>
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<td>(From SR 121 to Mare Island)</td>
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There is only one difference between Alternatives B1A and B1B. Alternative B1A would include a section of embankment for approximately 2 miles between Tolay Creek and Sonoma Creek, but the remainder would be a causeway (7.5 miles), whereas Alternative B1B would be causeway for the entire 9.5 miles. Therefore, these two alternatives are similar in how they would perform among the criteria. Alternative B2 is not interchangeable with Alternatives B1A or B1B since it would uniquely connect with Alternative A2 and be dependent upon the DAA US 101 – SR 121 alternative to connect with US 101 and/or the connection leg with SR 121. Due to the few alternatives associated with DAA SR 121 – Mare Island, the assessment results of the alternatives are described within each evaluation category (Transportation, Natural Resources, Built Environment, Social Equity, and Fiscal Feasibility), rather than by alternative. Exhibit 6-4 summarizes the assessment results.

Transportation: Alternatives on the SR 37 alignment (both B1A and B1A) generally perform well under transportation criteria except for preserving existing access. Alternative B2 could result in lowering VMT for many of the trips between Marin and Solano counties but could result in longer VMT for other destinations. However, under Alternative B2, the existing SR 37 may be used to access local destinations. Alternatives B1A and B1A are assessed as favorable for encouraging multimodal choices compared to Alternative B2. This study did not evaluate traffic operation for the combined alternatives between US 101 – SR 121 and SR 121 – Mare Island. A highway performance analysis prepared for the Highway 37 Sears Point to Mare Island points out that improvements in this portion of SR 37 would release the backup currently at SR 121 in Napa County and shift the queue to the interchange at US 101 in Marin on SR 37 (AECOM 2021). In other words, releasing traffic pressure at one bottleneck pushes the pressure to the next bottleneck. Improvements in the transportation system are interdependent and require further study than this DAA study provides.

Natural Resources: Alternatives on the SR 37 alignment (both B1A and B1A) would result in greater non-tidal and tidal wetland effects than Alternative B2. However, they would have nearly no effects on waters, which are also classified as critical habitat for salmonids and sturgeon, and these alternatives would
support positive ecological connectivity. All three DAA SR 121 – Mare Island alternatives would impact areas where special-status species have potential to occur. With respect to future tidal, bird habitats, and ecological connectivity, Alternative B1A does not perform as well as Alternative B1B, and Alternative B2 performs the best because it would stay almost completely out of future wetland areas.

**Built Environment:** The only difference between Alternatives B1A and B1B is in how they would perform for air quality during construction. Alternative B1A would result in more emissions associated with more cement and fill material than would Alternative B1B during construction. Alternative B2 would result in more substantial visual effects by establishing a new transportation corridor in the San Pablo Bay, but it could result in impacting fewer culturally sensitive or historic resources. There are no differences in conversion of land uses and community compatibility. Alternative B2 is assessed as having less impact on recreational resources. However, that would be due in part because the effects to the San Pablo National Wildlife Refuge are accounted for in the rating of Alternative A2 in DAA US 101 – SR 121, but B2 cannot have independent utility without connecting with A2.

**Social Equity:** All three DAA SR 121 – Mare Island alternatives would connect as a causeway at the SR 37 interchange at Mare Island; therefore, construction-related effects to the local community members would be the same for pile-driving noise and construction air emissions. Alternative B2 could result in lower VMT for trips between Marin and Solano counties, but a new transportation infrastructure in San Pablo Bay would cause a potentially higher visual impact than Alternatives B1A and B1B and would not promote multimodal opportunities as well as those two alternatives. Alternatives B1A and B1B could affect more cultural and historic resources because they follow the historical SR 37 alignment.

**Fiscal:** In terms of capital cost, Alternative B2 would be the costliest of the DAA SR 121 – Mare Island alternatives (by over 100 percent), but it would have the least lifecycle costs. Compared with Alternative B1B, Alternative B1A would be slightly (approximately 6 percent) more costly to build and have 25 percent more costs associated with lifecycle maintenance.

**Exhibit 6-4: DAA SR 121 – Mare Island Alternatives Assessment Summary**

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<tr>
<th>Alternatives</th>
<th>Positive Advantages</th>
<th>Negative Issues</th>
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| On-SR 37 Alternative B1A – Hybrid | • Low land use conversion  
• Community compatibility  
• Positive for encouraging multimodal opportunities | • Performs poorly for non-tidal and tidal wetlands and special-status species with potential to occur  
• Performs poorly for future habitat |
| On-SR 37 Alternative B1B – Causeway | • Least costly alternative  
• Low land use conversion  
• Community compatibility  
• Positive for encouraging multimodal opportunities | • Performs poorly for tidal wetlands and special-status species with potential to occur |
| Over-Bay Alternative B2       | • Performs well for future connectivity  | • High impact on waters/critical habitat  
• Not positive for change of access  
• Highest cost alternative (>100 percent)  
• Visual effects from a new bay crossing |
6.3 Assessment Including Stakeholder Input

The evaluation data and assessment tables were shared with the ETWG, RAP, and SWG for input and discussion. The ETWG emphasized observations on the direct measurements, assumptions, and limitations on some measures. Through this professional exchange with persons with personal insights on local sensitive habitats, the assessment ratings were slightly adjusted and updated as such in the final assessments reflected in Sections 6.1 and 6.2. Following these adjustments, the RAP and SWG provided their input on the evaluation results.

The study team received 11 review submittals from the RAP and SWG. A few submittals included the discussions and distillation of several members within one agency. Respondents included representation from:

- Marin Conservation League
- National Marine Fisheries Service
- San Francisco Bay Regional Water Quality Control Board
- San Francisco District, U.S. Army Corps of Engineers
- San Francisco Estuary Institute & Marin Audubon Society
- Sierra Club
- Solano County, Department of Resource Management
- Sonoma-Marin Area Rail Transit District
- Transportation Solutions Defense and Education Fund
- Vallejo, City of, Transportation Department
- Representative at-Large

The following sections reflect their input by alternative, followed by broader suggestions offered.

6.3.1 Assessment by Alternative

To assist in understanding the more substantial trade-offs, Exhibit 6-5 presents the high-level key trade-offs for each alternative. Information in Exhibit 6-5 further distills the information provided in Section 6.1 and Section 6.2 to better illustrate the most substantial positive advantages and negative issues for the DAA US 101 – SR 121 and DAA SR 121 – Mare Island alternatives. This information was offered to the SWG, and their comments are summarized in Exhibit 6-5.
### Exhibit 6-5: Key Trade-offs between Alternatives for DAA US 101 – SR 121 Alternatives

<table>
<thead>
<tr>
<th>Alternatives</th>
<th>Key Differences per Assessment Results</th>
<th>SWG Observations by Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>On-SR 37 Alternative A1A</strong></td>
<td><strong>Key Advantages:</strong></td>
<td>• Poor performance for most natural resources in the long term</td>
</tr>
<tr>
<td>(predominantly embankment)</td>
<td>• Low wetland/water effects.</td>
<td>• Worst emissions during construction</td>
</tr>
<tr>
<td></td>
<td>• Low acres of right-of-way needed</td>
<td>• Likely to result in significant environmental impacts, high mitigation requirements, and constructability challenges</td>
</tr>
<tr>
<td></td>
<td>• Only 12 percent more costly than least cost alternative.</td>
<td>• Requires enormous amounts of clean fill to build</td>
</tr>
<tr>
<td></td>
<td><strong>Primary Disadvantages:</strong></td>
<td>• Potential impacts of deep soil mixing on groundwater and sediment transport processes</td>
</tr>
<tr>
<td></td>
<td>• Performs poorly for future habitat and ecological connectivity</td>
<td>• Costs associated with deep soil mixing anticipated to be high</td>
</tr>
<tr>
<td></td>
<td>• Worst emissions during construction</td>
<td>• Likely to result in significant environmental impacts, high mitigation requirements, and constructability challenges</td>
</tr>
<tr>
<td></td>
<td>• Deep soil mixing has potentially detrimental effects on cultural resources, if present, groundwater flows, and future tidal marsh development</td>
<td>• Berms affect the migration of tidal wetlands northward across the SR 37 alignment</td>
</tr>
<tr>
<td><strong>On-SR 37 Alternative A1B</strong></td>
<td><strong>Key Advantages:</strong></td>
<td>• A1B performed well among most criteria</td>
</tr>
<tr>
<td>(predominantly causeway)</td>
<td>• Performs best on transportation-related criteria</td>
<td>• Most advantageous for tidal wetlands and waters</td>
</tr>
<tr>
<td></td>
<td>• Performs well on natural resource criteria (ranks best for non-tidal, water, ecological connectivity, and future water crossing).</td>
<td>• Higher capital cost in comparison with the hybrid/embankment as previously understood</td>
</tr>
<tr>
<td></td>
<td>• Low acres of right-of-way needed</td>
<td>• Most Positive Mentions to Carry Forward</td>
</tr>
<tr>
<td></td>
<td><strong>Primary Disadvantages:</strong></td>
<td>• No votes to dismiss from consideration</td>
</tr>
<tr>
<td></td>
<td>• Not as positive for future bird habitat and noise during construction as others, but not the worst either</td>
<td>• Ratings captured the superior performance of the causeway</td>
</tr>
<tr>
<td></td>
<td>• 30 percent higher cost than least costly alternative.</td>
<td>• Most practicable and constructible alternative, and most likely to minimize the near-term and long-term environmental impacts of an SR 37 facility</td>
</tr>
<tr>
<td><strong>Over-Bay Alternative A2</strong></td>
<td><strong>Key Advantages:</strong></td>
<td>• Impacts of causeway on tidal wetlands are much less than stated if use Clean Water Act definition</td>
</tr>
<tr>
<td>(predominately causeway except over Novato Creek area)</td>
<td>• May reduce miles for those origin-destination pairs between Marin and Solano Counties</td>
<td>• High impacts for tidal wetlands and other waters -</td>
</tr>
<tr>
<td></td>
<td>• &gt;300 percent more costly than least cost alternative</td>
<td>• The fact that A2, that primarily spans open water, would have such a poor rating for impacts to tidal wetlands</td>
</tr>
<tr>
<td></td>
<td>• Does not encourage multimodal opportunities and poor for change of access</td>
<td>• High impact associated with the right-of-way in park/recreation/refuge properties</td>
</tr>
<tr>
<td></td>
<td>• Only alternative to impact both national refuge and wildlife preserve</td>
<td>• Large property acquisition needs</td>
</tr>
<tr>
<td></td>
<td>• Land-side results in high impacts on tidal wetlands and waters/ critical habitat and ecological connectivity</td>
<td>• Performs so poorly in many of the measurements</td>
</tr>
<tr>
<td></td>
<td>• Visual impact of new in-bay crossing</td>
<td>• Several dismissed this alternative from further consideration, listing high costs and visual impacts reasons, conversely, some expressed an interest in further refining the design to reduce direct impacts to waters of the state (including wetlands)</td>
</tr>
</tbody>
</table>
### Alternatives

<table>
<thead>
<tr>
<th>Alternatives</th>
<th>Key Differences per Assessment Results</th>
<th>SWG Observations by Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bahia/Atherton</strong></td>
<td><strong>Key Advantages:</strong></td>
<td><strong>Permanent impacts on mature marsh areas, which is likely to result in negative impacts to essential fish habitat</strong></td>
</tr>
<tr>
<td>Alternative A3</td>
<td>- Shorter crossing of the floodplain</td>
<td>• Result in significant ecological impacts</td>
</tr>
<tr>
<td>(predominantly causeway except where at-grade was possible and some embankment near SR 121)</td>
<td>- Nearly worst for transportation-criteria</td>
<td>• Goes through CDFW Petaluma Wildlife Area and Marin County Rush Creek Preserve</td>
</tr>
<tr>
<td></td>
<td>- Generally poor on natural resources</td>
<td>• Low support for carrying this alternative forward</td>
</tr>
<tr>
<td></td>
<td>- Visual impact of new bay crossing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Would remove an existing recreational trail in Rush Creek Open Space Preserve.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- About 30 percent higher cost than least costly alternative.</td>
<td></td>
</tr>
<tr>
<td><strong>Burdell/Hog Island</strong></td>
<td><strong>Key Advantages:</strong></td>
<td></td>
</tr>
<tr>
<td>Alternative A4</td>
<td>- Least costly alternative</td>
<td></td>
</tr>
<tr>
<td>(causeway over floodplain and at-grade along SR 121)</td>
<td>- Lowest non-tidal wetland and low waters effects</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Primary Disadvantages:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Nearly worst for transportation-related criteria</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Generally poor on natural resources</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- High potential to effects special-status species and poor for ecological connectivity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Most new right-of-way needed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Visual impact of new bay crossing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Potential operation noise effects to residential areas along Lakeville Highway</td>
<td></td>
</tr>
</tbody>
</table>

CDFW = California Department of Fish and Wildlife; SMART = Sonoma-Marin Area Rail Transit

#### 6.3.2 SWG Concluding Observations

The summary comments documented in Exhibit 6-5 indicates that there was widespread support for Alternative A1B — On-SR 37 Causeway. The most frequent statements justifying support were that Alternative A1B would:

- Enhance current and long-term hydrologic and wildlife connectivity
- Benefit associated with maintaining the current alignment and taking advantage of existing right-of-way
- Result in lowest lifecycle cost
- Be most likely to minimize the near-term and long-term environmental impacts

Of those who commented, most felt that it was premature to dismiss alternatives in this stage of the study. Some expressed an interest in obtaining more detailed analysis or further refinements of the current alternatives.

The primary concern was an understanding of what could become of the existing SR 37 for alternatives that would not use the SR 37 right-of-way. There is a perception that alternatives might receive a ‘credit’ for potential restoration of remnant lands and adjacent wetlands where portions of the existing SR 37
roadway could be returned to natural state. However, despite this potential benefit, commenters generally did not support Alternatives A3 and A4 (Bahia/Atherton and Burdell/Hog Island, respectively) because it would:

- Result in high right-of-way needs
- Impact pristine and ancient wetlands and marsh area
- Provide the least transportation benefits

In addition, commenters provided valuable suggestions for areas that could be improved or approaches for addressing additional questions about the alternatives and analyses. The commenters’ suggestions are paraphrased below.

Listed below are suggestions for further alternatives development:

- **No Build alternative.** The No Build alternative should remain throughout the comparison because there are tangible economic, social, and environmental impacts from the no action that should be part of the comparative discussion.
- **Retreat alternative.** The retreat alternative was screened from the evaluation based on comparatively high potential for increases in VMT and potential for increases in congestion. However, keeping it may have shed light in the comparative analysis and/or provided other advantages that were not fully vetted in this assessment.
- **Incorporate rail.** It is important to incorporate transit and rail in this multimodal infrastructure project. A well-planned multimodal project will provide transportation options (both for humans and goods) as well as minimize environmental impacts.
- **Review necessity for access points.** Suggest being critical on how much to accommodate all levels of access and whether limiting access might be equally important to the objectives of the Project and surrounding landscape.
- **Two lanes versus three lanes.** There was concern that a long-term solutions would not maximize the transportation needs without considering a third lane (adding the HOV lane to the existing two general purpose lanes), thus more easily making room for transit.
- **Resolve use of left-over SR 37 right-of-way.** Need to understand what may become of the existing SR 37 right-of-way if a causeway or new alignment are preferred. This may change the analysis results.
- **Right-of-way over San Pablo Bay.** New right-of-way acreage over the bay should be distinguished from new right-of-way acreage on land/wetlands for the purpose of the alternatives analysis. Costs may be different, and temporary impacts related to staging construction equipment in wetlands would be very different from construction staging in open waters of the bay.
- **Conversion impacts of making Lakeville Highway an expressway.** The Alternative A4 evaluation doesn’t seem to fully discuss and disclose the potential impacts associate with conversion of an existing roadway (Lakeville Highway) into becoming the future expressway and what localized impacts would be associated with that.
- **Continue to refine alignments.** Further refinements would be advisable to avoid impacts on restoration lands, state property, and other valuable resource lands.

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4 Please review page 5-19, *Preserving Access* for details on how this DAA addressed the use of remaining SR 37 roadway under future condition.
• **Availability of fill material.** A feasibility analysis should consider whether there is enough fill possible for embankment solutions.

Listed below are the Alternatives Assessment Suggestions:

• **Reducing VMT.** This study does not resolve the issue of compliance with the regional VMT reduction. A traffic assessment is needed. Capacity enhancement projects are not supported.

• **Greenhouse gas.** This study did not address greenhouse gas emissions, which is a factor of construction materials (concrete for causeway and cement in the DSCM approach) as well as operations. This is in direct conflict with the objective of addressing sea level rise.

• **Wetland and U.S. waters.** For the purposes of the federal Clean Water Act, impacts would only be associated with the discharge of fill within wetlands and other waters. Such a differentiation would have a major shift on many of the current natural resources ratings for all the alternatives and in particular the causeway alternatives (A1B, B1B) and the over-bay (A2, B2) alternatives. Furthermore, pilings are usually not considered a fill discharge since they do not necessary change the flow or reach of waters.

• **Critical habitat.** Critical habitat was combined with the “waters” category. Tidal wetland habitat in San Pablo Bay is also designated critical habitat for endangered Sacramento River winter-run Chinook salmon, threatened Central California Coast steelhead Distinct Population Segment (DPS), and the threatened southern DPS of North American green sturgeon. In addition, all waters and tidal wetland in the assessment area are designated Essential Fish Habitat under three federal Fishery Management Plans under the Magnuson-Stevens Act: Pacific Coast Groundfish, Pacific Coast Salmon, and Coastal Pelagic Species.

• **Social equity.** Social equity issues need to be explained in more detail by expanding how specific neighborhoods or communities near the alternatives would be impacted by the construction and future roadway operations. The element of tolling needs to be explored and how the alternatives would differ in the placement of a tolling facility and the effect on the trips.

• **Managed Lanes/Tolling.** Differing methods for managing lanes could be integrated into the assessment process.

• **Assessment structure.** Consider separating out temporary from permanent and cumulative impacts as distinct categories.

• **Post-useful-life costs.** Consider the longer-term costs associated with removing the causeway/berm after their useful life.
7. Implementation

The vision for SR 37 presented in this DAA US 101 – SR 121 is not a static product. The driver of this study is to continue the discussions and discovery for solutions to address the long-term future of SR 37. Through both the DAA SR 121 – Mare Island and DAA US 101 – SR 121 studies, groups of vested stakeholders and agencies have become organized, increased their knowledge, and have answered many questions on how best to address a range of issues facing SR 37 and the surrounding environment. However, conceptual alternatives and analysis have run their course, and the pressure is building to move forward with results. This section summarizes the momentum, the next steps, and opportunities present.

7.1 Maintaining Momentum

Improving the near- and long-term resiliency and efficiency of the SR 37 corridor has brought stakeholder and political support in the Bay Area, at the state level, and in Washington, D.C. At the foundation of its support are well-established and trusted environmental organizations. These entities as well as their dedication and involvement are outlined below and continue to be valuable for maintaining the momentum of the SR 37 corridor solutions.

Vested Stakeholders. The environmental community is intimately involved with SR 37 corridor activities through a variety of means, including supporting the SR 37 DAA studies via their commitment in participating in the Environmental Technical Working Group. This community includes numerous non-profit organizations (such as Ducks Unlimited and Audubon Society) and land managers (such as California Department of Fish and Wildlife, water agencies, and California State Coastal Conservancy) as well as regional, state, and federal regulatory agencies. Many other stakeholders are equally invested, as evidenced by their involvement in the SWG. The SWG included the environmental stakeholders listed above plus landowners and stakeholders interested in finding transportation solutions (such as SMART), reducing greenhouse gas, and upholding the traditional and cultural resource values, to name a few. These parties are engaged and organized and see a mutual benefit in collaborating on how the SR 37 corridor will evolve. Collectively, this group understands that regional resiliency is the key to the future and aligning resources is the only way to facilitate long-term sustainability. These voices are allies in building support for long-term solutions.

Transportation Agency Jurisdictions. The SR 37 corridor crosses several agency jurisdictions, each with their own champions and political leaders. Chiefly through the SR 37 Policy Committee, the corridor has advanced with the leadership of the MTC/BATA, the Sonoma County Transportation Authority, the Transportation Authority of Marin, the Napa Valley Transportation Authority, the Solano Transportation Authority, and Caltrans. This spectrum of agencies provides political leaders on various boards and legislative bodies with multiple funding avenues. The SR 37 planning leadership team meet regularly to discuss and resolve issues expeditiously. Mega-projects such as SR 37 are vulnerable to discord; therefore, it is critical to maintain consistency in approach and public support to advance long-term solutions. This coordination is unique and a promising sign for forward movement.

Elected Officials. Local elected officials hold leadership positions on the MTC, which is at the forefront of advancing both the Interim and ultimate SR 37 solutions. The SR 37 corridor is also a priority for Bay Area leaders in the California legislature, including Senators Bill Dodd (SD-3), Mike McGuire (SD-2), and Assemblymember Marc Levine (AD-10). These state-elected officials have identified and secured millions
of dollars in state funding to advance critical components of the SR 37 corridor. Having multiple legislative districts in strong support of a major infrastructure investment is a benefit to securing funding and building political support with colleagues in the California legislature. Senator McGuire helped organize a widely attended virtual town hall in 2021 with agency and political leaders to educate the public on the importance of the SR 37 corridor and in 2019 secured significant state funding for the corridor. Senator Dodd is a strong support of the corridor and has previously proposed and continuing to propose legislation that would authorize tolling on the corridor to help finance the ultimate solutions. Assemblymember Levine has been a constant advocate for addressing the environmental and flooding issues associated with the current facility.

**Federal Officials.** At the federal level, Congressman Mike Thompson (CA-5) and Congressman Jared Huffman (CA-2) are strong advocates for the corridor and addressing the sea level rise risks facing the corridor as well as making equitable infrastructure investments to benefit disadvantaged communities who rely on the corridor.

Momentum and trust are key in maintaining these relationships to achieve mutual benefits. MTC and Caltrans commissioned the development of the SR 37 Comprehensive Multimodal Corridor Plan (Caltrans et al. 2021), which outlines a series of project-level priorities that may collectively lead to fulfilling the vision for SR 37. If momentum wanes, then engagement is likely to wane, and the chance for realizing long-term solutions weakens.

### 7.2 Process Going Forward

In the final steps of the DAA US 101 – SR 121, many inquired about how the data and assessment collected will lead to decision-making. Indeed, there are many requirements before the final solutions can become approved and funded.

During the SR 37 DAA development, Caltrans committed to developing the PEL study (see text box to right for description of PEL), which will assess SR 37 alternatives within the entire SR 37 study area.

The PEL will ultimately lead to a recommended set of alternatives to carry forward into the environmental review process and by doing so, streamline the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) review process. Caltrans is committed to incorporating information developed from the DAA SR 121 – Mare Island and DAA US 101 – SR 121 studies to inform the PEL as part of the process.

**Planning and Environmental Linkage (PEL)** refers to the process of using and relying on planning analyses, studies, decisions, or other information for the project development and environmental review of transportation projects. With PEL, the agencies can establish a project’s purpose and need; eliminate the need to further consider alternatives deemed to be unreasonable by relying on alternatives analyses conducted during planning; rely on future land use plans as a source of information for the cumulative impacts analysis required under NEPA; and/or rely on the modal choice selection as a method of establishing the criteria for the consideration of reasonable alternatives to address the identified need—provided such strategies are consistent with NEPA for the particular project.

This has been codified under 23 US Code 168, which provides additional weight to the PEL process, to enable the lead agency to defensibly rely on “planning agencies work” as long as it is “performance based” to reduce redundancy. Appendix A to 23 Code of Federal Regulations part 450 provides detailed guidance on how information, analysis, and products from transportation planning can be incorporated into and relied upon in NEPA documents.
By narrowing the range of solutions prior to beginning the CEQA and NEPA processes, resources can be more focused and streamlined in Project Approval and Environmental Document phase (referred to as the PA&ED phase).

When the environmental review process is complete and the state issues project approval, depending on available funding, final design, permitting, and construction could advance. Exhibit 7-1 outlines the process steps that follow this study. Funding opportunities are described in Section 7.3 below.

![Exhibit 7-1: Process Steps and Timeline Expectations](image)

### 7.3 Funding Pathways to Consider

The scale of solutions addressing the SR 37 corridor requires a multi-prong and broad approach to identify and secure funding and potentially financing such an investment. With the support of the political champions identified in Section 7.1 Maintaining Momentum, substantial funding has been lined up to begin advancing the critical early-phase development activities.

As mentioned, legislation is continuing to be proposed by California State Senator Bill Dodd to authorize tolling on the corridor, which would generate substantial funding toward implementing ultimate solutions. Any such plan to institute a fee on the corridor would take into account equity considerations, such as proposing means-based tolling.

There are ongoing conversations in the Bay Area to generate additional revenue for transportation operations and projects. The collected public outreach and listening sessions for these avenues can serve as an opportunity to build support for mega-projects like the SR 37 corridor and others that are on the front lines of resiliency and sea level rise impacts.

The California state budget can serve as a pathway for significant funding because the state is strongly supporting investment in climate change mitigation with projects that reduce greenhouse gas emissions and adaptation of infrastructure to sea level rise. California's PROTECT Formula Program offers over one-half a billion dollars over the next five years for infrastructure resilience planning and projects.
State funding is important in leveraging opportunities to secure major federal funding for mega-projects. A key theme in federal funding opportunities is resiliency, which aligns with the SR 37 corridor objectives. The resiliency funding opportunities are guaranteed through 2026 as a result of the Infrastructure Investment and Jobs Act. Resilience is a newly eligible funding objective within the National Highway Performance Program which is the largest funding program. This legislation provides unprecedented discretionary grant funding, to be administered by the U.S. Department of Transportation (USDOT), for large-scale surface transportation projects and the ultimate solutions for SR 37 corridor are already considered a priority by senior staff at the USDOT.

Themes that will continue to help position the SR 37 corridor for these funding options are resiliency, multimodal corridor solutions, and increasing efficiencies in moving goods and persons (as opposed to capacity enhancing). Additionally, there are opportunities to partner with the environmental community and regulatory agencies who may view a long-term SR 37 corridor solution as a significant improvement to current conditions that impede restoration efforts. Some of these opportunities are outlined in the next section.

7.4 Environmental Opportunities

The environmental community is committed to the ecological opportunities that the redesign of SR 37 could offer in allowing restoration and connection of valuable marsh and critical habitat areas. Not only do these marshlands have the potential to benefit federally listed California Ridgway’s rail, salt marsh harvest mouse, and many other species, but there are far-reaching benefits for the region. The San Pablo Baylands and tidal wetlands provide broad societal benefits, including:

- Reducing flood damage and erosion in low-lying areas like Petaluma, Novato, and SR 37 by absorbing floodwater and attenuating waves
- Benefitting regional water quality
- Sequestering and storing carbon, complementing statewide efforts to reduce greenhouse gas emissions
- Delivering scenic, aesthetic, recreational, historical, economic, and cultural values
- Enhancing conditions for threatened and endangered fish, such as steelhead trout and salmon

The marshlands that surround SR 37 are particularly valuable. In comparison to much of the rest of the San Francisco Bay, the San Pablo Baylands are relatively undeveloped, with intact natural processes. As a result, there is tremendous opportunity for restoration to create a mosaic of dynamic, diverse, and connected habitats from the bay to its watersheds. There are many opportunities to integrate infrastructure improvements for SR 37 with existing and future habitat planning, conservation, and restoration projects to ensure healthy ecosystem function and resilience to landscape-scale change of San Pablo Bay. To the extent that the following environmental benefits could be realized, highway proponents and the environmental community remain dedicated to a mutual vision.

1. Facilitating conveyance of current and future water, sediment, and species, in concert with restoration objectives which could be achieved through:
   - Building new SR 37 bridge crossings to allow existing and future restored tidal wetlands to connect fully through the channels to bay waters that are foundational to the health of the wetlands, and
Removing barriers to restoration efforts by raising SR 37 and the SMART railroad on a causeway.

2. Converting roadway into habitat when land uses change and local access is no longer needed which would be helping to enhance wetland, upland, and other habitats in these areas.

3. Acquiring property for the mutual benefit of SR 37 mitigation and restoration. This is a natural opportunity for partnership. For example, the Sonoma Land Trust has already acquired or has easements on significant Baylands parcels. A coordinated approach should result in more efficient use of resources.

4. Integrating SR 37 mitigation early into the planning process guided by a regional, ecosystem-based approach to species protection and recovery. This approach will improve ecosystem function and landscape resilience into the future.

An example of this integration is MTC’s initiative to advance mitigation planning by developing a North Bay Baylands Regional Conservation Investment Strategy (RCIS). A Wildlife Conservation Board provided a ‘San Francisco Estuary Partnership grant’, providing MTC, together with Caltrans and SCTA an opportunity to advance mitigation planning. RCIS will create a framework to inform landscape-scale conservation, enhancement, and restoration actions to benefit the ecological health and climate resilience of focal species and sensitive habitats within the RCIS boundary. The RCIS will identify high-value conservation and habitat enhancement opportunities and provide a science-based guide for both voluntary conservation and mitigation actions. The California Department of Fish and Wildlife (CDFW), other resource agency staff, and stakeholders will be engaged throughout the RCIS development process.

Other opportunities exist with partnering with existing environmental restoration planning. Mitigation for the SR 37 redesign should be integrated with the extensive ecological planning for this region that has already occurred. Potential mitigation sites have been identified by the Baylands Group and collected in Appendix J, Potential Ecological Restoration and Mitigation Opportunities.

### 7.5 Considering the Full Impact of Delay

Momentum for finding viable solutions for projected sea level rise on SR 37 is present but can easily wane. The need for finding long-term solutions (see Section 2.1, Needs Statements) is well documented in many studies. While it is important to seriously weigh the need for major capital investments, it is also essential to consider the broad environmental, community, and social equity costs of continuing to delay action. A few of these costs of delay are listed below:

- **Cumulative cost of incremental improvements and maintenance.** The long-term cost of incrementally raising SR 37, which may require multiple construction projects throughout the entire corridor and multiple years of traffic delays.

- **Environmental cost of interim solutions.** Interim solutions should not pre-determine the range of long-term solutions for SR 37, but repetitive construction projects may impact the ecology with incremental cumulative impacts.

- **Regional cost of restricting rising sea waters in San Pablo Bay.** Continuing to restrict flood waters from flowing into the Baylands can lead to higher storm surges throughout the bay, thus potentially worsening damages elsewhere. Modeling with 2 meters (6.5 feet) of sea level rise has shown that
continued flood restrictions (not restoring flow to Bayland areas) along the SR 37 corridor would increase bay water levels by 0.5 foot in San Pablo Bay and lesser amounts elsewhere in San Francisco Bay, with effects felt as far as the South Bay (Hummel and Stacey 2021). Allowing flow into the San Pablo Bay Baylands and other San Francisco Bay Baylands is one component of regional flood risk reduction being considered by area flood protection agencies in order to reduce the number and height of flood defenses required around the Bay with sea level rise.

- **Adverse social equity impacts of letting the roadway become inoperable.** The COVID-19 pandemic has provided a perception that routine commuting may change from the previous status quo, but traffic has already returned to pre-pandemic conditions in the SR 37 corridor. While it is difficult to anticipate broad trends in professional business, there are social equity injustices in assuming roadways could diminish in importance. The service industry cannot be transported to virtual rooms. Maintenance workers, emergency providers, and teachers are frequently unable to afford to live near their place of work nor can they resort to virtual work.

- **Regional transportation impact of SR 37 closures.** The study team received abundant public comments about their exasperation from recurring closures on SR 37 bringing traffic to a standstill. These SR 37 closures have shown that traffic will disperse and impact regional circulation which affects emergency services, goods movement, as well as long delays in the region’s productivity. Transportation modeling can help reveal these impacts of no action.

- **Emergency Preparedness.** North of the San Rafael-Richmond I-580 bridge, SR 37 is the most direct west-east highway and a vital link in many northwest - southeast or southwest – northeast circulation pattern for the northern San Francisco Bay Counties. SR 37 is recognized as the Recovery-Route. Recovery Routes are a subset of the California Lifeline Route System. Lifeline Routes take first priority in terms of route recovery/restoration following a major incident or disaster for the purpose of emergency movement of goods and services. Recovery Routes are considered the next priority for recovery/restoration to further expand the movement of goods and services after major incidents or disasters. If the San Rafael-Richmond I-580 bridge, which is a lifeline route, were impaired, SR 37 would be the primary access and evaluation route for Marin County. SR 37 corridor is vital to the circulation and emergency preparedness for the region.

This list is by no means complete, but the messages need to represent the concerns that face this region to maintain the conviction for action.
8. References

AECOM. 2021. Traffic Operations Analysis Report for Highway 37 Sears Point to Mare Island Improvement Project.


