JANUARY 2020

THE ALVISO WETLAND RAILROAD ADAPTATION ALTERNATIVES STUDY

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The railroad corridor linking Alameda and Santa Clara Counties in the San Francisco Bay Area is owned by Union Pacific Railroad (UPRR) and is known as the Coast Subdivision. In addition to UPRR freight trains, the Coast Subdivision is used by passenger trains operated by the Capitol Corridor Joint Powers Authority (CCJPA), San Joaquin Regional Rail Commission (SJRRC), and Amtrak. Together, the three passenger rail agencies operate up to 24 trains per day on the corridor. Both CCJPA and SJRRC plan to increase passenger train frequency between Alameda and Santa Clara Counties. Improvements to the rail infrastructure along the Coast Subdivision are an important component of those plans.

The Coast Subdivision traverses a low-lying, environmentally sensitive wetland area between the City of Newark and the community of Alviso that is subject to inundation with even a moderate amount of sea-level rise (please see *Figure ES-1 below*). Because the Coast Subdivision is the only passenger rail route connecting Alameda County with Santa Clara County, inundation of the rail line would disrupt passenger rail service between these counties, affecting thousands of travelers each day and causing train delays throughout the larger Northern California rail network.

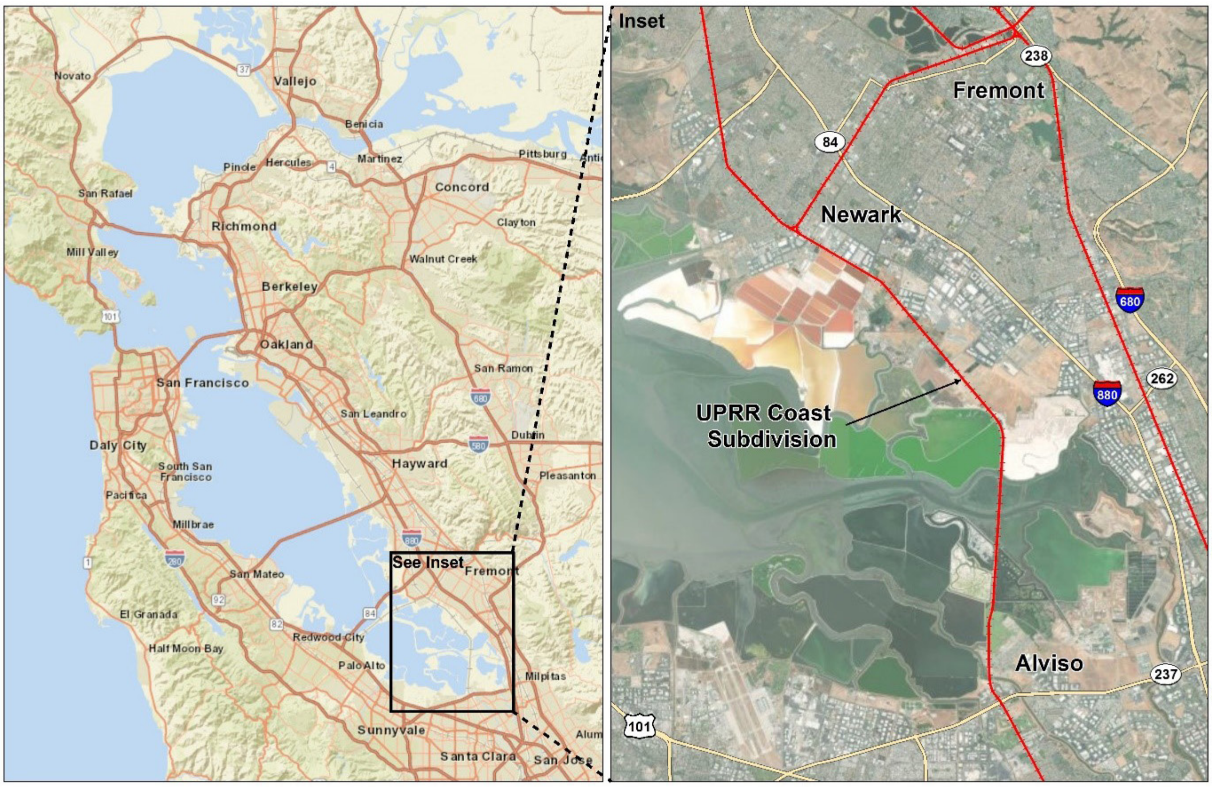


Figure ES-1

Moreover, between Newark and Santa Clara, the majority of the Coast Subdivision consists of a single track, which limits the number of trains that can traverse this area. Additional tracks would be required to enable more passenger trains to operate on this section of the Coast Subdivision.

To prepare for future sea-level rise and to understand how planned increases in passenger rail service could be achieved on the Coast Subdivision between Newark and Santa Clara, the CCJPA initiated this Alviso Wetland Railroad Adaptation Alternatives Study. The Study process engaged a broad range of key stakeholders and allowed the CCJPA to better understand the issues and interests related to the existing infrastructure, effects of sea-level rise, ecological systems, and local communities in the Study area. If CCJPA elects to pursue rail line capacity or sea-level rise adaptation and resiliency improvements in the Study area, CCJPA will be better informed as to all these issues.

To guide the Study, CCJPA established three main objectives:

- Improve resiliency to sea-level rise,
- Improve the existing railroad infrastructure to provide more operational capacity, and
- Identify potential benefits for stakeholders.

The Study commenced with several conceptual adaptation options for raising and/or realigning the railroad tracks, an assessment of existing conditions, identification of opportunities and constraints to possible future adaptation options, and extensive stakeholder engagement. A series of stakeholder meetings was convened to:

- Introduce stakeholders to the purpose of the Study and outline the Study process,
- Introduce preliminary conceptual options for the rail alignment,
- Listen to stakeholder concerns, priorities, and questions, and
- Refine the conceptual options based on stakeholder input.

Stakeholder outreach extended over approximately nine months and focused on agencies and organizations with a direct interest in the rail alignment and its surrounding area. It included federal, state and local government agencies, non-governmental organizations, community groups, local residents, land owners, Native American organizations, and local businesses. The stakeholder input was crucial in the understanding of the opportunities and constraints facing possible adaptation and alignment options. Outreach efforts also included Union Pacific Railroad, the owner of the Coast Subdivision. While UPRR has received a copy of this Study, UPRR has not endorsed any of the options.

The stakeholder outreach process resulted in four conceptual options for routing the rail line between Newark and Santa Clara. Each option would elevate the railroad tracks to address sea-level rise and also allow for up to three parallel tracks to increase rail line capacity. The options are briefly summarized here. More detailed descriptions are provided in the remainder of the Study Report.

The conceptual options include completely new alignments (Option 1 and Option 2) located to the west of the existing alignment. These new alignments would rely on long bridge structures extending several miles across wetland and open water areas. The two other options included more modest modifications of the existing alignment (Option 3), or would simply raise and widen the existing railroad embankment to allow for additional tracks (Option 4).

As part of the evaluation of each of the Options, the Study includes preliminary research into the resources (cultural, historic, environmental, private property, etc.) and communities potentially affected by each option. In addition, rough-order-of-magnitude cost ranges are included for each of the conceptual options. The resulting costs range from the lowest of $800 million to the highest of $2.1 billion. The estimate for each option includes a substantial contingency.

Please note that this study is not intended to identify a preferred option or to rank options, and it is not the commencement of a formal environmental documentation process. However, the evaluation does include a subjective comparison of the potential effects of each option and the stakeholders and resources potentially affected. In addition, the Study identifies potential benefits for stakeholders, such as opportunities for habitat restoration, safety improvements, and possibilities for reduction of train effects (e.g., noise) in the community of Alviso. The Study also identifies benefits for rail operators, such as increased resiliency to sea-level rise and improved rail line capacity, which would result in more frequent and reliable train travel options for the public.

REPORT

I. INTRODUCTION

The passenger railroad corridor that connects Alameda County with Santa Clara County is known as the Coast Subdivision[1]. This corridor is owned by Union Pacific Railroad (UPRR) and serves both UPRR freight trains and the passenger rail services operated by the Capitol Corridor Joint Powers Authority (CCJPA), Altamont Corridor Express (ACE), and Amtrak. Between Newark and the community of Alviso, the Coast Subdivision consists of a single track that traverses a low-lying area, often described as the Alviso wetlands, that will be subject to flooding with even a moderate amount of sea-level rise.

Flooding of the rail line would sever passenger service between these areas, potentially affecting thousands of travelers each day. In addition, while both CCJPA and ACE plan to expand train service to Santa Clara County, the existing single track constrains the number of passenger trains that can be operated in this area.

The CCJPA, managing agency of the Capitol Corridor intercity passenger rail service, has undertaken this Alviso Wetlands Railroad Adaptation Alternatives Study (Study) to prepare for future sea-level rise and increases in passenger service.

This Study evaluates infrastructure options that would both address the effects of sea-level rise and improve the capacity of the rail corridor. As described in this report, the Study process developed possible adaptation alternatives for the railroad infrastructure in the low-lying wetland area between Newark and Alviso, often known as the "Alviso wetlands."

I.A. About the Capitol Corridor Joint Powers Authority

The Capitol Corridor intercity passenger rail service provides a convenient alternative for travel along the congested Interstate 80, 680, and 880 freeway corridors. Funded by the State of California, the Capitol Corridor operates reliable, time-competitive passenger rail service to 18 stations within the eight Northern California counties of Placer, Sacramento, Yolo, Solano, Contra Costa, Alameda, San Francisco, and Santa Clara; a rail corridor totaling approximately 170 miles. In conjunction with an extensive network of dedicated motor coaches, the Capitol Corridor serves the second-largest urban area in the Western United States. Capitol Corridor services are developed with input from riders, stakeholders from both the private and public sectors, and with the partners who help deliver the Capitol Corridor service: Amtrak, UPRR, the California Department of Transportation (Caltrans), and the various transportation agencies and local communities along the route.

The CCJPA is a partnership among the six local transit agencies in the Capitol Corridor's eight-county service area that shares administration and management responsibilities for this train service. In the last five years, the CCJPA has developed a long-range Vision Plan Update (https://www.capitolcorridor.org/vision-plan/) that contemplates an increase in the frequency and speed of passenger trains throughout the corridor. The improved service would ultimately result in half-hourly Capitol Corridor service in both directions, in addition to the commuter rail service provided by ACE and long-distance rail service provided by Amtrak.

In addition to the Vision Plan Update, CCJPA is committed to realizing the goals of another long-range planning document, the Caltrans 2018 California State Rail Plan (State Rail Plan).[2] The State Rail Plan lays out an ambitious vision for a coordinated, statewide passenger rail network that is built on increased frequencies and reliability, among other service concepts. The State Rail Plan's 2040 Vision Rail Map identifies half-hourly rail service between Oakland and San Jose. It is important to note that the State Rail Plan does not identify any specific passenger rail service providers, meaning that the half-hourly service could be provided by the Capitol Corridor, ACE, or some future operator.

I.B. Background and Purpose of Alviso Wetlands Railroad Adaptation Alternatives Study

A key objective of this Study is to identify the steps necessary to improve resiliency against sea-level rise in the rail corridor between Newark and Alviso, in the area of the Alviso wetlands. However, the investments necessary to provide such resiliency could also create other benefits. For example, passenger rail operators have determined that the portion of the corridor between Newark and Alviso needs additional capacity to meet increased demand

1 Although the term "Coast Subdivision" describes the entire rail line between Oakland, San Jose, and San Luis Obispo, the subject of this Study is only the section between Newark and Alviso. Union Pacific Railroad owns the entire Coast Subdivision. Another corridor also owned by UPRR, the Warm Springs Subdivision, extends between Fremont and San Jose. However, because of its alignment, many grade crossings, multiple freight yards, and lack of access to the two passenger stations in Santa Clara, the Warm Springs Subdivision is not available for use by passenger trains.

2 The 2018 State Rail Plan is available on the Caltrans website at https://dot.ca.gov/programs/rail-and-mass-transportation/california-state-rail-plan.

for passenger rail service linking Alameda and Santa Clara Counties. In this case, "capacity" would take the form of additional tracks that could be constructed in conjunction with sea-level rise resiliency improvements. Increasing the number of tracks would allow more trains to operate over this section of railroad, and to do so more reliably.

A suite of infrastructure investments to improve sea-level rise resiliency and rail line capacity may also achieve benefits for the environmentally sensitive area between Newark and Alviso. Previous studies of this corridor[3] identified the sensitive nature of the landscape surrounding the tracks for nearly the entire distance between Newark and Alviso, particularly the Don Edwards San Francisco Bay National Wildlife Refuge (Refuge), which owns property on both sides of the rail line. These earlier efforts also determined that numerous interest groups are actively invested in the Refuge. This Study has identified these groups and performed initial outreach to engage them and understand their priorities.

Likewise, the previous studies identified constraints on the expansion of rail line capacity in the community of Alviso. Currently, the railroad bisects a residential and commercial portion of Alviso. The railroad runs through a narrow corridor in Alviso, sandwiched between roadways and private properties; there are also two at-grade crossings in Alviso. Because more frequent trains in the Study corridor would increase train traffic through Alviso, this Study identified stakeholders in the Alviso community and engaged them to understand their priorities.

Thus, to reflect the potential for wide-ranging benefits from investments in the rail corridor, this Study focused on the investments that would accomplish one or more of three main objectives:

- Improve resiliency to sea-level rise
- Improve the existing railroad infrastructure to provide more operational capacity
- Provide benefits for local stakeholders

Each of these objectives is discussed in greater detail in *Section I.B.2, Objectives*, below.

The extent of the Study area was considered to be the railroad corridor bounded on the north by a point in Newark, midway between Central Avenue and Mowry Avenue and on the south by a point just north of State Route 237, near the community of Alviso (see *Figure 1, Study Area*).

As part of this Study, four alignment options were developed for the railroad corridor between Newark and Alviso. These options are described in detail in *Section III, Development of Conceptual Options*. The options are numbered from west to east, "Option 1" through "Option 4." In general terms, the options range from completely relocating the tracks to west of the current railroad alignment and to west of the community of Alviso (Option 1), to generally remaining on the existing railroad alignment but simply raising the tracks several feet to provide resiliency to sea-level rise (Option 4).

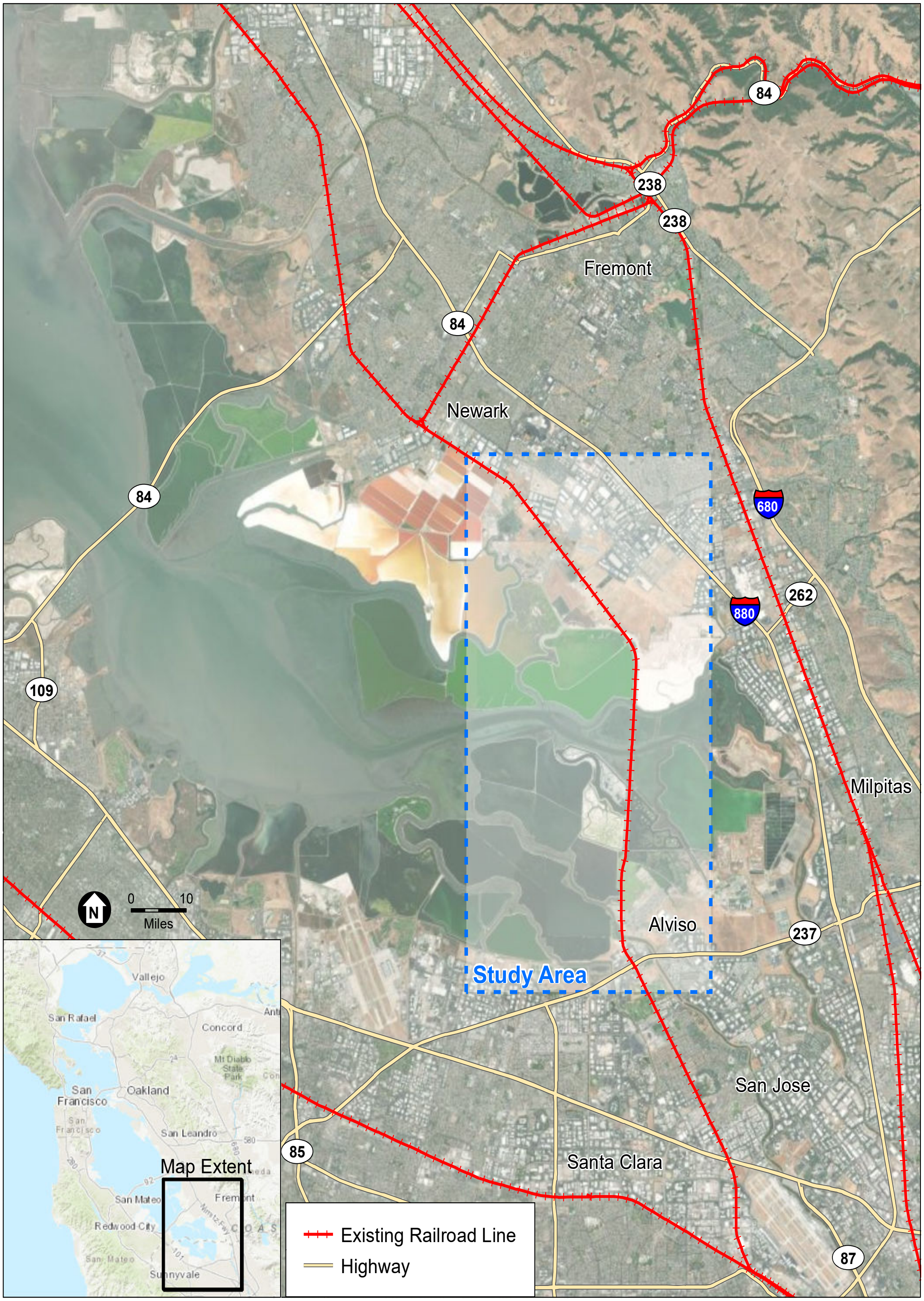
This Study is not initiating a formal environmental documentation process and will not result in the identification of "preferred" alternatives. Rather, this Study is intended to identify the constraints and opportunities in this corridor, engage stakeholders, and identify the stakeholders' key issues.

I.B.1. ADJACENT LAND MANAGEMENT AND REGULATORY OVERVIEW

Land Management Overview

The majority of the existing railroad right-of-way between Newark and Alviso is surrounded by the Don Edwards San Francisco Bay National Wildlife Refuge, a federally designated refuge established in 1972 to preserve and enhance wildlife habitat; protect migratory birds and threatened and endangered species; and provide opportunities for wildlife-oriented recreation and nature study for the surrounding communities. Major portions of the Refuge consist of vernal pools, wetlands, and "ponds." The ponds are low-lying areas of land encircled by low levees that were previously used for commercial production of table salt by solar evaporation of seawater. Many of the ponds on both sides of the existing rail line are being restored to a natural, wetland state, though some continue to be used for salt production.

3 Both CCJPA and the San Joaquin Regional Rail Commission (operator of the ACE passenger rail service) have conducted previous planning efforts in this corridor, most recently the 2017 ACE*forward* Draft Environmental Impact Report. In 2014, CCJPA conducted a sea level rise vulnerability assessment along the entire CCJPA corridor. In 2002 CCJPA performed an informal high-level review of infrastructure constraints.



Alviso Wetlands Railroad Adaptation Alternatives Study

Figure 1
Study Area

The south end of the Refuge is bordered by the community of Alviso, which itself is low-lying and has been subject to flooding in the past. Current efforts to protect Alviso and major portions of Santa Clara and San Jose from flooding include the South San Francisco Bay Shoreline Project, which includes construction of levees; and the South Bay Salt Pond Restoration Project, which includes restoration of the low-lying marsh areas and former salt ponds, which will not only create wildlife habitat, but also afford flood protection.

Where the Refuge surrounds the existing railroad right-of-way, any future rail corridor relocation that would extend beyond or entirely depart from the existing right-of-way could involve acquiring property from the Refuge. Because the Refuge was originally established by an act of Congress, any property acquisition from the Refuge would require enabling legislation by Congress. Several of the options would require acquisition of right-of-way from the Refuge.

The Refuge is the major landowner, but several other key landowners surround the UPRR rail line:

- Cargill Salt (Cargill), which operates salt production ponds
- The Santa Clara County Parks and Recreation Department (Santa Clara County Parks), which operates the Alviso Marina
- Owners of residential and commercial properties in the Alviso area

UPRR owns the existing railroad track and right-of-way, which is generally 100 feet wide between Newark and Alviso (although UPRR's right-of-way narrows in Alviso)

Regulatory Overview

Because there is a federal nexus (based, for example, on adjacent land ownership and effects on waters of the United States), an environmental impact statement developed in accordance with the National Environmental Policy Act (NEPA) would be required for any future project. In addition, based on likely funding sources from and engagement with a host of California agencies, an environmental impact report (EIR) prepared in accordance with the California Environmental Quality Act (CEQA) would also likely be required. The scope of any environmental documentation effort would be defined by both federal and state law. The environmental documentation process also requires consideration of a "no-build" or "no project" option.

Any future environmental documentation process would address many other resources that could be affected by the various options, such as historic resources; threatened and endangered species; environmental justice communities; private properties; and air quality, to name a few. Stakeholder engagement would be particularly important because various stakeholder groups have made substantial investments in infrastructure and environmental restoration along the corridor.

After completion of the environmental documentation process, if any of the options were selected, an extensive permitting process would be required for construction.

I.B.2. STUDY OBJECTIVES

As discussed previously, this Study focused on investments that would accomplish one or more of three main objectives:

- Improve resiliency to sea-level rise
- Improve the existing railroad infrastructure to provide more operational capacity
- Provide benefits for local stakeholders

These objectives and their underlying issues are discussed individually below.

While the Study focused on infrastructure investments, a key component of the Study process was to identify and contact stakeholder groups, to understand stakeholder concerns, and to provide stakeholders with an opportunity to shape future efforts.

Improve Resiliency to Sea-Level Rise

Global sea-level, and thus sea-level in San Francisco Bay, is expected to rise as a result of climate change. Accompanied by storms, high winds, and waves, even a small amount of sea-level rise has the potential to flood the existing railroad tracks in the low-lying area between Newark and Alviso. Under current conditions, the rail line infrastructure between Newark and Alviso is nearly flooded during combined "King Tide" and storm surge events, as these events result in high water only a few feet below the existing railroad tracks.

If nothing is done to adapt the vulnerable railroad infrastructure, intermittent storms and permanent sea-level rise will cause closures of the rail line, which would become more frequent over time. Each closure will disrupt both passenger and freight traffic. Initially, with a small amount of sea-level rise, such closures would occur only during high tides and storm conditions. After each flooding, the railroad infrastructure would need to be inspected for damage before reopening for service. The inspection process itself would disrupt regular train service even if no damage is found. If the inspection finds damage, the rail infrastructure would require restoration measures after such closures to reopen the line for service. For example, rock reinforcement might need to be installed in order to stabilize and rebuild the embankment supporting the rail line.

Eventually, more significant sea-level rise would make rail line closures more frequent. In some cases, other routing options may be available for freight traffic, bypassing the Newark and Santa Clara areas by using a more circuitous route (with many at-grade crossings) through downtown San Jose. However, because several passenger stations are served only by the current route (e.g., Santa Clara–Great America and Santa Clara–University stations), no other routing options are available for passenger trains.

Adaptation to sea-level rise has already influenced the infrastructure of the Alviso area. The South Bay Salt Pond Restoration Project is currently improving flood protection around Alviso by restoring the former solar evaporation ponds to natural, wetland habitat, which will also provide some level of resiliency against sea-level rise and wave action. The South San Francisco Bay Shoreline Project is a joint project between the U.S. Army Corps of Engineers (USACE), Santa Clara Valley Water District (Valley Water), and the California State Coastal Conservancy which will also provide flood protection by building an approximately four-mile-long section of levee and enable the future restoration of several former salt production ponds. The Army Corps' current planning efforts assume that the new levee will be built-up around the existing rail line, with the railroad passing through the levee and a new flood gate, which would normally be open, but which could be closed during high water events, located at the railroad tracks.

In addition, the existing conditions of the ponds are in flux as the South San Francisco Bay Salt Pond Restoration Project implements an adaptive management approach for habitat restoration and the Army Corps constructs the new levee. The elevation of the new levee will be approximately 15.3 feet North American Vertical Datum of 1988[4] (NAVD88), a height that USACE and Valley Water determined was necessary to protect the Alviso and Santa Clara areas from forecasted sea-level rise until the year 2067. This elevation is based on a 50-year projection of sea-level rise (starting from 2017, the completion date of their study) as outlined in state sea-level rise guidance ("Curve 3"), plus two feet of additional clearance to account for wave run-up. To be consistent with these other efforts, this Study has also adopted 15.3 feet NAVD as the elevation above which the railroad infrastructure must be raised to consistently protect the railroad from sea-level rise, and to enable the railroad tracks to pass over the flood protection levee (rather than through it via a floodgate).

Improve Existing Railway Infrastructure

Currently, the number of trains that can traverse the rail line between Newark and Santa Clara is limited by the existing single railroad track. The Capitol Corridor operates seven round-trip trains between Oakland and San Jose, ACE operates four round-trip trains on weekdays, and the Amtrak long-distance Coast Starlight has one daily round trip. In addition, several UPRR freight trains traverse this rail line each day.

As outlined in the CCJPA Vision Plan and reinforced in the State Rail Plan, CCJPA is developing plans to increase the frequency of passenger train service and reduce travel time along the Capitol Corridor between Oakland and San Jose. In the future, CCJPA contemplates as many as 15 daily round trips. By increasing the frequency with which trains are available to passengers and reducing the time required to travel between these locations, CCJPA anticipates that more travelers will choose to use the train over automobiles, with the associated benefits of reduced roadway congestion, reduced greenhouse gas emissions, and improved air quality.

ACE also has planning documentation that contemplates an increase in the number of passenger trains it operates through the Study area.

4 The "zero" elevation of mean lower low water as reflected on tidal charts is approximately 0.9 feet below the NAVD88 datum elevation. This conversion is based on information provided by the National Oceanic and Atmospheric Administration's Online Vertical Datum Transformation tool ("VDatum") available at https://vdatum.noaa.gov/vdatumweb/.

Currently, passenger train travel time through the Study area — between Newark (near the existing Central Avenue grade crossing) and the Gold Street Connector, just south of Alviso — is approximately eight to nine minutes. Today the maximum passenger train speed through the Study area is 70 miles per hour (mph), although in many portions of the Study area, passenger trains are limited to lower speeds. To reduce travel time, this Study contemplates increasing passenger train speeds through the Study area. Conceivably, future passenger train speeds could range between 79 mph and 150 mph, depending on the infrastructure options selected. Federal regulations dictate the types of infrastructure required for various speed ranges. The most stringent requirements (e.g., the broadest curves and complete elimination of grade crossings) are associated with the highest speeds, over 110 mph. For reference, if trains were to operate at the maximum contemplated speed of 150 mph, there would be a time savings of approximately four to five minutes, compared with today's travel time between Newark and Alviso.

Freight trains usually operate at much slower speeds than passenger trains; in the Study area freight trains are limited to 60 mph. Similar to a highway, faster trains must reduce speed when a slower train is ahead of them. Thus, to allow passenger trains to operate at consistently higher speeds without interference from freight trains, it is often necessary to provide separate tracks for the passenger trains. In addition, if the passenger train system is ever converted to a fully electrified system that draws power from a system of overhead wires, the significantly taller freight trains could interfere with the overhead system and may need their own dedicated track without overhead wires.

This Study has incorporated separate tracks for freight and passenger trains as a base assumption, meaning that the infrastructure options described below contemplate up to three parallel tracks between Newark and Alviso.

Enable Benefits for Stakeholders

CCJPA expects that a project to provide sea-level rise resiliency for the rail line could also benefit additional stakeholders. For example, the project offers the opportunity to collaborate with the Don Edwards San Francisco Bay National Wildlife Refuge to provide opportunities to restore habitat, improve the connectivity of existing habitats, otherwise accommodate sea-level rise, and/or improve public access to the Refuge. There are also opportunities to collaborate with the community of Alviso to improve safety around the railroad corridor and to identify options that could entirely remove the railroad from Alviso.

I.B.3. OPTIONS CONSIDERED

This Study ultimately focused on four conceptual alignment options between Newark and Alviso. These are described in more detail in *Section III, Development of Conceptual Options,* of this Study. However, to understand the features and resources that set the backdrop for this Study, see *Figure 2, Conceptual Option Overview*, which illustrates the four conceptual options considered.

I.C. Previous Efforts

The most recent effort to examine rail capacity in the Newark-to-Alviso corridor was led by the San Joaquin Regional Rail Commission (SJRRC), the operator of the ACE service. In addition, CCJPA performed a general study of sea-level rise vulnerability along the entire corridor from San Jose to Sacramento. In approximately 2002, CCJPA also conducted preliminary planning to assess the constraints of adding capacity in the Study area. These efforts are described below.

I.C.1. ACE*forward* ENVIRONMENTAL IMPACT REPORT

In 2017, the SJRRC developed the ACE*forward* Draft Environmental Impact Report (DEIR) that analyzed the impacts of a proposed service expansion between San Jose, Stockton, and Merced. The primary purposes of the project were to increase the frequency and reliability of existing ACE service; expand the service to reach new markets in the Central Valley (e.g., Merced); enhance intercity transit connectivity; and reduce travel times, traffic congestion, and greenhouse gas emissions. The DEIR contained near-term and long-term improvements at a project level and program level of detail, respectively.

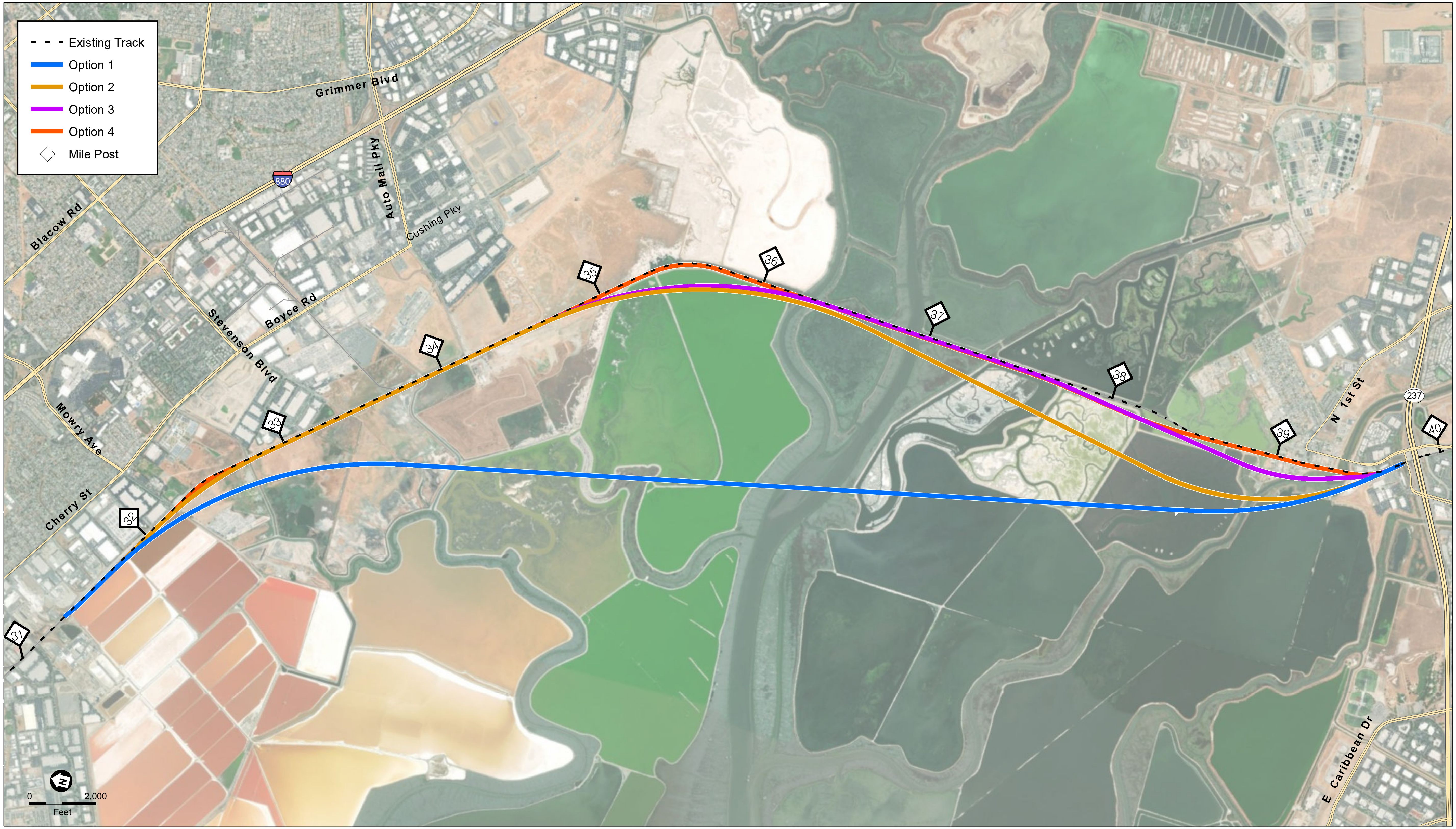
In the area between Newark and Alviso, the DEIR identified several long-term improvement alternatives. The DEIR assumed that improvements would be contained entirely within the UPRR right-of-way while still raising the tracks to address sea-level rise. To accomplish this, the tracks would be raised on either vertical-faced retaining walls or embankments with relatively steep side slopes.

I.C.2 CCJPA SEA-LEVEL RISE VULNERABILITY ASSESSMENT AND PRIOR EFFORTS

The CCJPA Sea-Level Rise Vulnerability Assessment (2014) identified physical, functional, governance, and information vulnerabilities for different rail assets (such as tracks and stations) in six focus areas along the Capitol Corridor route. These vulnerabilities were identified through Geographic Information Systems analysis and consultation with asset managers. The Newark-to-Alviso area was one of the six focus areas, based on the proximity of the railroad tracks to San Francisco Bay.

The vulnerability assessment used adaptation planning methods developed by the San Francisco Bay Conservation and Development Commission's Adapting to Rising Tides Program. The program comprises multi-sector, cross-jurisdictional projects that build local and regional capacity in the San Francisco Bay Area to plan for and implement adaptation responses. The vulnerability assessment helped CCJPA staff to plan for future impacts on the Capitol Corridor passenger train service caused by climate change, such as increased frequency of flooding events and increased rates of shoreline erosion.

In 2002, CCJPA conducted a brief technical study of the constraints associated with adding one track through the Study area. That effort identified the existence of technical hurdles and identified that there are many stakeholders in the area of any potential project. The study determined that, while technically feasible to increase the number of tracks between Newark and Alviso, any proposed project and its associated environmental documentation would be very complex and would need to engage diverse stakeholder groups.



Alviso Wetlands Railroad Adaptation Alternatives Study

Figure 2
Conceptual Option Overview

II. EXISTING CONDITIONS AND STUDY METHODOLOGY

II.A. Existing Conditions in the Study Area

The existing railroad right-of-way between Newark and Alviso is owned by UPRR and is part of a longer segment of track (extending between Oakland and San Luis Obispo) known as UPRR's Coast Subdivision. The Coast Subdivision is part of the rail link between the Bay Area and Los Angeles. Three passenger rail operators — CCJPA, SJRRC, and Amtrak — have separate agreements with UPRR allowing their respective passenger services to operate on the UPRR track.

Points along the UPRR corridor are defined by "mileposts," markers along the track that indicate the number of miles from a given starting point[5]. The north end of the Study is at UPRR MP 31.5, which is approximately 4,000 feet north of the existing Mowry Avenue grade crossing. The south end of the study area, the grade crossing at the Gold Street Connector, immediately north of the State Route 237 overcrossing, is at approximately MP 39.8.

The width of the existing UPRR right-of-way between Newark and Alviso varies, but generally ranges from 100 feet between MP 31.5 (near Mowry Avenue) and MP 39.0 (near Alviso), to as narrow as 50 feet near MP 39.8, at the Gold Street Connector grade crossing, just south of Alviso.

At Albrae, there is a relatively short passing siding (0.8 mile long, approximately MP 34.0 to MP 34.9). However, many freight trains are longer than this siding, meaning that two freight trains may not be able to meet at this location, or a meet between a long freight train and a passenger train would require the passenger train to stop. Because passenger trains are typically shorter than freight trains, two passenger trains could meet at the Albrae siding. However, the next opportunity for CCJPA or ACE passenger trains to pass each other is at Santa Clara–University station, near MP 45.

In the portion of the Study area that lies between Albrae (just south of the existing Auto Mall Parkway grade crossing) at MP 34.9 and Alviso, the existing railroad consists of a single track. In this area, trains traveling in opposite directions cannot pass each other and trains traveling at different speeds, but in the same direction, cannot overtake one another.

The following sections further describe existing conditions in the Study Area. As noted, the four alignment options considered are discussed more comprehensively in Section III. At this early stage of study, "hybrid" options — for example, mixing parts of Option 1 and Option 4 — have not been considered, even though such hybrids may be technically feasible.

II.A.1 PHYSICAL FEATURES AND PROPERTY OWNERSHIP

Physical Features

The following description of community and environmental features along the corridor proceeds from north to south, in the direction of increasing mileposts.

From the beginning of the Study area (approximately MP 31.5) to the Mowry Avenue grade crossing (MP 32.2), the railroad is bounded on the west by Cargill's salt harvest ponds and on the east by a UPRR switching yard and industrial development. The salt ponds rely on a complex series of channels and pumps to route seawater through the ponds, allowing water to evaporate until the salt is sufficiently concentrated into a solid form to allow it to be mechanically collected.

Between the grade crossings at Mowry Avenue (MP 32.2) and Stevenson Boulevard (MP 33.4), the railroad is surrounded by private lands. This area is characterized by privately-owned, mostly open space on the west, designated as "Newark Area 4" (currently used for agriculture), and mostly by light industrial space on the east. There have been multiple plans for residential development in Area 4. Those plans have not yet been realized, but current development proposals are pending with the City of Newark. Area 4 lies within the federally designated boundary of Don Edwards San Francisco Bay National Wildlife Refuge. Although the Refuge does not own the Area 4 property, the Refuge may acquire the property if funding becomes available and the Refuge is able to reach agreement with the private owner of the Area 4 property.

5 In the case of the Coast Subdivision, the starting point for milepost numbering is in Oakland. Milepost numbering increases proceeding southward from Oakland toward San José.

Between the grade crossings at Stevenson Boulevard (MP 33.4) and Auto Mall Parkway (MP 34.2), the railroad is bounded by additional portions of Newark Area 4 on the west and by the Refuge's Stevenson Unit on the east. The Stevenson Unit includes several environmentally-sensitive vernal pools.

Between the Auto Mall Parkway grade crossing (MP 34.2) and the south end of the Albrae siding (MP 34.9), the railroad is bounded on the west by the Tri-Cities landfill and on the east by the Refuge's Warm Springs Unit, which, like the Stevenson Unit, includes several vernal pools.

South of the Albrae siding, the railroad curves almost due south and crosses the Mud Slough movable bridge at MP 36.3. Unlike most bridges, this bridge can rotate ("swing") to allow vessel traffic to pass, although records indicate that it has been many years since the bridge was opened for vessel traffic. In this area, the railroad is bounded on the west by Cargill evaporation ponds and on the east by the Refuge. The railroad is mostly on a low embankment for this distance.

South of Mud Slough near the abandoned town of Drawbridge (MP 36.5), the railroad crosses the fixed bridge over Coyote Creek at MP 36.9. At MP 38.5 there is a spur track leading to Valley Water's water treatment plant, located approximately 1.5 miles east of the main track. The railroad is mostly on a low embankment for this distance.

The railroad enters the community of Alviso at the Elizabeth Street grade crossing near MP 39.0. Through Alviso, the railroad is on a low embankment or is supported on low retaining walls. There is a parallel street to the east of the railroad (El Dorado Street) and private properties to the west of the railroad.

South of Alviso, the railroad embankment increases in height to allow the railroad to cross over the flood protection levees on each side of the Guadalupe River channel. The railroad crosses the Guadalupe River on a bridge, then descends as it passes between commercial developments before reaching the Gold Street Connector at-grade crossing at MP 39.8, which is the south end of the Study area. The commercial developments include a hotel property and surface parking lots on the west and low-rise office buildings on the east side of the tracks. The property to the west of the tracks is the site of a former landfill that has been capped and redeveloped.

Much of the existing railroad embankment through Alviso and through the Refuge is an approximate elevation 9 feet (NAVD88). For bridges such as the Guadalupe River, Coyote Creek, and Mud Slough moveable bridge, the track is somewhat higher to match bridge elevations. This allows for sufficient freeboard (clearance from the water surface to the bottom of the bridge) to accommodate current high-water levels.

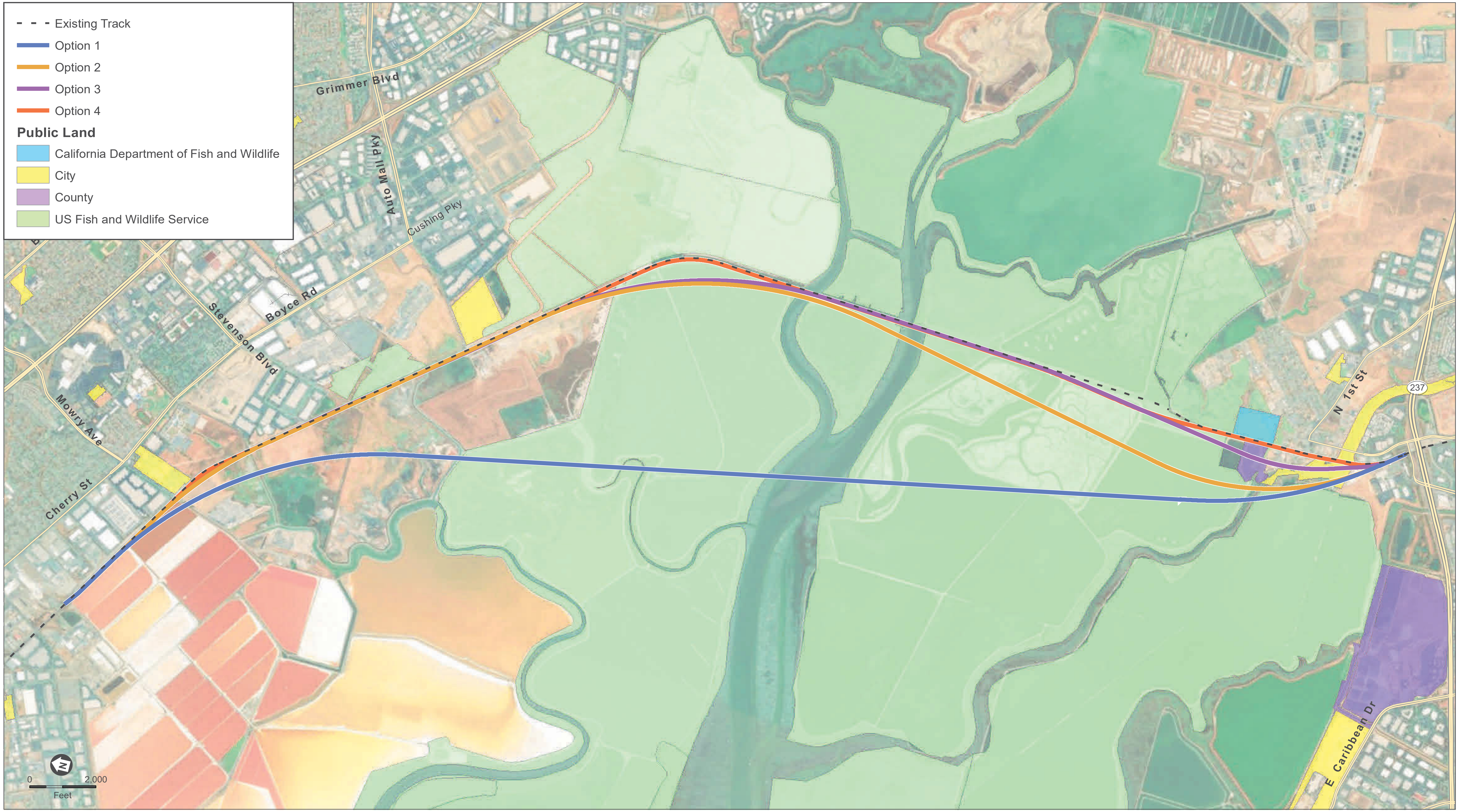
In the project area, water level fluctuates approximately seven feet due to tidal action.[6] The existing track has only a few feet of freeboard above high tide. There are no documented occurrences of closure of the existing rail line because of high tides. However, if no preemptive measures are taken, the existing rail embankment will be flooded at the forecast sea-level rise, resulting in periodic closure of the rail line and interruption to passenger and freight service.

Property Ownership

The railroad corridor itself is owned by Union Pacific Railroad. Property ownership adjacent to the existing railroad corridor is a mix of public and private (see *Figure 3, Land Ownership*). Numerous private holdings occur at the north and south ends, including light industrial developments and the Tri-Cities landfill. Public ownership in the area is dominated by the U.S. Fish and Wildlife Service (from approximately MP 31.5 to MP 39), as the rail line crosses through the Refuge. Other public landowners include local municipalities, Santa Clara County, the State Lands Commission, and the California Department of Fish and Wildlife. Cargill controls the salt evaporation ponds, which compose much of the adjoining land on the east side of the existing alignment south of the Tri-Cities landfill, even though the Refuge technically owns the underlying land. Conversely, Cargill owns the salt harvest ponds, located on the west side of the existing alignment, and north of Mowry Avenue.

Through the community of Alviso, nearly all surrounding property is privately owned. The exception is El Dorado Street, a public street, which closely parallels the track. Other properties in Alviso are a mix of residential and commercial enterprises, including restaurants and a storage and distribution facility for plastic drain pipe.

6 Based on information in National Oceanic and Atmospheric Administration nautical charts, available online.



Alviso Wetlands Railroad Adaptation Alternatives Study

Figure 3
Land Ownership

II.A.2 HISTORICAL RESOURCES

As described below, there are two major groups of historical resources in the rail corridor: the now-abandoned buildings that once composed the town of Drawbridge and the community of Alviso (*Figure 4, Historic and Cultural Resources*).

Drawbridge

The town of Drawbridge was located on Station Island, between Mud Slough and Coyote Creek, approximately 2.5 miles north of Alviso, near MP 36.5. Drawbridge is considered a ghost town today. Many of the town's wood-framed structures are deteriorating and slowly sinking into the Bay Mud on which Station Island was formed. In the late 19th century, the opening of the South Pacific Coast Railroad along the rail alignment of the present-day Capitol Corridor service made Station Island accessible to individuals interested in hunting and fishing for waterfowl, fish, and shellfish. The first residence was constructed in 1894. By the 1930s, there were more than 90 structures on the island, all generally distributed around the railroad track. By 1980, because of declining waterfowl numbers and decreased access via waterways, the last residents vacated Drawbridge.

Drawbridge is not currently listed in either the National Register of Historic Places or the California Register of Historical Resources, but remains a historical resource that is tied to the history of San Francisco Bay. The remaining buildings in Drawbridge are in a state of decay; there is currently no effort to stabilize or preserve them.

Alviso Historic District

The community of Alviso is located at the northernmost end of the city of San Jose, where San Francisco Bay transitions to tidal marshes, sloughs, salt ponds, and rivers. Alviso was incorporated in 1852 and then annexed by San Jose in 1968. Prior to its incorporation, Alviso served as the Port of San Jose and was a transportation hub for Santa Clara County. Throughout the early 20th century, Alviso was home to several large business ventures, including the Alviso Mills, the Leslie Salt Company, and the Bayside Canning Company. In 1973, nine acres of Alviso were added to the National Register of Historic Places under the name "Alviso Historic District". *Figure 4* shows the location of this district.

A total of 16 buildings have been recognized in the historic district, some of which have been removed. Several key buildings that remain near the railroad tracks are the Tilden-Laine Residence, Alviso Hotel, Railroad Depot, Robert Trevey Residence, Constable's Office and Jail, and Wade Residence. Alviso has a long, rich history and is another key resource for the history of San Francisco Bay.

II.A.3 EXISTING PUBLIC FACILITIES AND UTILITIES

The middle of the Study area includes an undeveloped area within the Don Edwards San Francisco Bay National Wildlife Refuge, while the northern and southern sections of the Study area are surrounded by developed land. This section briefly describes key public facilities and utilities (both public and private), as well as major infrastructure.

Between MP 31.5 and MP 32, a sanitary sewer force main is located on the west side of the tracks. Near MP 32, the force main crosses to the east side of the track. From MP 32, the force main continues on the east side of the track southward to approximately MP 34.

From approximately MP 33 to MP 33.9, a 115-kilovolt overhead power transmission line owned by Pacific Gas and Electric Company, supported by tall wooden poles, extends along the west side of the tracks. Near MP 34 is a major Pacific Gas and Electric Company substation on the east side of the tracks. In this area, several high-voltage transmission lines, which lead to the substation, cross the tracks.

Between MP 33.9 and MP 34.1, a drainage channel flows along the east side of the tracks. This channel receives pumped storm drainage from the surrounding developed area. The channel outflows toward San Francisco Bay by crossing under the railroad tracks; where the channel crosses under the railroad, the tracks are supported by a small bridge. The drainage channel is maintained by the Alameda County Flood Control and Water Conservation District.

The next major public infrastructure is near MP 38.1, where USACE is constructing the South San Francisco Bay Shoreline Project. As mentioned previously, this project will build a levee system with a crest elevation of 15.3 feet. The levee system will provide flood and sea-level rise protection for Alviso, Valley Water's treatment plant (approximately 1.5 miles east of the track), and the cities of Santa Clara and San Jose.

Alviso Wetlands Railroad Adaptation Alternatives Study

Figure 4

Historic and Cultural Resources

At MP 39, the railroad enters the community of Alviso. A substantial amount of urban infrastructure is present in Alviso: storm drains, sanitary sewers, and overhead power lines, including the historic resources mentioned above. Alviso is bounded on the north by New Chicago Marsh in the Refuge and on the south by the levees that form the Guadalupe River channel.

Just south of Alviso, between the Guadalupe River and the Gold Street Connector, is a former landfill located west of the railroad tracks. The landfill has been closed and capped, and "America Center," a mixed-use commercial development with hotels and office buildings, has been constructed on top of the landfill. East of the tracks in this area is additional commercial development, again consisting of hotels and office buildings.

II.A.4 HABITATS

The Study area crosses through multiple habitat types consisting of tidal and non-tidal wetlands, salt evaporation ponds, and upland habitats such as vernal pool grasslands. Urban development and landfills also make up a portion of the Study area. Habitat types in the Study area are described in detail below. *Figure 5, Habitat Types*, illustrates the habitat types in the Study area and shows their locations relative to the existing and proposed alternative rail lines.

Tidal Marsh (Tidal Marsh, Muted Tidal, Restoring Tidal Marsh)

Marshes along San Francisco Bay that are subject to tidal action are considered tidal marshes. Some tidal marshes are completely open to tidal action from the bay. Other, muted tidal marshes are still subject to flooding, but obstructions such as culverts reduce the range of tides. Some of these tidal marshes were formerly diked-off from tidal influence and are being restored. Many wildlife species use tidal marshes for foraging and breeding habitat; thus, as the marshes are restored, habitat is also restored. Tidal marshes are present at a variety of elevations. As a result, they provide important transitional habitat for the many species found in the Refuge, including threatened and endangered species.

Diked Wetlands

Diked wetlands are not subject to tidal action. Much of San Francisco Bay's original wetland habitats have been diked or otherwise bermed-off from tidal action. These habitats are made up primarily of diked salt marsh and brackish marsh. Although diked wetlands usually are not considered as productive as tidal marshes, the wildlife and vegetation communities in these wetlands resemble those of tidal marshes.

Open Water (Channels, Managed Ponds, Salt Ponds)

Open-water habitats in the Study area include channels, sloughs, salt ponds, and managed ponds. Channels and sloughs transport tides in and out of tidally influenced marsh systems and provide habitat for aquatic invertebrates, fishes, waterbirds, and harbor seals. Several varieties of birds rely on open water or channel mudflats for their respective food sources, while the surrounding levees provide roosting habitat. Managed ponds vary greatly in their levels of salinity and often provide habitat for waterfowl, shorebirds, and other waterbirds. Even salt evaporation ponds provide habitat for various species of insects and invertebrates upon which birds feed.

Managed Mudflats

Mudflats are areas of open mud habitat that are minimally vegetated, often by cordgrass and pickleweed, or completely unvegetated. These areas are flooded regularly and support a diverse array of benthic invertebrates, thus providing valuable foraging habitat for shorebirds, waterbirds, and fish.

Uplands (Undeveloped)

Undeveloped habitat in the Study area that does not include marshes or mudflats consists of uplands dominated by annual, nonnative plants; agricultural areas; and areas with native upland vegetation. These areas can provide habitat for many wildlife species. These undeveloped areas generally lie adjacent to marshes and other aquatic habitats.

Vernal Pool Grasslands

Vernal pools and freshwater wetlands are found in the Study area and are concentrated around the Refuge's Warm Springs and Stevenson Units. Vernal pools are short-lived, seasonal wetlands that provide habitat for a distinct assemblage of plants and wildlife. Several species are found only in this type of wetland, such as vernal pool tadpole shrimp and Contra Costa goldfields plants.

Developed Areas (Urban Development, Landfill)

Developed areas in the Study area include residential and commercial areas, roads, and landfills. These areas are typically maintained free of vegetation but may occasionally support some ruderal upland vegetation. Wildlife species occurring in developed habitats are typically associated primarily with adjacent habitats and use developed areas only occasionally. Some wildlife species, such as gulls, regularly use developed and landfill areas as foraging habitat.

II.A.5 SPECIAL-STATUS SPECIES

The San Francisco Bay Area provides habitat for a large number of special-status wildlife and plant species, including several that have the potential to occur in the Study area. Special-status species are wildlife and plants that are legally protected under the California Endangered Species Act, federal Endangered Species Act, or other regulations or rankings established by the scientific community. Special-status species include:

- Species that are federally listed or state-listed as endangered or threatened
- State-designated Species of Special Concern and Fully Protected Species
- California Native Plant Society–ranked rare species
- Bat species that are designated as "Red" or "High" by the Western Bat Working Group's Bat Species Priority Matrix

Table 1 lists the special-status species known to occur within three miles of the Study area. Additional information is available in *Appendix A: Special-Status Species*, including visual representation of all potential special-status wildlife and plant species known or with the potential to occur in the Study area.

TABLE 1
SPECIAL-STATUS ANIMAL AND PLANT SPECIES KNOWN TO OCCUR WITHIN THREE MILES OF THE STUDY AREA

Species	Status	Listing
California Ridgway's Rail	Endangered	Federal and State
California Black Rail	Threatened	State
Burrowing Owl	Species of Concern	State
Western Snowy Plover	Threatened	Federal
California Tiger Salamander	Threatened	Federal and State
Vernal Pool Tadpole Shrimp	Endangered	Federal
Salt Marsh Harvest Mouse	Endangered	Federal and State
Central California Coast Steelhead Distinct Population Segment	Threatened	Federal
Longfin Smelt	Threatened	State
Contra Costa Goldfields	Endangered	Federal

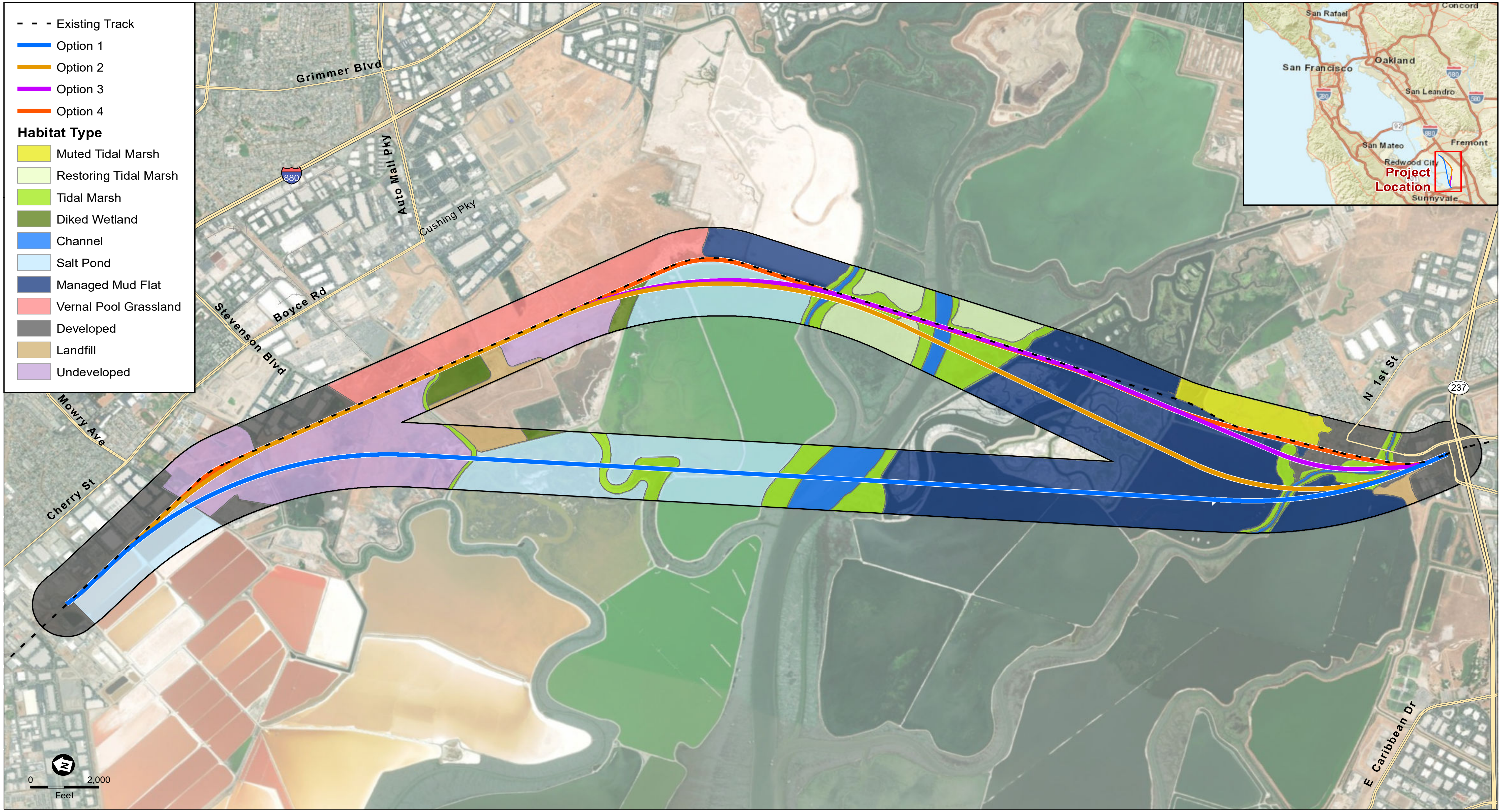


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Figure 5
Habitat Types

II.B Stakeholder Outreach

II.B.1 STAKEHOLDER ENGAGEMENT

In addition to the need to assess the existing conditions of the Study area, CCJPA recognized the importance of early engagement with stakeholders as a critical step in understanding all aspects of the Study area, particularly the concerns of stakeholder groups. There are numerous sensitive community and environmental considerations; there is also the possibility of using a future railroad realignment to help improve conditions on the ground for a variety of stakeholders. Therefore, CCJPA used the following three-step approach to develop options for potential rail alignments and better understand opportunities and constraints for Alviso, residents, local businesses, and the ecological resources in the far South Bay:

(1) Gather information about existing railroad infrastructure, the existing ecological environment, and relevant habitat restoration/species conservation projects (described in *Section II.A, Existing Conditions in the Study Area*).

(2) Develop conceptual options that are technically feasible and that would likely be acceptable from the environmental protection and community perspectives. This step included extensive outreach (described in more detail below).

(3) Evaluate and refine conceptual options according to the objectives of increased resiliency against sea-level rise, increased train capacity, minimized environmental disturbance, and minimized effects on stakeholders.

If CCJPA chooses to develop a project based on the options developed as part of this Study, that project would be subject to additional stakeholder outreach, planning, environmental, and engineering design processes.

II.B.2 PURPOSE AND GOALS

A series of meetings was convened to:

- Introduce stakeholders to the need for the Study, process, and conceptual options for the rail alignment
- Hear stakeholder concerns, priorities, and questions
- Establish communication protocols for stakeholder feedback and input following each meeting
- Refine concepts based on input from stakeholders

II.B.3 OVERVIEW OF STAKEHOLDER OUTREACH

Outreach focused on agencies and organizations with a direct interest in the rail alignment and the surrounding area. It included federal, state, and local government agencies (such as the Refuge and the city councilmember for the community of Alviso); nongovernmental organizations and community groups (such as the Citizens Committee to Complete the Refuge); residents and landowners (via the Alviso Neighborhood Group); Native American organizations; and local businesses. At this early stage of study, not all affected agencies were contacted.

The following stakeholder groups were engaged in the outreach effort:

- Alviso Neighborhood Group
- Don Edwards San Francisco Bay National Wildlife Refuge
- Citizens' Committee to Complete the Refuge
- Cargill Salt
- Santa Clara County Parks

These groups were engaged because of their interest in the lands surrounding the existing rail alignment and their interest in previous efforts (such as the ACE*forward* DEIR). While UPRR, the owner of the Coast Subdivision, has received a copy of this Study, UPRR has not endorsed any of the options. Any future project would need to respect UPRR's investments in their current (and future) freight customers and protect the flexibility of UPRR's overall rail network.

Outreach occurred via a series of meetings held at three stages of development of the conceptual adaptation options. The first stage of the outreach process engaged stakeholders before conceptual designs were prepared. During the second stage of the outreach effort, preliminary concepts were provided for stakeholders to review. Stakeholders had the opportunity to provide feedback that would influence subsequent refinement of the options.

After the conceptual options had been refined (to the extent possible in this early effort), they were presented to the stakeholder groups during a third, and final stage of meetings. Stakeholders had the opportunity to provide feedback and offer comments on the final version of the conceptual options.

II.B.4 FIRST-STAGE STAKEHOLDER MEETINGS

In the first stage of stakeholder meetings, CCJPA presented the purpose of the Study; described previous studies examining passenger service in Santa Clara County; and provided examples of preliminary adaptation concepts that could support the rail alignment, such as trestle-type configurations and levee embankments. A poster board displayed at each meeting showed an aerial image of the existing rail alignment, the community of Alviso, the Alviso north levee being constructed by the Army Corps, and the series of former salt evaporation ponds now managed by the Refuge.

A general project schedule was provided to show the next steps, which included additional meetings in spring and summer 2019 before preparation of the final Study report. At the conclusion of these meetings, CCJPA provided a physical address, email address, and phone number to which commenters could send concerns, potential alternative options, or questions.

A description of the meetings with three specific stakeholder groups and their feedback on the first-stage presentation follows.

Alviso Neighborhood Group

The Alviso Neighborhood Group is a collective of Alviso community members and representatives who work together for changes and improvements to the community of Alviso. Proponents of public works projects have often presented to this group. This Study's first-stage meeting took place on November 14, 2018, during the Alviso Neighborhood Group's monthly meeting at the Alviso Branch Library and Community Center.

The Alviso Neighborhood Group was initially interested in planned track capacity, pedestrian safety around the tracks, train noise, alignment right-of-way options, future electrification of the tracks, alternative routes, and the potential for locating a new passenger train station in Alviso.

Don Edwards San Francisco Bay National Wildlife Refuge

The Refuge manages a 30,000-acre expanse of tidal marshes, ponds, and sloughs. Its mission is to preserve and enhance wildlife habitat, protect migratory birds, and provide opportunities for wildlife-oriented recreation and nature study for surrounding communities. The existing rail alignment (depicted in both *Figure 1, Study Area*, and *Figure 2, Conceptual Option Overview*) runs through lands managed by the Refuge. CCJPA introduced the study to the Refuge on September 10, 2018, at the Refuge's administrative office in Fremont.

The Refuge expressed a desire for the Study to present concepts such as potential methods for increasing hydrologic connectivity in aquatic and marsh habitats; using former rail berms as a basis for a future public access trail where appropriate; and providing upland habitat with long, gently sloping embankment slopes (known as "ecotones") in areas where fill is appropriate. The Refuge also expressed concerns about the safety, speed, and noise of potential rail alignments and a desire to minimize construction-related impacts to the extent possible.

Citizens' Committee to Complete the Refuge

The Citizens' Committee to Complete the Refuge (CCCR) is an organization dedicated to protecting shoreline habitat by acquiring land to expand the boundary of the Don Edwards San Francisco Bay National Wildlife Refuge. CCJPA introduced the study at the monthly CCCR meeting held at the Refuge's administrative office in Fremont on November 15, 2018.

The CCCR expressed interest in ensuring opportunities for community input during the development of options. Committee members asked questions regarding multiple topics: anticipated future track capacity and frequency of trains; the location and design of potential alignments; future electrification of the tracks; and the feasibility of placing the rail alignment underground in a tunnel to minimize impacts on the Refuge.

II.B.4 SECOND-STAGE STAKEHOLDER MEETINGS

During the second-stage meetings, CCJPA presented the initial iteration of conceptual options based on feedback received during the previous (first-stage) meetings. Several conceptual options were presented, including a bridge configuration on piles, an "ecotone" embankment configuration with vegetated slopes, and a tunnel concept. These configurations are described in more detail in *Section II.A.1, Development of Typical Sections*. CCJPA prepared several maps illustrating potential rail alignments in the Study area, each considering track geometry and speed, as well as the complexity of implementation.

Note that, based on feedback during the first-stage meetings, Cargill and Santa Clara County Parks were added to the stakeholder outreach effort for the second stage.

Alviso Neighborhood Group

CCJPA's second-stage presentation to the Alviso Neighborhood Group's monthly meeting occurred at the Alviso Branch Library on March 13, 2019. Immediately after this presentation, community members asked about the feasibility of the tunnel alternative and how the long approach grades (and associated open trench construction) would affect or alleviate automobile, freight train, and commuter train traffic. They also expressed concern about the effect of a widened rail alignment through Alviso and the effect on adjoining properties.

Members of the Alviso Neighborhood Group wanted to ensure that their voices would be heard and that their comments would be incorporated into any project that might emerge from this Study. They were interested in how to stay involved with the Study after outreach meetings and throughout other phases of the rail adaptation process.

After the second-stage meeting, CCJPA received written comments that emphasized the importance of the historic nature of the Alviso community. The written comments also stressed the importance of respecting the adopted Alviso Master Plan, which itself emphasizes "maintaining Alviso's small town feeling," and of respecting Alviso's natural and historic setting.

Don Edwards San Francisco Bay National Wildlife Refuge

CCJPA's second-stage presentation to the Refuge occurred at the Refuge's administrative office on February 22, 2018. The Refuge expressed interest in the potential acquisition process for expanded tracks; the potential for the future height of rail bridges to allow greater boating access during high tide; and options for pedestrian crossings.

The Refuge also asked about the possibility of using the UPRR Warm Springs Subdivision (the inland rail corridor) and the potential for environmental benefits from alternatives, such as increases in hydrologic connectivity and recreational public access. Refuge representatives noted that any transfer of Refuge property to another party (e.g., if an option would require additional property) would require federal legislative action.

Citizens' Committee to Complete the Refuge

CCJPA's second-stage presentation to the CCCR occurred at the monthly CCCR meeting that was held at the Refuge's administrative office on March 21, 2019. During this second meeting, committee members asked about the anticipated future frequency of trains; future train speeds; potential for increased bird strikes; potential noise and vibration impacts along the rail alignment during both construction and operation; and the alignment options' consideration of other shoreline adaptation projects.

The CCCR was also interested in understanding the amount of fill required for various track concepts and the material used for trestle piles. Committee members expressed interest in keeping any future tracks as close to the original alignment as possible.

After the second meeting, CCJPA received written comments (via email) from several CCCR members. The comments emphasized minimizing impacts on wetlands while remaining on the existing alignment (an approach best characterized by Option 4). They suggested that bridge structures might achieve better hydraulic and hydrologic connectivity than embankments, with reduced impacts. Commenters also noted that the option located closest to the existing alignment (Option 4) would avoid new impacts on the Guadalupe River and would appear to minimize the footprint of new private property impacts.

Cargill

Cargill Salt is a major landowner in the South Bay area. Indeed, the company was the original owner of much of the property that became the Refuge. Cargill continues to own salt harvest ponds on the west side of the existing tracks between Central and Mowry Avenues in Newark. Cargill also maintains the right to produce salt in perpetuity in the evaporation ponds (located south of the Tri-Cities landfill) on the west side of the existing tracks, even though the

Refuge currently owns the land under those ponds. Note that Option 1 would affect the salt harvest ponds north of Mowry Avenue and Options 2 and 3 would affect the salt evaporation ponds near MP 35 to MP 36.3.

CCJPA met with Cargill representatives at the CCJPA offices on April 10, 2019, and again at the Cargill site on July 10, 2019. Cargill sent comments (via email) to CCJPA explaining that Option 1 would affect Cargill's salt harvest operations, and that Options 2 and 3 would affect its evaporation operations. Cargill was concerned about the potential for Option 4 to expand into the evaporation ponds.

Santa Clara County Parks and Recreation Department

Representatives of Santa Clara County Parks were unable to attend the other second stage meetings. CCJPA held a conference call with Santa Clara County Parks on April 4, 2019, to discuss the project. Santa Clara County Parks' key concerns were related to the Alviso Marina, which provides the only public boat launch area in the South Bay. In addition, Santa Clara County Parks operates a "Safari Tour" motor barge, based at the marina, that provides tours of normally inaccessible portions of the Refuge via the waterways. Santa Clara County Parks expressed desire that future projects do not reduce public access, boat launch access, or the size of the Alviso Marina.

II.B.5 THIRD-STAGE STAKEHOLDER MEETINGS

CCJPA presented a final iteration of conceptual options developed in response to the interests and concerns identified during the previous meetings, including the need to mitigate potential environmental and pedestrian-related impacts. The conceptual options are described in detail in the following *Section III, Development of Conceptual Options*. Alternatives included a conceptual elevated track and grade-separated crossing through Alviso and a revised bridge and ecotone concept, as well as various construction techniques to reduce potential impacts. Graphics provided at the meetings depicted alignments relative to public lands and biological resources, and a preliminary cost comparison showed the estimated costs of each alternative. CCJPA concluded the third stage meetings with a summary of possible future efforts, which include identifying funding sources, coordinating with transportation agencies, and performing additional studies to refine the information gathered.

Alviso Neighborhood Group

During the Alviso Neighborhood Group meeting on August 14, 2019, community members expressed a concern regarding whether additional track capacity would create increased frequency of trains carrying coal, oil, or other hazardous materials, and whether elevated tracks would cause train operating noise to travel farther. Participants expressed interest in restoring trail access along potential alignments, creating safe pedestrian crossings, reducing noise from train horns with separated grade crossings. Neighborhood group members also asked whether a potential inland route along the Warm Springs Subdivision would be considered. Participants requested a future potential timeline, which, given the uncertainty of funding, would be on the order of several years, at minimum, for even the simplest of options.

Don Edwards San Francisco Bay National Wildlife Refuge

CCJPA met with the Refuge on August 5, 2019, to review the alternatives concepts before presenting to the CCCR on August 15, 2019. This meeting was also intended to update the new Refuge manager. CCJPA did not receive any new or additional feedback during this meeting.

Citizens' Committee to Complete the Refuge

CCJPA met with the CCCR at the Refuge's administrative offices on August 15, 2019. During this meeting, the CCCR asked about the maximum footprint of the elevated track; the cost and constructability differences between the bridge and embankment alternatives; whether construction would take place in the Warm Springs vernal pool grasslands; and whether an inland alignment was being considered. Committee members asked what happens to the existing tracks, whether pile driving would be used, and whether CCJPA could provide an analysis of bird strikes and potential environmental benefits.

Several members of the CCCR offered written comments (via email) after the meeting, summarized here. Commenters expressed concern about the technical feasibility of various options because they would pass through Alviso and over various flood control structures, but would still need to pass under the existing opening under State Route

237. They also expressed concern about a space required for a three-track option passing through Alviso on the existing alignment. Commenters also provided background information on a proposal that will likely be presented to the City of Newark for future residential development of Area 4 (west of the existing tracks). If approved, note that this proposal could develop the property that underlies portions of the new rail corridor that would be needed for Option 1.

Altamont Corridor Express

CCJPA met with representatives from the San Joaquin Regional Rail Commission, operator of the ACE commuter rail service, on September 17, 2019. In 2017, ACE released a DEIR that contemplated a substantial suite of improvements along the rail lines connecting San Jose, Fremont, Stockton, and Merced. Although CCJPA's Option 4 alignment is generally similar to that contemplated by the ACE DEIR, the ACE DEIR contemplated a different suite of improvements than those considered by CCJPA. The key differences are listed below.

- The study area for CCJPA's Study extends from MP 31.5 to MP 39.8, but the ACE DEIR covered the area from MP 33 to MP 39.8. Thus, this Study covers a somewhat longer distance than the ACE DEIR did
- This CCJPA Study assumes a footprint wide enough for three tracks, whereas the ACE DEIR assumed a footprint wide enough for two tracks
- The ACE DEIR employed lower volumes of fill and large amounts of retaining wall between Newark and Alviso to keep its proposed improvements entirely within the existing UPRR right-of-way. This CCJPA Study considers several alignment options well outside the existing UPRR right-of-way, although even the footprint for CCJPA Option 4 (which follows the existing UPRR alignment closely and most closely resembles the concepts in the ACE DEIR) extends well beyond the existing UPRR right-of-way because of the wider space necessary for triple tracks and ecotones
- This CCJPA Study contemplates a more substantial track raise for the entire length of the Study area. The ACE DEIR assumed a somewhat lower track elevation north of MP 34.9. That lower track elevation would, in turn, result in reduced embankment width, and thus fewer impacts on habitat and right-of-way

II.C Evaluation Criteria

After the second-stage meetings, and following the receipt of stakeholder input, the options were evaluated based on the five criteria listed below. Although these criteria were not used to select preferred options, they do provide a basis for comparison of the options.

- Technical characteristics
- Effects on natural resources
- Social and cultural resource effects and effects on properties
- Restoration opportunities/potential habitat benefits
- Cost

These criteria are describe in more detail below.

II.C.1 TECHNICAL CHARACTERISTICS

Technical characteristics refer to the engineering considerations associated with various options. Examples include the sharpness of railroad curves, stability of embankments, and types of bridge construction. These criteria influence both the performance, in terms of travel time, and the cost of the resulting railroad. Technical criteria also establish design elements that would not be feasible, such as grades that are excessively steep, curves that are too sharp, or embankments that are not high enough to protect the railroad from sea-level rise. These considerations are described in *Appendix B: "Railroads 101" — Railroad Terminology and Concepts*.

II.C.2 EFFECTS ON NATURAL RESOURCES

Railroad infrastructure and operations may affect wildlife by causing direct mortality, creating barriers that contribute to habitat loss and fragmentation, and generating indirect disturbance. Habitat loss and fragmentation can be addressed by design and habitat mitigation measures; however, addressing direct mortality and indirect effects of disturbance may be more complicated, particularly because these impacts can vary by species.

Habitat and species effects may occur during both construction and operation of a rail project. In the Study area, primary operational effects would be animal strikes by moving trains or noise and vibration caused by moving trains, as explained further below.

Construction activities also could affect species. These impacts would be temporary, lasting only the duration of the specific construction activity, but could be significant. Examples include noise and vibration from pile driving, soil placement, and soil compaction, and animal strikes from moving construction equipment. These activities, and potential mitigation measures, have been studied extensively for other construction projects in California. Based on information provided by stakeholders, it appears that viable mitigation strategies are available for construction effects on wildlife. These strategies range from avoiding pile driving in aquatic environments during migration and spawning seasons, to placing exclusion fencing in construction areas to protect terrestrial species.

Bird Strikes

Wildlife mortality on roadways has received substantial attention. By contrast, studies on mortality along rail lines have been scarce until recently, and they have focused primarily on impacts on large mammals. Only recently have those studies been expanded to also focus on birds.

The San Francisco Estuary as a whole, and the Don Edwards San Francisco Bay National Wildlife Refuge specifically, provides habitat for both resident and migratory birds. It is an important stopover site for birds moving along the Pacific Flyway, supporting more than one-half million wintering and migratory shorebirds. Because of the high abundance of migratory birds and the presence of resident special-status bird species (e.g., California Ridgway's rail, which is federally-listed and state-listed as endangered) in the vicinity of the Study area, the potential rerouting of rail lines would need to be addressed in future environmental documentation.

The Study area, which includes four potential rail line options in addition to the existing rail alignment, passes through multiple bird species habitats: tidal marsh, diked marsh, channels and sloughs, salt ponds, mudflats, and vernal pool grasslands. Re-routing the rail line or operating at speeds in excess of 100 mph may have negative effects on some bird species, which is particularly significant for the endangered species that inhabit the Refuge. As such, species-specific impact minimization measures would be considered during future evaluations of alignment and design options. These could include sections of exclusion fencing, elevated tracks[7], placement of vertical infrastructure to attract birds away from the rail line, or avoidance of the most densely wildlife populated areas.

Areas densely populated by wildlife, such as sections of tracks between managed ponds that provide foraging areas for wintering waterfowl, should be considered when evaluating alignment options.

Noise and Vibration

Noise and vibration are a source of potential disturbance and barrier effects on wildlife. There is evidence that vibrations and noise that can reach from 85.5 to 97 A-weighted decibels (dBA) can affect insects, amphibians, and birds. Tables 2, 3, and 4 describe approximate noise levels measured in dBA and vibration levels measured in vibration decibels (VdB) that might be expected from passenger railways.

It is important to note that the decibel levels — particularly vibration decibels — indicated in the tables are approximations. The actual noise and vibration decibel levels experienced at a given location are highly dependent on site-specific conditions. For example, the configuration of buildings and elevation of tracks relative to receptors can have a substantial effect on noise levels (possibly either amplifying or mitigating them), while soil types can have a substantial effect on how vibrations propagate across the ground.

Few studies examine the impacts of railway vibration on wildlife. Vibrations may actually reduce mortality of some terrestrial vertebrates from railway operations, as the vibrations can warn them about an approaching train.

Noise produced during train operation (such as noise from engines and wind noise) is arguably one of the most important long-term disturbances. Studies on the impacts on wildlife, including birds, from railway noise have provided contradictory findings, possibly because the respective studies have had divergent approaches and assumptions and possibly because confounding variables were not being controlled. Several studies have concluded that railways had either no impact or a positive impact on bird species richness and abundance in their study areas. However, anecdotal evidence suggests that railway noise is more likely to have negative consequences for at least

7 Exclusion fencing or elevated tracks may reduce impacts on wildlife species that are less or not reliant on flight, such as California Ridgway's rail and salt marsh harvest mouse. Placement of vertical structures may also reduce wildlife mortality. For example, vertical structures may be placed or designed in a way to deter and minimize strikes to perching birds like raptors.

some sensitive species and/or during the most restrictive (breeding, migration) seasons. Site-specific research in the Refuge may be appropriate.

Note also that the noise and vibration levels identified in Tables 2, 3, and 4 are also relevant to effects on residences and businesses.

TABLE 2
NOISE LEVELS FROM PASSENGER RAILWAYS

	Distance from Track Centerline				
	20 Feet	35 Feet	50 Feet	100 Feet	250 Feet
Source	Approximate Maximum dBA				
High-Speed Rail at 150 mph	93	91	89	86	82
Locomotive Passenger Train at 90 mph	93	89	87	84	80
Locomotive Passenger Train at 50 mph	90	86	84	81	77
Locomotive Passenger Train at 25 mph	84	82	79	75	71

NOTES: dBA = A-weighted decibels; mph = miles per hour
SOURCES:
Illingworth Rodkin. 2006.
Federal Railroad Administration. 2012.
Federal Transit Administration. 2018.

TABLE 3
VIBRATION LEVELS FROM PASSENGER RAILWAYS

	Distance from Track Centerline				
	20 Feet	35 Feet	50 Feet	100 Feet	250 Feet
Source	Approximate Maximum VdB				
Locomotive passenger train at 50 mph	91	87	85	77	69
Locomotive passenger train at 90 mph	96	92	90	82	74
High-speed steel-wheel passenger train at 150 mph	88	85	82	76	67

Notes: mph = miles per hour; VdB = vibration decibels
High-speed rail technology does not include locomotive engines and therefore has a lower vibration profile.
SOURCES:
Federal Railroad Administration. 2012.
Federal Transit Administration. 2018.

TABLE 4
REPRESENTATIVE ENVIRONMENTAL NOISE LEVELS

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
	110	Rock band
Jet fly-over at 100 feet		
	100	
Gas lawn mower at 3 feet		
	90	
Diesel truck going 50 mph at 50 feet		Food blender at 3 feet
	80	Garbage disposal at 3 feet
Noisy urban area during daytime		
Gas lawn mower at 100 feet	70	Vacuum cleaner at 10 feet
Commercial area		Normal speech at 3 feet

Table 4 continued on next page

TABLE 4 *(Continued from previous page)*
REPRESENTATIVE ENVIRONMENTAL NOISE LEVELS

Heavy traffic at 300 feet	60	
		Large business office
Quiet urban area during daytime	50	Dishwasher in next room
Quiet urban area during nighttime	40	Theater, large conference room (background)
Quiet suburban area during nighttime		
	30	Library
Quiet rural area during nighttime		Bedroom at night, concert hall (background)
	20	
		Broadcast/recording studio
	10	
	0	

NOTES: dBA = A-weighted decibels; mph = miles per hour
SOURCE: California Department of Transportation. 2013. *Technical Noise Supplement to the Traffic Noise Analysis Protocol*. September 2013. Page 2-20.

II.C.3 SOCIAL AND CULTURAL RESOURCE EFFECTS AND EFFECTS ON PROPERTIES

Social and cultural resource effects include effects on both the existing built environment and neighboring properties, on significant historic and cultural resources, and on individuals and communities. Cultural resources include those properties eligible for protection under Section 106 of the National Historic Preservation Act. Potential effects include noise and vibration effects on residents and structures, and more direct impacts on private properties and historic properties and structures from new alignments. Resources include the historic town of Drawbridge, historic cannery buildings in Alviso, or the South Bay Yacht Club, which includes historic buildings and, as an institution, is one of the oldest yacht clubs in the region. In addition, portions of the existing railroad infrastructure (such as existing bridges) may qualify as historic resources.

II.C.4 RESTORATION OPPORTUNITIES/POTENTIAL HABITAT BENEFITS

The potential for beneficial effects on habitats was also considered as the options were developed. The possible realignment of rail lines (as in Options 1, 2, and 3) presents a unique opportunity to rethink the placement of embankments and bridges in the context of what is best for the area's sensitive natural resources, particularly in light of the South Bay's large ongoing habitat restoration efforts.

These considerations resulted in modifications to earlier versions of the options (i.e., the initial versions prepared for review by stakeholders during the second-stage meetings). Benefits included the addition of large habitat transition zones (ecotones); high-tide "refugia" areas that extend under bridges but do not transition up to the rail line itself; and carefully selected additional bridge structures to promote hydraulic connectivity in areas that provide the most ecological value.

II.C.5 COST RANKING

At this initial, conceptual stage of development, the options were developed without respect to cost, although they were ranked based on their relative costs. Order-of-magnitude cost estimates were developed after the second-stage meetings, when the options were refined. The order-of-magnitude cost estimates and key cost drivers for each option are described in more detail in Section III.

III. DEVELOPMENT OF CONCEPTUAL OPTIONS

III.A Introduction

During the first- and second-stage meetings, stakeholders provided CCJPA with feedback and thoughts on multiple topics, such as:

- Future track capacity and train frequency
- Pedestrian safety
- Potential impacts of noise and vibration
- Risk of bird strikes
- Location of alignment options
- Increasing hydrologic connectivity

Stakeholders also asked questions regarding construction methods and materials, amount of fill, planned track height, increased public trail access, and opportunities for environmental benefits. The stakeholder input was crucial to understanding the opportunities and constraints facing the possible alignment options, and substantially helped to shape the final options outlined in this section.

The Study developed four conceptual options for routing the rail line in the north-south corridor between Newark and Santa Clara (*Figure 2, Conceptual Option Overview*). These options are described in detail below. For consistency and to provide a common basis for comparison, each option is assumed to begin at UPRR MP 31.5 (north of the current Mowry Avenue grade crossing) and end at the Gold Street Connector grade crossing, MP 39.8. (The Gold Street Connector grade crossing is parallel to and immediately north of the location where State Route 237 passes over the railroad.) The Study assumed that each option would include three parallel tracks between MP 31.5 and MP 39.8. The description of each option begins at the north end and proceeds southward.

The options were developed in accordance with railroad regulatory criteria and typical design criteria often used on other projects CCJPA has performed in conjunction with UPRR. This Study assumes that both passenger trains and UPRR trains would operate over the alignment for any selected option. This assumption was made because several alignment options propose tracks widely separated from the existing track, yet stakeholders have indicated a very strong preference for all tracks to be in a single corridor (as opposed to separate freight and passenger corridors). Note that at this early stage of study, UPRR has not endorsed any of the options.

To assist readers in understanding concepts that influence railroad design and the development of the options, *Appendix B: "Railroads 101" — Railroad Terminology and Concepts*, provides a high-level description of several key concepts in railroad engineering and operation. As described in *Appendix B*, it is helpful to understand that railroads require very broad curves. For example, for a passenger train to achieve speeds in the range of 79 mph[8], curves would have a radius of approximately 3,500 feet. To achieve speeds exceeding 100 mph, curves would have a radius of approximately one mile or greater. The requirements for such broad curves substantially influence the geometry of the options.

Note that the scope of infrastructure improvements for each of these options was based primarily on stakeholder input. The scope for each option thus reflects the desires of the stakeholder groups; no value-engineering efforts or refinements in scope have been performed as part of this Study. At this early stage of study, "hybrid" options that combine elements from multiple options have not been considered.

The outreach process revealed that some stakeholder groups had divergent desires. For example, the Alviso community was generally very sensitive to noise, vibration, and railroad safety issues. These considerations led to options that skirted to the west of the Alviso community. Conversely, the Refuge was sensitive to expansion of a project footprint and impacts on habitat and species. These considerations led to options that followed the existing alignment more closely.

For ease of identification, options were labeled 1 through 4, with Option 1 being the westernmost alignment and Option 4 being the easternmost alignment. The numerical designation is simply a method to distinguish one option from another. The numbers do not reflect preference, ranking, or priority on the part of CCJPA or any of the stakeholders engaged during this Study.

8 Various infrastructure design thresholds occur at different speed increments. One such threshold occurs where trains travel at speeds of 80 mph or faster. Thus, 79 mph is often used as a maximum speed.

III.B Development Of Typical Sections

"Typical sections" refer to the type and form of construction in a given area. A typical section represents a "slice" through the railroad embankment and identifies characteristics such as the width of the top and bottom of the embankment and the steepness of the side slopes. A typical section is assigned to each region of the alignment; thus, the typical sections effectively determine the overall construction footprint.

The Study developed three typical sections. Each section is assumed to allow space for up to three tracks at the top of the railroad embankment.

Embankment or Embankment with Ecotone

An embankment with ecotone is simply an earth embankment with load-bearing portions constructed of engineered fill material. The load-bearing portions of the embankment may include some combination of lightweight fill material and/or reinforcing fabric. This Study assumes that the embankment slopes in any area would be no steeper than three units horizontal to one unit vertical (known as 3:1 slopes).

In selected areas on the west side of the embankment (the side nearer San Francisco Bay), an "ecotone" may be added. Ecotones are very shallow vegetated slopes. For the ecology and hydrology of San Francisco Bay, optimal slopes for an ecotone are thought to be on the order of 30 units horizontal to 1 unit vertical ("30:1 slopes"). Ecotones provide an area of safe refuge for wildlife during high-water events and a shallow slope to dissipate energy from wave action. As sea-level rises over time, the water level would slowly reach farther up the ecotone slope, offering the potential for habitat to migrate upslope over time and for species to adapt. An example of a typical section for the embankment with ecotone is shown below. Note the shallow slope on the right side of the embankment; this shallow slope would be on the west side of the embankment, facing the Bay, with a slope on the order 30:1, which would provide the zone of refuge for wildlife.

Embankment with Ecotone

Bridge

The typical section for a bridge, for which an example is shown on the following page, is a common type used by both freight and passenger railroads. The superstructure consists of precast concrete boxes set on piles. The piles could be steel H-piles, precast concrete piles, or hollow steel tubes filled with concrete. Because of poor soil conditions through the corridor, many of the piles would likely be more than 80 feet long, and in some locations possibly as long as 200 feet. Manufacture, transportation, and handling of extremely long precast concrete piles is difficult, so steel piles would be most likely assembled on-site from shorter pieces. The precast concrete boxes comprising the superstructure would form a "tub" in which the track (rails, ties, and rock ballast to support the ties) would be constructed. The various precast concrete elements are of a simple, modular design, allowing easy transportation and construction, and they can be readily repaired or replaced in the event of damage.

Bridge

Bridge with Refugia

The refugia concept is based on the bridge typical section and adds the benefits of the ecotone slope described above. An earthen berm would be constructed below the bridge, leaving five to six feet of clearance beneath the bridge. This berm would have shallow, vegetated slopes on the order of 30:1 in order to provide a transition zone habitat area for wildlife and plants. In this regard, the slopes would function in a manner similar to an ecotone, with the added benefit of not having any direct connectivity between the refugia habitat and the tracks themselves, thus minimizing the potential for train/wildlife interactions. An example of a typical section for a bridge with refugia is shown below.

Bridge with Refugia

III.C. Development Of Options

Four representative alignments, or options, were developed through the Study area. These options were used to illustrate possible concepts to stakeholders and as the basis for conceptual cost estimates. The options intentionally employed different construction methods (i.e., varying lengths of bridge or embankment) so that the conceptual cost estimates would reflect these different approaches to the infrastructure. Descriptions of the options follow.

III.C.1 OPTION 1

III.C.1.1 DESCRIPTION — OPTION 1

Option 1 would reroute the rail line to the west of the existing alignment and west of the community of Alviso. It would depart from the existing rail alignment near MP 31.5, north of the existing Mowry Avenue grade crossing, and would veer to the southwest. The embankment for the new rail alignment would pass over portions of the existing Cargill salt harvest ponds. Just south of the salt harvest ponds, a new grade separation would be constructed at Mowry Avenue, where the roadway would be elevated over the railroad.

The rail line would proceed southward through a currently undeveloped portion of the city of Newark known as “Area 4,” and would pass to the west of the Tri-Cities landfill on an embankment. Near the landfill, where the railroad enters the Don Edwards San Francisco Bay National Wildlife Refuge, the railroad would transition from an embankment onto a bridge and cross existing Cargill salt evaporation ponds (known as ponds M4, M5, and

M6), and then cross Coyote Creek. Where Option 1 would cross Coyote Creek, a new movable bridge would be constructed to allow marine traffic to transit Coyote Creek and upstream to Mud Slough.

Proceeding southward from Coyote Creek, Option 1 would continue on a bridge, passing over several ponds (known as A12, A13, A14, and A15). Although the track would be elevated on a bridge, refugia embankments would be constructed under the bridge in several areas to provide habitat and refuge for plants and animals during extreme tides and storms and as sea-level rises. From there, the alignment would pass to the west of the community of Alviso, crossing over the Guadalupe River and then transitioning onto land at the site of the existing Residence Inn. It is assumed that the Residence Inn property would be affected by construction. The alignment would rejoin the existing railroad right-of-way just north of the Gold Street Connector. Option 1 assumes that mooring locations for high-masted vessels (vessels too tall to pass under a railroad bridge) that are part of the South Bay Yacht Club would be relocated to the west of the new railroad bridge over the Guadalupe River. Similarly, access for the Alviso Marina and boat launch would be relocated to the west of the tracks.

By using a bridge more than five miles long, Option 1 would provide a relatively straight rail corridor, both shortening the existing route and reducing the sharpness of the curves or eliminating the curves altogether. This option could facilitate passenger train speeds of up to 150 mph, if electrified. An entirely new right-of-way through Newark Area 4, through the Refuge, and around Alviso would be required for Option 1.

Option 1 assumes that all trains, including freight trains, would be rerouted to the new alignment. As such, the existing railroad alignment and embankment would be removed as part of Option 1. Presumably, the existing right of-way would be turned over to the Refuge and would be available for restoration.

A graphic illustrating the rail alignment for Option 1 is presented in *Figure 6, Conceptual Option 1* on the following page.

III.C.1.2 CONSTRUCTION TECHNIQUES AND CONSTRUCTABILITY — OPTION 1

Construction of Option 1 could proceed without interrupting operation of the existing rail line. Areas where an embankment would be constructed would likely involve some combination of lightweight fill or soil reinforcement.

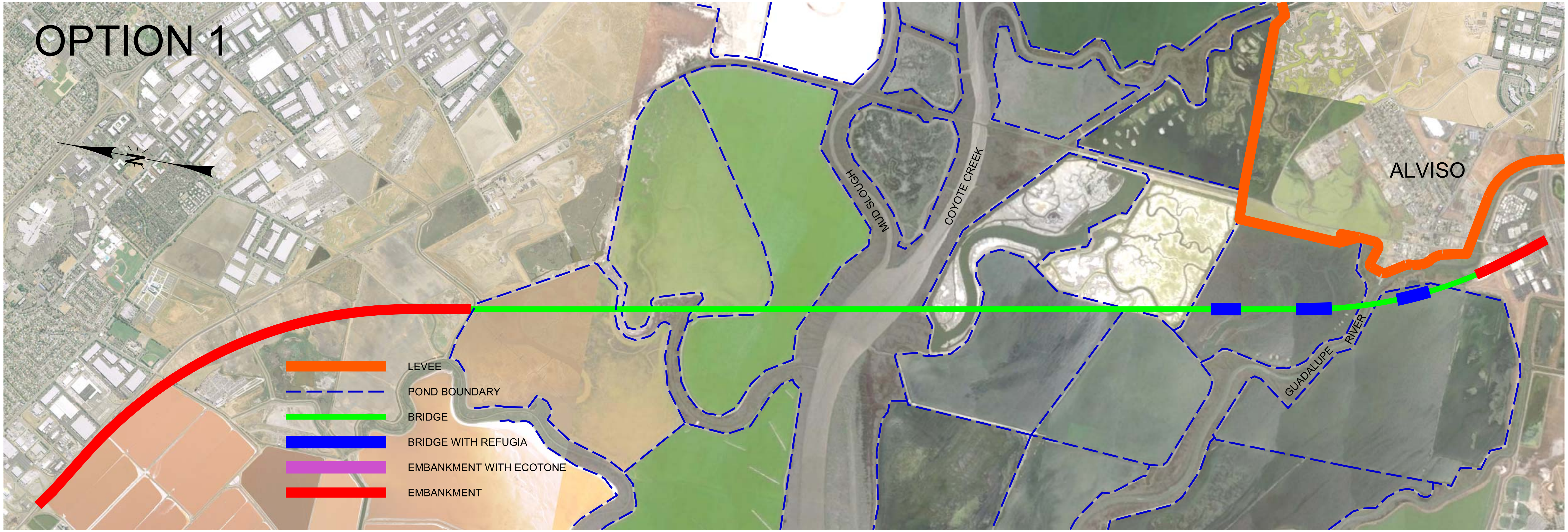
Bridge construction would involve pile driving activities, with pile lengths currently estimated to range from 40 feet to as much as 200 feet below ground, depending upon the depth of Bay Mud, which has extremely limited load bearing capacity. Piles would likely be either precast concrete, structural steel, or tubular steel filled with concrete, while the bridge superstructure would likely consist of precast concrete structural members that could be lifted into place and subsequently tied together to form a “tub” in which the railroad track and rock ballast would be placed.

Pile driving activities may require a barge-mounted pile driver, or possibly a “bridge launcher,” a large machine that stabilizes itself on piles already driven and cantilevers or “reaches out” to drive the next row of piles ahead of it. Using a bridge launcher in this manner would involve minimal ground disturbance. Where refugia would be located underneath the bridge, the refugia would likely be constructed as a low embankment before the bridge piles were driven, because placing refugia soil after the installation of piles would be more challenging.

Construction of the movable bridge across Coyote Creek would require multiple large foundations deep in the ground to stabilize the approaches to the bridge, which must remain in precise alignment whether the bridge is open or closed.

Construction of the rail line south of Alviso, through the Residence Inn property, would involve building demolition, but also may involve shallow excavations of the fill atop which the hotel was constructed. This work may involve demolishing the piles that support the Residence Inn, rerouting leachate pipes, and disposing of the excavated material at an approved landfill. It is possible that further refinement of the alignment in this area may identify ways to avoid impacts to the Residence Inn property.

Figure 6, Conceptual Option 1



III.C.1.3 KEY COST ELEMENTS — OPTION 1

The key cost element for Option 1 is the length of the rail bridge. Most of the alignment for this option would be elevated on bridge structures, and the supporting piles are expected to be quite long (possibly more than 100 feet deep); therefore, not unexpectedly, bridge construction is the key cost driver. Construction of the movable bridge is also a major cost driver.

In addition, estimated costs for Option 1 include acquisition of new right-of-way through the Refuge, a grade separation at Mowry Avenue, and acquisition of a private property (the recently constructed Residence Inn, located just south of Alviso and the Guadalupe River, on the west side of the tracks), the price for which would be subject to negotiation. As discussed in Section I, since the Refuge is a federal entity, any right-of-way acquisition from the Refuge would require new congressional legislation.

III.C.1.4 SUMMARY OF TRADE-OFFS AND IMPACTS — OPTION 1

As the straightest, most direct, and shortest route among all the options, Option 1 would provide a faster train travel time and smaller actual footprint of direct environmental impacts than the other options. It would remove the railroad from the center of Alviso and eliminate the two grade crossings in the community, thereby eliminating the noise and vibration from train traffic. However, it would deviate most substantially from the existing right-of-way (where many environmental impacts of railroad infrastructure and operations are already realized), and because it would consist almost entirely of bridge structure, it is the most expensive option. Option 1 would affect the Cargill salt harvest ponds and would pass through Newark Area 4; and, on the southern end of the Study area, this option would affect the South Bay Yacht Club and boat passage in Alviso Slough, and would require demolition of the recently constructed Residence Inn hotel south of the Guadalupe River.

III.C.2 OPTION 2

III.C.2.1 DESCRIPTION — OPTION 2

Option 2 would follow the existing rail alignment southward from MP 31.5, north of the existing Mowry Avenue grade crossing, to approximately MP 34.9, near the south end of the existing Albrae siding (south of the Tri City landfill). The new tracks in this section would be elevated to address sea-level rise and would be constructed on top of the existing track, thereby incorporating the existing embankment beneath them. The new embankment would be wider (to accommodate three tracks) and higher than the current embankment (to accommodate sea-level rise). The roadway profiles at grade crossings would be raised to meet the new track elevation.

At MP 34.9, the existing alignment continues southward for several thousand feet, then curves sharply to the right to head almost due south toward Alviso. The existing curve limits maximum passenger train speeds. Option 2 assumes that a new, broader curve would be constructed to the inside of the existing track. This alignment would pass over the existing Cargill evaporation ponds on a bridge structure, briefly rejoining the existing alignment near MP 36. At this location, Option 2 would cross over Mud Slough on a new movable bridge. After crossing Mud Slough, Option 2 would veer westward (becoming progressively farther from the existing track) to curve around the west side of Alviso. This section would be entirely on a bridge, similar to that described in Option 1.

Upon reaching the northern edge of Alviso, near and just west of the existing Alviso Marina, Option 2 would curve back to the east. Where it would be just west of the town of Alviso, the Option 2 alignment would be on an embankment with ecotone until it reaches the Guadalupe River. Option 2 would cross the Guadalupe River on a bridge. Then, Option 2 would transition back to an embankment and rejoin the existing alignment just north of the Gold Street Connector, near MP 39.8.

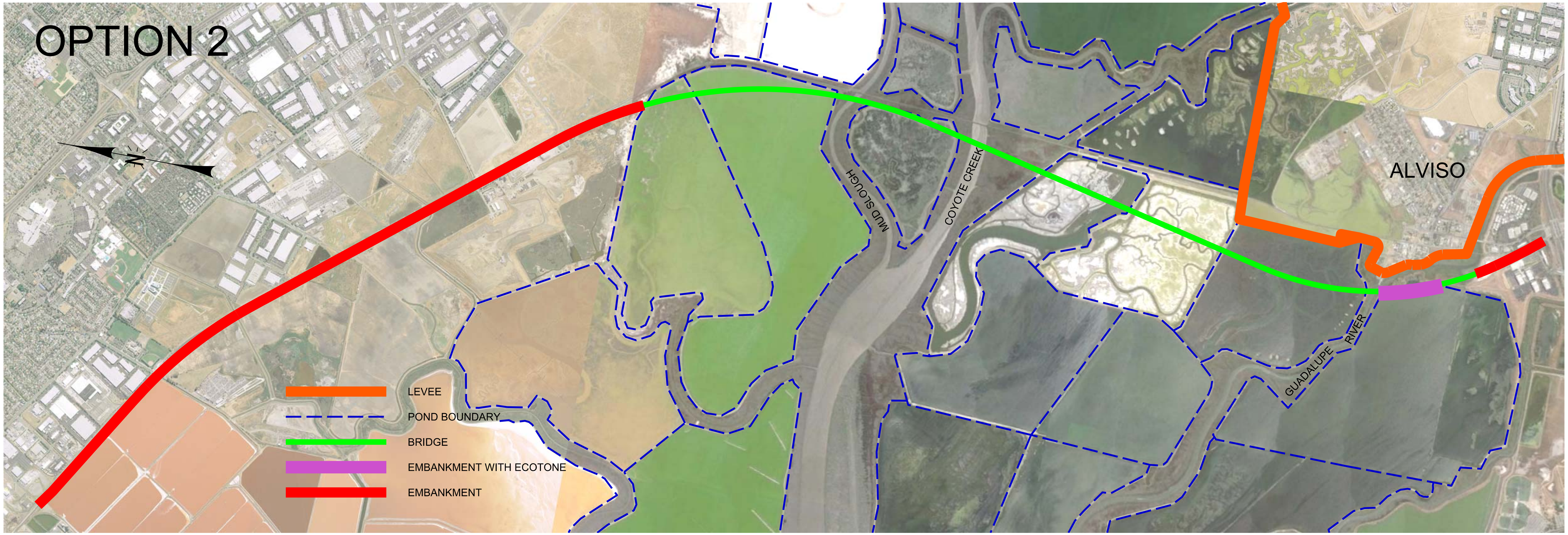
Option 2 would relocate the existing Alviso Marina to west of the railroad, with access provided by a grade separated crossing; because the railroad would be elevated, the roadway would pass under the railroad. It would also pass through the existing Residence Inn property. Option 2 assumes that mooring locations for high-masted vessels (vessels too tall to pass under a railroad bridge) that are part of the South Bay Yacht Club would be relocated to west of the new railroad bridge over the Guadalupe River, and that the Alviso Marina boat launch would also be relocated west of the tracks. (similar to Option 1).

The Option 2 alignment would hug the existing alignment more closely and incorporate more curves than Option 1. As a result, Option 2 would be a longer overall route and likely would have somewhat slower train speeds than Option 1. Like Option 1, Option 2 assumes that all trains, including freight trains, would be rerouted to the new alignment where the new alignment would veer away from the existing alignment. As such, the existing railroad corridor and embankment would be removed as part of Option 2.

Unlike Option 1, which would require an entirely new right-of-way for most of the distance between Newark and Alviso, Option 2 assumes the use of the existing right-of-way from Newark southward to a location just north of Mud Slough. A new right-of-way would be required from Mud Slough southward, around Alviso, to where Option 2 would rejoin the existing right-of-way between Alviso and State Route 237. However, even where Option 2 would employ the existing right-of-way, some additional right-of-way would be required to accommodate three tracks and the taller embankment necessary to provide resiliency against sea-level rise.

A graphic illustrating the rail alignment for Option 2 is presented in *Figure 7, Conceptual Option 2* on the following page.

Figure 7, Conceptual Option 2



III.C.2.2 CONSTRUCTION TECHNIQUES AND CONSTRUCTABILITY — OPTION 2

Construction of the northern portion of Option 2, from the beginning at approximately MP 31.5 to approximately MP 34.9, would occur essentially on top the existing railroad alignment. One side of the new embankment, wide enough to support one track, would be constructed to one side of the existing track. Once complete, a new track would be constructed on top of the embankment. After at least one track was constructed on top of the new embankment, the existing track could be removed and the new embankment (and remaining new tracks) completed over the former location of the existing track.

South of MP 34.9, beginning at the Cargill evaporation ponds, the new railroad would diverge from the existing alignment on a long bridge, extending as far south as the Guadalupe River, approximately MP 39.5. As with Option 1, the bridge would be supported on piles made of precast concrete, structural steel, or tubular steel filled with concrete, and the bridge superstructure would likely consist of precast concrete structural members that could be lifted into place and subsequently tied together to form a "tub" in which the railroad track and rock ballast would be placed. The relatively long length of bridge considered for Option 2 is such that a bridge launcher, as described for Option 1, would be a possibility. Because Option 2 passes over wetland areas, the water depth would likely be too shallow to allow for a barge-mounted crane.

As with Option 1, construction of the movable bridge across Mud Slough would involve multiple large foundations founded deep in the ground to stabilize the bridge approaches, which must remain in precise alignment whether the bridge is open or closed.

Construction of Option 2 west of Alviso is assumed to involve an ecotone.

Again, as with Option 1, construction of the rail line south of Alviso, through the Residence Inn property, would involve building demolition, demolition of the piles that support the Residence Inn, and possibly shallow excavations of the fill atop which the hotel was constructed. This work may involve rerouting leachate pipes and disposing of the excavated material at an approved landfill. It is possible that further refinement of the alignment in this area may identify ways to avoid impacts to the Residence Inn property.

III.C.2.3 KEY COST ELEMENTS — OPTION 2

The key cost element for Option 2 is the length of the bridge. Although the Option 2 bridge would be nearly one mile shorter than the bridge considered for Option 1, it is still a major cost factor. The supporting piles for the bridge are expected to be quite long (as mentioned, possibly more than 100 feet deep); therefore, not unexpectedly, bridge construction is the key cost driver. Construction of the movable bridge is also a major cost driver. In addition, Option 2 closely parallels Option 1 south of the Guadalupe River. Thus, the estimate for Option 2 also includes costs for acquisition of a private property (the recently constructed Residence Inn), the price for which would be subject to negotiation.

III.C.2.4 SUMMARY OF TRADE-OFFS AND IMPACTS — OPTION 2

Option 2 would reduce the length of the bridge compared to Option 1. Because embankments are less expensive than bridges, Option 2 would have a lower cost. Like the Option 1 alignment, the Option 2 alignment would pass west of Alviso and eliminate the grade crossings in the community. However, Option 2 would be slightly longer than Option 1, and it would pass through the middle of ponds currently being restored, or programmed to be restored, by the Refuge. Option 2 would not affect Newark Area 4, but it would affect the South Bay Yacht Club and boat passage in Alviso Slough, and would require demolition of the recently constructed Residence Inn hotel south of the Guadalupe River.

III.C.3 OPTION 3

III.C.3.1 DESCRIPTION — OPTION 3

Option 3 would follow the existing rail alignment southward from MP 31.5, north of the existing Mowry Avenue grade crossing, to approximately MP 34.9, near the south end of the existing Albrae siding (south of the Tri City landfill). The new tracks would be elevated to address sea-level rise and would be constructed on top of the existing track, thereby incorporating the existing embankment beneath them. The new embankment would be wider (to accommodate three tracks) and higher than the current embankment (to accommodate sea-level rise). The roadway profiles at grade crossings would be raised to meet the new track elevation. (Note that between Newark and MP 36, Option 3 is identical to Option 2.)

At MP 34.9, the existing alignment continues southward for several thousand feet, then curves sharply to the right to head almost due south toward Alviso. The existing curve limits maximum passenger train speeds. Option 3 assumes that a new, broader curve would be constructed to the inside of the existing track. This would pass over the existing Cargill evaporation ponds on a bridge structure, rejoining the existing alignment (likely immediately adjacent to, rather than exactly on top of, the existing alignment) near MP 36. Option 3 would continue along the existing alignment on an embankment between Mud Slough and Coyote Creek, cross Coyote Creek on a bridge, then transition back to an embankment on the existing alignment.

Near MP 37.3, Option 3 would veer to the west, away from the existing alignment. This would occur about one mile north of the community of Alviso, just north of the location where the existing alignment has a "reverse curve" (two back-to-back curves). In this area, Option 3 would be constructed on an ecotone. Near MP 38.2, Option 3 would cross over the shoreline levee and pass through the community of Alviso on a new alignment west of Hope Street. While this would eliminate two grade crossings in Alviso, the Option 3 alignment would affect two historic buildings, the Bayside Cannery and the Union Warehouse.

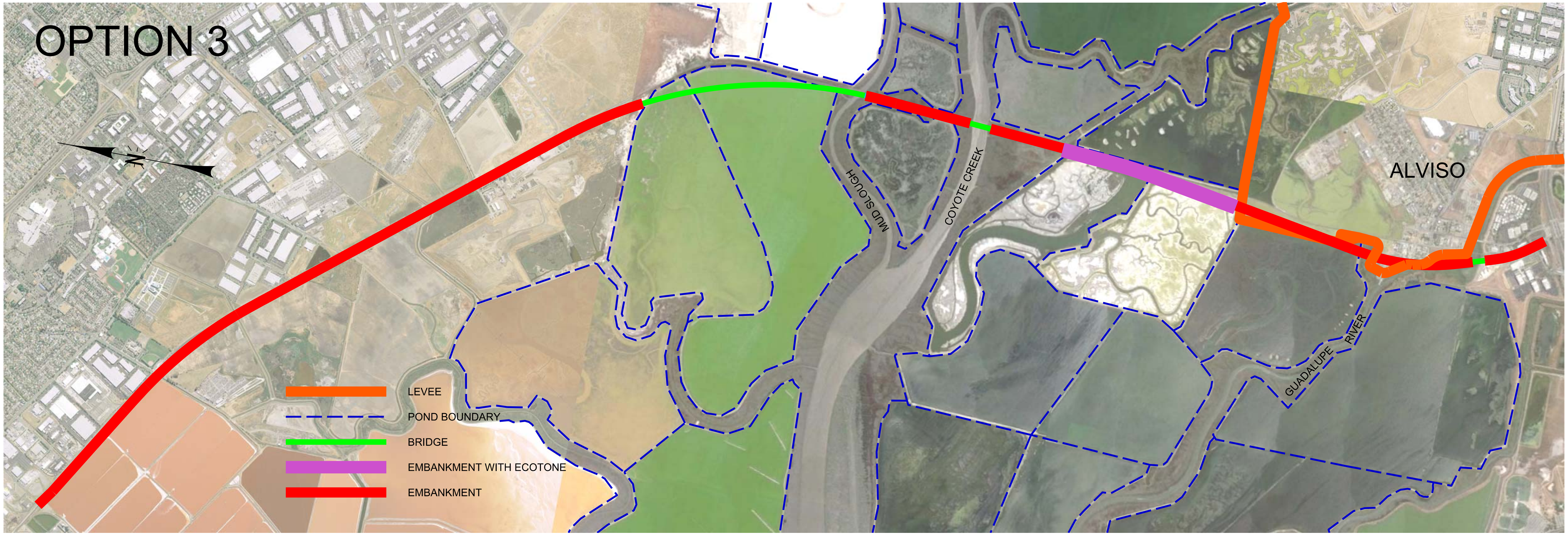
Option 3 would pass just west of the South Bay Yacht Club on a bridge, then would cross the Guadalupe River channel at a skewed angle to rejoin the existing alignment near MP 39.5, just south of the current Guadalupe River bridge. From there, Option 3 would proceed on an embankment on top of the existing alignment for the remaining distance to MP 39.8. It is assumed that mooring for the yacht club would be reestablished west of the Option 3 alignment; similarly, the Alviso Marina and boat launch would be relocated to west of the new alignment, with grade-separated vehicle access.

Option 3 would occupy the existing railroad corridor from Newark to a point just north of Alviso. Although additional right-of-way would be required along the existing right-of-way. However, from approximately halfway between Coyote Creek and Alviso to a point south of Alviso, Option 3 would be in an entirely new corridor; the new alignment would be located on an entirely new right-of-way. In this area, it is assumed that the existing right-of-way would be turned over to the Refuge and restored.

Like Option 2, Option 3 assumes that all trains, including freight trains, would be rerouted to the new alignment where the new alignment would veer away from the existing alignment just north of Alviso. As such, the existing railroad corridor and embankment between MP 38 and MP 39.5 would be removed as part of Option 2.

A graphic illustrating the rail alignment for Option 3 is presented in *Figure 8, Conceptual Option 3* on the following page.

Figure 8, Conceptual Option 3



III.C.3.2 CONSTRUCTION TECHNIQUES AND CONSTRUCTABILITY — OPTION 3

Construction of the northern portion of Option 3, from the beginning at approximately MP 31.5 to approximately MP 34.9, would occur essentially on top the existing railroad alignment, in the same manner as discussed previously for Option 2. One side of the new embankment, wide enough to support one track, would be constructed to one side of the existing track. Once complete, a new track would be constructed on top of the embankment. Once at least one track was constructed on top of the new embankment, the existing track could be removed and the new embankment (and remaining new tracks) completed on top of the (then-removed) original track location.

South of MP 34.9, beginning at the Cargill evaporation ponds, the new railroad would diverge from the existing alignment on a long bridge, extending as far south as the south side of Mud Slough, at approximately MP 36.3. At Mud Slough, there would be a new movable bridge, followed by an embankment extending past the abandoned town of Drawbridge, and then another short section of bridge across Coyote Creek. The total length of fixed bridge would be substantially shorter than that contemplated for Options 1 and 2 and would be broken up by a section of embankment between Mud Slough and Coyote Creek. Because of this short length, this section of bridge may be unsuitable for construction with a bridge launcher; rather, because the bridge would be over a waterway, a barge-mounted pile driver may be employed. Or, since the alignment is mostly comprised of embankments, after the embankments were completed, a pile driver could be driven to the bridge locations on the new embankment.

South of Mud Slough, approximately MP 36.3, the embankment would be constructed in a manner similar to construction of the northern embankment section. South of the Coyote Creek bridge, construction of the embankment would again mimic the previous methods: construction of part of the embankment adjacent to the existing track, construction of a new track on top of the partially completed embankment, removal of the existing track, and then completion of the embankment and remaining tracks.

The section of ecotone from approximately MP 37.3 to MP 38.2 would be constructed outside the limits of the existing track. Thus, construction of the new embankment could proceed without interrupting rail operations. South of MP 38.2, Option 3 would be adjacent to the existing alignment and, through Alviso, would be located west of Hope Street. Building demolition may be required in this area before construction of the embankment. South of Alviso, Option 3 would transition back to a bridge, which would cross the Guadalupe River at an oblique angle, rejoining the existing right-of-way just south of the river.

As currently conceived, Option 3 would require acquisition of private properties and demolition of masonry structures in Alviso, although it would avoid the Residence Inn and construction through the capped landfill south of Alviso.

III.C.3.3 KEY COST ELEMENTS — OPTION 3

Key cost elements for Option 3 are the quantities of new embankment and bridge. Although the total length of the bridge would be substantially less than for Options 1 or 2, this difference would be offset by a large volume of earthwork. Option 3 also would require acquisition of private property west of Hope Street in Alviso. An allowance has been made for these acquisitions, and for other areas where the embankment would extend beyond the right-of-way or the track would leave the existing right-of-way (such as at the Cargill salt ponds). Another major cost driver for Option 3 would be the new movable bridge, which could cost in the range of $150 million to construct on poor soils and in an environmentally sensitive area. Although the same movable bridge was also assumed for the previous options, it represented a smaller proportion of their total cost. For Option 3, the movable bridge represents a larger proportion of the total cost.

III.C.3.4 SUMMARY OF TRADE-OFFS AND IMPACTS — OPTION 3

Because this option would remain near or on top of the existing alignment for most of its length (with the exception of the curve over the Cargill evaporation ponds between MP 35 and MP 36.3, and through Alviso), Option 3 would appear to substantially reduce effects on the Refuge compared to Option 2. Option 3 also would be less expensive than either Option 1 or Option 2 because it would involve a much shorter length of comparatively expensive bridge construction. Although Option 3 would eliminate grade crossings in Alviso, thus reducing train horn noise, it would do so by traversing privately owned properties and crossing through the sites of two historic buildings, and through the Alviso Marina County Park parking lot, trails, and boardwalks.

III.C.4. OPTION 4

III.C.4.1 DESCRIPTION — OPTION 4

Option 4 would follow the existing rail corridor southward for almost the entire distance from MP 31.5, north of the existing Mowry Avenue grade crossing, to MP 39.8, the Gold Street Connector grade crossing south of Alviso. The new tracks would be elevated to address sea-level rise and would be constructed on top of the existing track, thereby incorporating the existing embankment beneath them. The new embankment would be wider (to accommodate three tracks) and higher than the current embankment (to accommodate sea-level rise). The roadway profiles at grade crossings would be raised to meet the new track elevation. Note that between Newark and MP 34.9, the location of the sharp curve in the existing tracks, Option 4 is identical to Option 3. At MP 34.9, Option 4 would remain on the existing alignment around this curve; whereas Option 3 would cross the Cargill salt ponds on a long bridge to reduce the sharpness of the curvature, Option 4 would not cross the Cargill evaporation ponds. The trade-off for Option 4 is that there would be a permanent speed restriction at this curve, likely on the order of 70 mph for passenger trains.

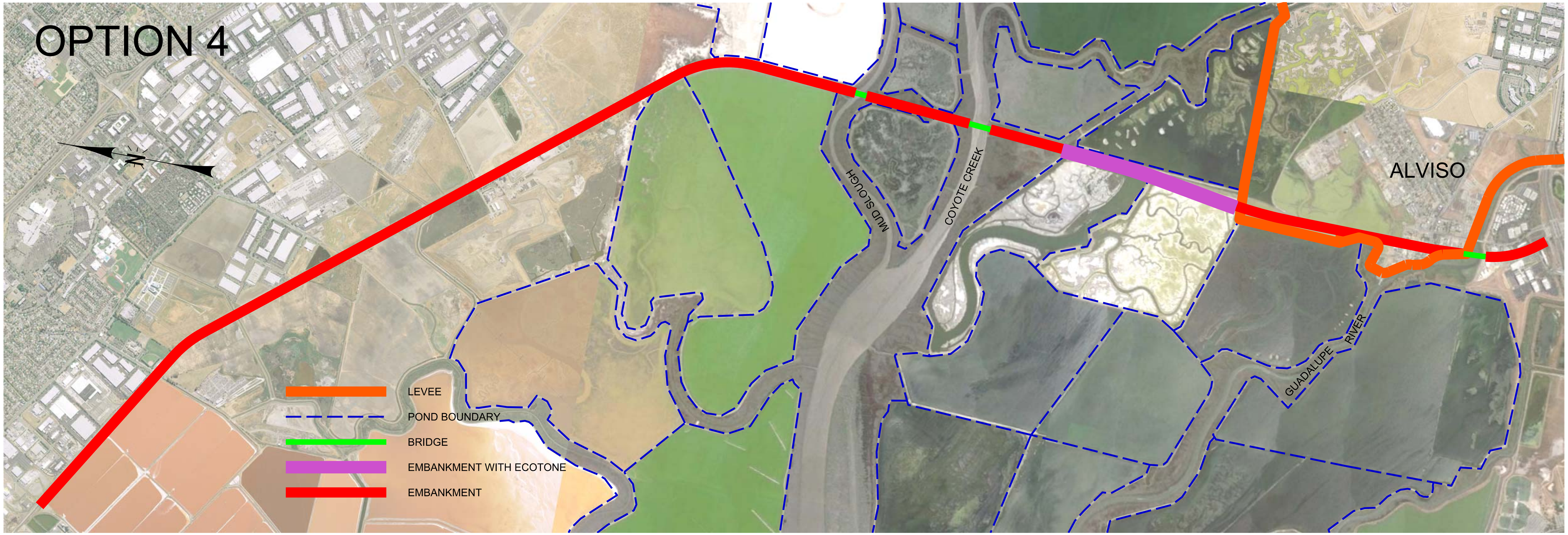
Option 4 would cross Mud Slough on a new movable bridge, although the new bridge may be constructed adjacent to the existing bridge to maintain operation of the existing bridge during construction. Continuing south toward Alviso, Option 4 would diverge from the existing alignment only between approximately MP 38.2 and MP 38.8, the area of the existing reverse curves. In this area, the new alignment would be on an embankment with ecotone. This alignment would provide a sufficient length of straight track after passing over the shoreline levee to descend from the relatively high elevation passing over the levee to a lower elevation matching the existing roadway elevations at the Elizabeth Street and Catherine Street grade crossings.

Once in Alviso, the new track would be at essentially the same elevation and alignment as the existing track. The two existing grade crossings would remain, although they would be widened to up to three tracks wide. With an alignment three tracks wide, portions of the ADS Pipe storage and distribution facility may be affected. After passing through town, the track would rise back up to cross the Guadalupe River on a bridge three tracks wide, essentially in the same location and at the same elevation as the existing bridge, and would remain on the existing alignment to the Gold Street Connector at MP 39.8.

For the majority of the Option 4 alignment, the new alignment would be effectively "on top" of the existing alignment. The main exception would be between MP 38.2 and MP 38.8, where the new alignment would diverge from the existing alignment to avoid the sharp "reverse curves" that limit train speeds. In this area, the existing track and embankment would be removed. As such, minimal new right-of-way would be required. Strips of new right-of-way would be necessary on each side of the existing right-of-way to allow the raising and widening of the railroad embankment, including through the community of Alviso. However, additional right-of-way through Alviso would be minimized because the railroad would not be raised through the community (although it would be widened to three tracks).

A graphic illustrating the rail alignment for Option 4 is presented in *Figure 9, Conceptual Option 4* on the following page.

Figure 9, Conceptual Option 4



III.C.4.2 CONSTRUCTION TECHNIQUES AND CONSTRUCTABILITY — OPTION 4

Option 4 would be almost entirely on top of the existing railroad embankment. Thus, to keep the existing railroad in operation, construction of the new embankment would be phased. One side of the new embankment, wide enough to support one track, would be constructed to one side of the existing track. Once complete, a new track would be constructed on top of the embankment. Once at least one track was constructed on top of the new embankment, the existing track could be removed and the new embankment (and remaining new tracks) completed on top of the existing embankment.

Because the majority of Option 4 would be on embankment, only comparatively short lengths of bridge would be required. Because the bridges would be over waterways, a barge-mounted pile driver may be employed. Alternately, after the embankment construction was completed, a pile driver could be driven to the bridge locations on the new embankment.

III.C.4.3 KEY COST ELEMENTS — OPTION 4

One major cost element for Option 4 is the quantity of new embankment. Note that Option 4 is generally similar to Option 3, except that Option 4 would remain on the existing embankment in the curve between MP 34.9 and MP 36.3; thus, a long bridge would not be necessary in this area. Although the length of bridge would be substantially less than in Option 1 or 2, this difference would be offset by a large volume of earthwork. Another major cost driver for Option 4 would be the new movable bridge, which could cost in the range of $150 million to construct on poor soils and in an environmentally sensitive area. Although the same movable bridge was also assumed for the previous options, it represented a smaller proportion of their total cost. For Option 4, the movable bridge represents a larger proportion of the total cost – nearly one third of the total construction cost (an even higher proportion of the total cost than in Option 3).

III.C.4.4 SUMMARY OF TRADE-OFFS AND IMPACTS — OPTION 4

Because it would remain on top of the existing alignment for essentially all its length, Option 4 would appear to substantially reduce effects on the Refuge, compared to other options. Option 4 also would be less expensive than other options, in part because it would involve the shortest length of expensive bridge construction. Option 4 would not, however, eliminate the grade crossings in Alviso and the tracks would remain close to residential and commercial areas of the community, potentially increasing noise and vibration effects during operation.

III.C.4.5 ELEVATED MODIFICATION IN ALVISO — OPTION 4

In response to comments from several members of the community of Alviso, a modified version of Option 4 was evaluated. This modification entailed elevating the railroad through Alviso on a bridge to eliminate the two grade crossings in town. This would be technically feasible. Elevating the three tracks would increase costs by approximately $25 million. This modification assumes that the entire distance between Elizabeth Street and North Taylor Street would be elevated on a bridge wide enough for three tracks.

III.D. Opportunities For Benefits To Stakeholders And Environmental Mitigation Approaches

Comments received during the stakeholder outreach process emphasized the substantial investments local stakeholders have made in their properties and in environmental restoration efforts, and that stakeholders are concerned about any project's potential impact on those investments. Measures to avoid or mitigate impacts will therefore be a critical component of any project and have been included in the conceptual options.

Because the options contemplate constructing additional rail lines through the community of Alviso and the sensitive habitat in the Refuge, temporary and permanent impacts on resources are expected to result from a potential project and mitigation would be necessary for any of the options. Examples of these impacts include noise and vibration, air quality, and transportation impacts, as well as impacts on recreation use, historic and cultural resources, natural resources, and private properties. Impacts could occur during both construction and subsequent operation of the rail line.

However, the options studied also provide the opportunity to provide benefits to local stakeholders. For example, by routing the railroad tracks around Alviso, the noise and vibration impacts from rail operation would be moved further from the community and the existing train noise affecting residents and businesses would essentially be eliminated. Based on comments from some stakeholders, this may be seen as a benefit of the project. Similarly, the inclusion of habitat transition zones alongside the railroad embankments or under bridge structures may be a benefit as sea levels rise and portions of the Refuge risk flooding; these transition zones may be perceived to be not simply mitigation, but rather a benefit by some stakeholders. Railroad bridges may also be a benefit insofar as they allow for hydraulic connectivity across the railroad and also provide a means for terrestrial species to cross the rail line without having to traverse the railroad tracks themselves.

Although minimization and avoidance measures would be used to the fullest extent possible, mitigation may be necessary. Examples of possible mitigation include restoring affected environments in situ; reducing or eliminating impacts over time; and finally, directly compensating for impacts. The cost of mitigation for such a large project incentivizes the minimization of impacts. If compensatory mitigation is pursued as one of the mitigation strategies, the limited availability of mitigation banks in the San Francisco Bay Area may be a constraint; as a result, environmental mitigation may be one of the key factors that affects the form of any future project.

It is important to note that the ponds in the immediate vicinity of the rail line that are already slated for or are undergoing habitat restoration by the South San Francisco Bay Shoreline Project by USACE and Valley Water would likely not be considered as mitigation for project impacts. However, ponds that are part of future phases of the South Bay Salt Pond Restoration Project may be an option; future discussion with the U.S. Fish and Wildlife Service would be needed to determine the feasibility of participating in that project.

In addition, the following alternative mitigation strategies could be designed to complement or enhance ongoing restoration efforts. These strategies could be combined to enhance their individual beneficial effects

- **Bridges**. Strategically placed sections of railroad bridge could mitigate safety risks and traffic impacts in urban areas by allowing roadways and pedestrians to pass beneath the track. Where a bridge replaces an at-grade crossing (known as a "grade separation"), such as the Option 1 grade separation at Mowry Boulevard, the elimination of the crossing would obviate the need for train horns to sound for the at-grade crossing.

  Outside of urban areas, benefits of bridges include increased capacity for wildlife to cross under the railroad, increased ability of plant species to pollinate in the area under the railroad, increased hydrologic connectivity, and potential to reduce the risks of wildlife strikes. This strategy could replace the use of railroad embankments or could be used in combination with gradually sloping, raised embankments built under the bridges designed to provide transitional high-tide "refugia" (also see "Transitional Ecotone Habitat" below).

- **Transitional Ecotone Habitat.** Constructing tracks on an embankment with an approximately 20:1 slope (20 units horizontal for every one unit vertical), or shallower, would allow for the creation of vegetated transitional habitat. Such a transition zone would provide upland refuge for wildlife species during high-tide and storm surge events. Although this strategy would be beneficial for creating wildlife habitat and increasing resiliency against sea-level rise for wildlife populations along the rail line, it is currently unknown whether the addition of fill for a gradually sloping ecotone area would be considered an impact rather than mitigation. Bay Area regulators (i.e., the San Francisco Bay Conservation and Development Commission and San Francisco Bay Regional Water Quality Control Board) are addressing bay fill for habitats in their policies (e.g., the San Francisco Bay Plan and the Water Quality Control Plan for the San Francisco Bay Basin). Thus, more clarity on the use of these areas as mitigation will likely be available in the future.

- **Restoration of Old Railroad Embankment.** The existing track runs through sensitive habitats including tidal marsh and vernal pool grasslands. Under all options, portions of the existing track that would abandoned in favor of a new alignment could be removed and the habitat restored. Options 1 and 2, which would diverge the greatest distance from the existing alignment, offer the most opportunity for restoration of the existing railroad embankment. Substantial habitat benefits may be realized by restoring the former rail bed to a "natural" condition. The same holds true for tracks through Alviso, as options that go around the community would mean that at-grade crossings in Alviso could be reduced or eliminated.

III.E. Cost Estimates For Sea-Level Rise Resiliency And Operational Capacity Improvements

Basis of Cost Estimates

The cost estimates developed for each option were based on the conceptual alignments, which, in turn, employed commercially available aerial imagery and survey data available from the U.S. Geological Survey. This approach produced a very coarse representation of the alignment options and associated earthwork, which was used as the basis for establishing quantities of earthwork and other materials.

Costs for different types of construction were based on the Study team's experience and recent projects in the area.

Right-of-way cost assumptions were based on the "net" increase in right-of-way. Where the existing railroad right-of-way would be abandoned in favor of new right-of-way, it was assumed that the area of abandoned existing right-of-way would be sold or, in the case of right-of-way within the Refuge, traded, to offset new right-of-way acquisition. Where developed properties would be acquired to allow for railroad right-of-way, an assumed value was used. However, no detailed right-of-way or property valuation was performed.

The resulting cost estimates — the combination of the quantities of construction and costs for each type of construction — are based on preliminary, highly conceptual designs. Thus, the cost estimates have a relatively low confidence level and should be considered as "rough-order-of-magnitude" estimates. To address the low confidence level, a 50 percent contingency has been applied to the construction costs in each estimate.

Cost estimates for each option are presented below. All costs are reported in 2019 dollars with no escalation. It bears repeating that these are rough-order-of- magnitude estimates; while the Study team believes that these estimates are conservative, these cost estimates would need to be refined with additional design and environmental effort.

Although the total rough-order-of-magnitude costs are substantial, particularly for Option 1 and Option 2, each option achieves the goals of providing sea-level rise resiliency and increasing capacity along the railroad. The most expensive option, Option 1, has a rough-order-of-magnitude total project cost, including a 50% contingency, of $2.1 billion. The key driver is the cost of over five miles of triple-track railroad bridge which was assumed to be necessary. To place that length into context, five miles is approximately the same length as the Oakland-San Francisco Bay Bridge. Option 2 is the second most expensive option, with rough-order-of-magnitude total project cost, including a 50% contingency of approximately $1.8 billion. However, as with Option 1, Option 2's four-mile long triple-track railroad bridge is a key cost driver.

Option 3 and Option 4 involve shorter lengths of railroad bridge. Option 3 assumes two miles of triple-track railroad bridge with rough-order-of-magnitude total project cost, including 50% contingency, of $1.3 billion. Option 4, which assumes less than one mile of triple-track railroad bridge, has a rough-order-of-magnitude total project cost of $800 million. However, the triple-track movable bridge (which is included in the total project cost estimates for all options) represents a much larger proportion of the cost in Option 3 and Option 4, as described in more detail below.

Costs were estimated in four major categories:

- Construction costs
- Environmental Mitigation, Site Restoration, and Right-of-Way Costs
- Mobilization, Bonds, Insurance, and Project Development Costs
- Contingency Costs

Descriptions of each these categories, and comparisons between options, follow. Costs have been rounded to the nearest $10 million.

Construction Costs

Construction costs include the cost of the physical infrastructure, exclusive of contingencies, mitigation costs, right-of-way costs, or project development costs. Key drivers of this cost category are the new tracks, new railroad signal equipment, embankments, fixed (i.e., non-movable) railroad bridges, and the movable bridge over Mud Slough. Indeed, the fixed bridges in Option 1 would be more than five miles long. In terms of construction cost, however, the cost of a bridge is also a function of the number of tracks. Thus, although Option 1 would include more than five linear miles of bridge (the length of the bridge), this also represents more than 15 track miles of bridge (the total length of the three tracks on the five-mile-long bridge). This makes the fixed bridge a key cost driver for Options 1 through 3, each of which would include a substantial length of bridge. For the five linear miles of triple-track bridge in Option 1, the construction cost would be over $800 million, and for the over two linear miles of bridge in Option 3, the construction cost would be over $330 million. Soil conditions and seismic considerations are also key drivers of bridge cost.

The movable bridge over Mud Slough is also a key cost driver. Unlike fixed bridges (which are what most people imagine when they think of a railroad bridge), movable bridges must physically move to allow passage of waterway traffic. The UPRR Carquinez Bridge connecting Martinez and Benicia (which lifts up-and-down to clear vessel traffic), is an example of a movable railroad bridge, as is the middle span of the now-unused Dumbarton railroad bridge (which, when active, rotated 90-degrees to clear vessel traffic). The movable bridge for this project has been estimated at $150 million for each option, although actual costs could vary substantially depending on the type of movable bridge (e.g., lift bridge, swing bridge, or bascule bridge) and the size and depth of the foundations required.

For the lower-cost options (i.e., Option 3 an Option 4), the movable bridge is a large percentage of the total construction cost. In the case of Option 4, for example, this one bridge alone is by far the largest single cost element, and would make up approximately one-third of the construction cost. In the event that the movable bridge could be replaced with a fixed bridge, a substantial cost reduction would be possible for each option.

Construction costs (excluding contingency, environmental mitigation, right-of-way, or project development costs) range from $1.1 billion for Option 1 (the highest) to $390 million for Option 4 (the lowest). The wide distribution of costs between options underscores the relatively high cost of railroad bridge construction in an area with poor soil conditions that would require deep foundations and, from a cost perspective, favors embankment construction, even where ecotones (which would require a large amount of embankment material) are used.

Railroad track and signal costs, which are considered part of the construction costs and include three parallel tracks, turnouts and crossovers (which allow trains to move from one track to another), railroad signal systems, and positive train control costs, are on the order of $80-$90 million for each option, with the key differentiator being the length of the total new track construction. More specifically, Option 1 is shorter than the other options, and so its track and signal construction cost is approximately $80 million. The other three options, all approximately the same length, have track and signal construction costs of approximately $90 million. As with the movable bridge, for the higher cost options, track and signal construction costs are a low proportion of the total cost. However, for the lower cost options, track and signal costs are a much larger proportion of the total cost.

Environmental Mitigation, Site Restoration, and Right-of-Way Costs

Environmental mitigation costs reflect the costs of activities necessary to offset the environmental impacts of the project, including habitat restoration, on-site mitigation, and off-site compensatory mitigation. These costs have been estimated based on the incremental increase in the footprint of the proposed options compared to the existing right-of-way width of the railroad embankment. This means that the Study assumes that the existing railroad right-of-way is considered "disturbed" for its entire width. At this conceptual level, it has been assumed that only this incremental increase in footprint area would require mitigation.

In the case of Option 1, which would include a relatively narrow bridge for much of the length of the alignment, the footprint area of the option would actually be smaller than the area of the existing railroad right-of-way, which would be restored to its natural state. As a result, this Study assumes that this option would result in a net decrease in the footprint area, and thus, no additional mitigation area would be required. Environmental studies would be needed to confirm these assumptions. Conversely, Option 4 would have a larger footprint than the existing railroad right-of-way, and thus, the incremental increase would be the area requiring mitigation. Ultimately, regulatory agencies would establish actual mitigation ratios and determine what constitutes a previously disturbed area versus impacts that would need to be mitigated.

Site restoration costs reflect the costs of activities needed to return the site to its preexisting condition upon completion of construction. Although site restoration is distinct from mitigation efforts, it includes activities such as reseeding of vegetation, removal of temporary access roads, and removal of temporary stormwater management controls.

For this Study, right-of-way costs have been determined based on the incremental increase in footprint in the same manner that the environmental footprint was determined. In addition, allowances have been made where acquisition of private properties is a possibility, such as the recently constructed hotel that would be affected by both Options 1 and 2, or for the properties in Alviso that would be affected by Option 3.

These costs range from \$50 million for Option 1 (which consists mostly of new bridge, and a substantial area of existing railroad embankment that could be restored to a natural state) to \$80 million for Option 4 (which assumes an expansion of the existing embankment). Recall that although Option 1 would have an entirely new alignment, substantially shorter than the existing alignment. It has been assumed that removal of the existing track and restoration of the existing right-of-way could represent a net "credit"; thus, the footprint of the railroad in Option 1 would be smaller than both the existing railroad footprint and the Option 4 footprint. As a result, Option 1 would have lower environmental mitigation costs.

Mobilization, Bonds, Insurance, and Project Development Costs

Mobilization represents the cost of the construction contractor and subcontractors starting work, including move-in of equipment, establishment of an office presence, early material purchases, etc. For example, in the case of Option 1, this might include the cost of acquiring, moving in, and assembling a bridge launcher. For options that would include more earthwork, this mobilization would include the cost of assembling specialized earthmoving equipment. For all options, this would include the cost of specialized equipment necessary to construct the movable bridge.

Bonds are various forms of financial guarantees by third-party entities that the work will be performed in accordance with a construction contract. As the size of a project size increases, the cost of these financial instruments also increases.

Insurance costs are those that the construction contractor pays for insurance such as workmen's compensation, automotive insurance, and general liability insurance. As with bonds, as project size increases, so does the cost of insurance.

Project development costs are expenses borne by the project sponsor for activities such as field reconnaissance, environmental studies, geotechnical studies, surveying, engineering design, construction management, and agency administration costs. Key drivers for these cost categories would be the detailed environmental studies at both the federal and state levels; the relatively high cost of geotechnical explorations, which would need to be extremely thorough and require specialized equipment to access the site; and the cost of design for the project, including the specialized equipment and foundations for the movable bridge. This cost also includes the cost of managing construction activities.

The mobilization, bond, insurance, and project development costs are not insignificant. They are assumed to be linearly related to the construction costs, a common assumption for high-level, conceptual studies. The mobilization, bonds, insurance, and project development costs are the highest for Option 1 (which has the highest construction cost) at \$190 million, while the mobilization, bonds, insurance, and project development costs for Option 4 (which has the lowest construction cost) are lowest of the four options, at \$70 million.

Contingency Costs

Contingency costs are intended to allow for the uncertainty of the project's scope. Although this Study has established conceptual alignments for four options, very limited engineering has been performed and a high degree of uncertainty exists in all cost categories. As a result of this high uncertainty, a relatively high "unallocated contingency"— a contingency applied to all other cost categories — has been employed. This study assumes a 50 percent contingency on top of all other costs.

Because contingency makes up one-third of each estimate, a reduction of contingency would seem to be an effective way to reduce project cost. For example, modest additional information gathering could lead to refinements in each option, which in turn could identify significant savings, or conversely, additional expenses. However, as more information is collected and the project scope becomes more certain, the percentage allowed for the contingency could be reduced.

As with the mobilization, bonds, insurance, and project development costs, the contingency is linearly related to other costs. For Option 1, the contingency amount is $680 million, while the contingency amount for Option 4 is $250 million.

I.F. Options Considered But Not Studied Further

The Study evaluated two other options: a route around the Refuge and a tunnel concept. Because this is not a formal environmental document, there was no evaluation of a "no-build" scenario. These options were considered but not brought forward as viable options for the reasons outlined below. In addition, the Study did not evaluate options including substantial amounts of retaining wall, since the ACE*forward* program EIR already evaluated such concepts. These options are illustrated in *Appendix C*.

III.F.1 ROUTE TO THE EAST OF THE REFUGE

A concept for a rail route around the Refuge was previously developed by the ACE*forward* program EIR. That concept effectively established a new corridor that would skirt the east edge of the Refuge, near Interstate 880. See *Appendix C-1, ACEforward Alignment Concept East of the Refuge*, for the route proposed by the ACE*forward* project. This Study reviewed the option ACE developed, and determined that it had several critical drawbacks:

- The new corridor around the Refuge would require property acquisition for the entire route. This acquisition would include both developed properties and portions of the Refuge that would be unavoidable where the proposed corridor would diverge from the existing corridor. (Because the existing corridor is bordered by the Refuge to the east, some portion of the Refuge must be crossed to reach Interstate 880.)
- This new corridor would have a substantially longer travel time than the existing route. The new corridor would require on the order of nine miles to cover the distance between the existing curve at MP 34.9 and the State Route 237 overpass, a distance of only five miles on the existing corridor. A train would require considerable additional time to traverse this additional distance. In addition, the sharp curvature required to avoid the Refuge would substantially limit train speeds; a detailed analysis has not been performed, but it was evident that several curves would limit train speeds to less than 60 mph, lower than current train speeds.
- The new corridor would require several grade crossings or grade separations to maintain access to the developed properties. For example, the corridor would cross freeway interchanges at both Dixon Landing Road and Warren Avenue. It also would cross several other roadways. Because of the level of vehicular traffic on these roadways, this new corridor would likely need to be entirely elevated, with the top of rail approximately 20 feet or more above the surrounding ground, increasing costs and visual and noise impacts.
- The new corridor would include many more curves than the existing corridor and would compare unfavorably for freight train operation. Thus, it is likely that the existing corridor through the Refuge would remain for freight service and eventually be raised to preserve freight train operations when future sea-levels rise.

III.F.2 TUNNEL

An option for multi-track railroad tunnel beneath both Alviso and the Refuge was also considered. At first glance, a tunnel offers an appealing option for constructing a "straight-line" alignment between Newark and Alviso. A single-track tunnel large enough to accommodate passenger trains would be on the order of 30 feet in diameter. Providing multiple tracks would require either two adjacent single-track tunnels or a single larger diameter tunnel (likely more than 40–50 feet in diameter) with space for multiple tracks.

However, geotechnical conditions constrain the options for a tunnel in this area. The entire area between Newark and State Route 237 is underlain by a thick layer of "Bay Mud," a muddy soil with very low strength. However, stronger soil exists below the layer of Bay Mud. To dig a tunnel, the surrounding soil must have sufficient strength to support itself for short distances. Thus, a tunnel would need to be excavated below the layer of Bay Mud, which ranges from 40 feet to 100 feet deep. The tunnel would need a thick layer of stronger, competent soil above it. Initial geotechnical and engineering information indicates that the top of a new tunnel would need to be at least one tunnel diameter below the bottom of the Bay Mud. Thus, at the very minimum, the track elevation would be at least 80–100 feet below the existing track elevation. See Appendix C-2, *Tunnel Concept Typical Section*, for a cross sectional view of a tunnel.

To descend, say, 100 feet below existing top-of-rail elevation, even at a relatively steep grade of 2 percent, the railroad would require on the order of 8,000 feet to allow space for the vertical curves at each end. In this 8,000-foot distance, the crown of a tunnel could not be supported by the overlying soil because it would be less than one tunnel diameter below the Bay Mud. Thus, to allow the railroad to descend to the tunnel, it would be necessary to construct an open-cut trench for the approaches to the tunnel. These trenches are estimated to be at least 5,000–8,000 feet long on each end of the proposed tunnel.

The tunnel concept has several critical drawbacks:

- The open-cut trenches would need to be constructed adjacent to the existing track to maintain the existing track in operation. This would be particularly challenging under State Route 237, in the urban area of Santa Clara, and through the Refuge.
- A tunnel approximately five to six miles long would require either a mid-tunnel ventilation structure (which would be located in the Refuge) or electrification of the entire railway.
- Freight trains would be unlikely to use the tunnel, particularly one with steep grades at each end. Thus, the existing railroad alignment through the Refuge would remain.
- A tunnel would not avoid property acquisition, because the open-cut trenches on each end of the tunnel would need to be constructed adjacent to the existing track. To be far enough away from the existing track for constructability, these open-cut trenches would be well outside the existing right-of-way.

Given the drawbacks of the route to the east of the Refuge and the tunnel, these concepts were not studied further.

III.F.3 RETAINING WALLS

The ACE*forward* program EIR studied a concept that included elevating the railroad tracks on the existing alignment using a combination of retaining walls and comparatively steep-sided embankments. See *Appendix C-3, ACEforward Typical Sections*, for examples of these concepts. These concepts were developed with the assumption that there would be only two tracks through the Study area. Environmental stakeholders reported that the retaining walls and steep slopes might interfere with wildlife habitat and could present a significant visual change in the Refuge. Because these ideas had already been examined, this Study did not consider them further.

IV. SUMMARY OF FINDINGS

IV.A Study Findings

Each of the four options developed as part of this Study meets the overall goals for the Study:

- Improve resiliency to sea-level rise
- Improve the existing railroad infrastructure to provide more operational capacity
- Provide benefits for local stakeholders

Resiliency to Sea-Level Rise

Resiliency to sea-level-rise is chiefly a function of elevating the railroad tracks above the predicted elevation of future sea-level and possible storm surges. The options explored in this Study employ two basic strategies to accomplish sea-level rise resiliency: 1) elevating the railroad on taller embankments or 2) elevating the railroad on bridges that would allow water to pass under the railroad. Railroad construction that would provide resiliency to sea-level rise, including construction of long bridges or construction of tracks in areas with poor soil conditions, is well understood from a technical perspective. In this regard, each of the four options is technically feasible, though each comes with significantly different construction approaches (e.g., whether a given option favors bridges versus embankments) and significantly different costs.

Improve the Operational Capacity of the Railroad

This Study assumes up to three parallel, adjacent tracks would be constructed through the study area. Three tracks would provide a significant increase in rail line capacity (i.e., the number of trains that could traverse the Study area in a given amount of time) compared to the existing single track. Capacity improvements would also result from the higher speeds than are possible today. The same infrastructure features that would provide resiliency to sea-level rise would also allow an increase in operational capacity of the railroad by adding tracks, or by widening curves to allow higher speeds.

Provide Benefits to Local Stakeholders

Benefits for local stakeholders are difficult to evaluate on a quantitative basis, since the benefits to stakeholders are distributed unevenly between options. For example, from the perspective of a resident or property owner in Alviso, an option which would impact private properties in the community may be less desirable than an option which would impact historic resources at the Drawbridge townsite between Mud Slough and Coyote Creek. Conversely, members of the historic preservation community may hold an opposite opinion. However, each option did create benefits for one or more stakeholder groups.

IV.B Comparison of Options

This Study was not intended to identify a preferred option or to rank options[9], though stakeholders who attended the outreach meetings or provided comments were able to offer their thoughts and insights. Opinions regarding any particular option depended, in large part, on the perspective of the stakeholder and whether or how the option affected that stakeholder.

The options were compared to the objectives and compared to each other on either a quantitative or qualitative basis. Table 5 on the following page illustrates the results of that comparison. Please note that the comparison itself is subjective, and is based on comments from stakeholders. A similar table was shared with stakeholders during the Stage 3 stakeholder meetings.

9 Note that the numbering process for the four options considered in this Study proceeded from west to east, with Option 1 being the western-most alignment and Option 4 being the eastern-most alignment. The number designation is simply a method of distinguishing one option from another; the numbers do not reflect preference, ranking, or priority on the part of CCJPA or any stakeholder.

TABLE 5
COMPARISON OF THE OPTIONS

	Option 1 (Western/ Bridge)	Option 2 (West of Alviso)	Option 3 (West of Hope Street in Alviso)	Option 4 (Existing Alignment)
Travel Time	●	◕	◔	○
Construction Cost	○	◔	◕	●
Impact on Historic Resources	●	◕	○	◔
Impact on Terrestrial Natural Resources	●	◕	◔	◔
Impact on Aquatic Natural Resources	○	◔	◕	◕
Noise/Vibration Impact on Developed Properties	●	●	◔	◔
Acquisition of Private Properties	○	◕	○	◔
Notes: ● = lowest cost/lowest impact/most favorable ◕ ◔ ○ = highest cost/highest impact/least favorable	Please note that, while each option offered the opportunity to provide benefits for various stakeholders, the benefits of different options accrued to different stakeholders. To avoid ranking stakeholder interests, specific benefits are not shown in this table. Possible benefits are described in Section III.			

The relative costs of each option provide a quantitative basis for comparison. As described in Section III.E, options which favored bridges (Option 1 and Option 2) were substantially more expensive than those options which favored embankments. This is because the Option 1 and Option 2 alignments include deep layers of poor soil and long pilings would be required to support bridges. The total rough-order-of-magnitude costs for Options 1 and 2 are estimated to be $2.1 billion and $1.8 billion, respectively. Alternately, options which favored embankments and ecotones (Option 3 and Option 4) were less expensive. The total rough-order-of-magnitude cost estimates for Option 3 and Option 4 were $1.3 billion and $800 million, respectively. Note that the total cost estimates include a 50% contingency. While the Study confirmed that all options are technically feasible, it also revealed that the costs of any options, as currently conceived, would be substantial.

Certain objectives, such as the benefits to local stakeholders, are more difficult to quantify. For example, the reduction of operational impacts in the community of Alviso, as afforded by Option 1 (which routes the rail line to the west of Alviso) may be more favorable to community members though, by constructing a long bridge across what is today a wetland, Option 1 may also create the most significant impacts to the Refuge and thus be less desirable to Refuge stakeholders. Conversely, by maintaining the existing rail corridor through Alviso (as in Option 3 or Option 4), effects on the Refuge could be reduced by minimizing the footprint of "new" railroad in environmentally sensitive areas, though effects on the community of Alviso would potentially be higher[10] Thus this table is based on a qualitative assessment of the impacts.

Note that hybrid options were not considered for this Study. An example of a hybrid option would be a scenario involving the alignment for Option 4, but with portions of the embankment replaced with bridges[11]. Subsequent technical analysis and further engagement with stakeholders may reveal that such hybrid options provide the best balance between minimizing impacts and providing the widest range of benefits to all stakeholders.

10 The "Elevated Modification" of Option 4 discussed in Section III.E.5 could mitigate those effects by eliminating the existing grade crossings and this eliminating the train horn noise.
11 Option assumes the tracks remain on the existing alignment and would be elevated on an embankment.

IV.C Summary of Option Comparison

The four options evaluated in this Study would lay the groundwork for the faster and more frequent passenger rail service contemplated by the CCJPA Vision Plan and the California State Rail Plan. Although all the options considered for this Study would accomplish the goals of the Study and would be technically feasible, all options would involve a significant investment, ranging from hundreds of millions to over a billion dollars. With a no-action approach, as sea-level rises, the low-lying section of railroad between Newark and Alviso could become , and passenger rail service could be subject to interruption and become unreliable. Conversely, any of the four options would provide sea-level rise resiliency for the railroad, improved operational capacity, and provide potential benefits for stakeholders.

During the stakeholder engagement process, it was evident that not all stakeholders view the effects of the project and the potential benefits through the same lens. For example, many stakeholders recognized the regional mobility benefits that would be achieved by increasing rail capacity and reliability in the corridor. Many stakeholders also recognized the benefits of providing sea-level rise resiliency for the railroad. However, stakeholders expressed concern that the local effects and potential impacts be balanced with the regional benefits. Engagement with the local stakeholders and a better understanding of the stakeholders' approach to these important issues was one of the important outcomes of this Study.

V. NEXT STEPS

As noted in *Section I, Introduction*, this Study is not the start of a formal planning process or of an environmental documentation process. This Study process engaged stakeholders and enabled CCJPA to understand the issues and interests related to effects of sea-level rise, effects on ecological systems, effects on communities, and stakeholders' interests and future plans. If CCJPA elects to pursue sea-level rise resiliency and rail line capacity improvements in the Study area, CCJPA will be better informed as to all of these issues.

If CCJPA does elect to pursue further efforts, there are several possible next steps, which may proceed sequentially or simultaneously.

(1) Conduct outreach to additional government and regulatory agencies. The current Study has focused on local stakeholder groups, but additional agencies would be involved with any planning efforts. Examples include the California State Transportation Agency, the United States Army Corps of Engineers, and the San Francisco Bay Conservation and Development Commission. In addition, since congressional action would be required to acquire right-of-way from the Refuge, engagement with the Refuge and development of a political coalition would be an important activity.

(2) Refine the rail operator scenarios and capacity demands on the rail line. Identify potential benefits to Capitol Corridor and other services. Engage ACE, Amtrak, and UPRR to evaluate potential network effects of increased passenger service. UPRR, as owner of the existing corridor, will have a considerable stake in future planning efforts.

(3) Identify the future phases and breakdown of the work. Identify potential "early start" activities that would generate near-term benefits. Identify how the planning effort should proceed. Develop a process by which project proponents and stakeholders can establish priorities. Develop an implementation strategy, including the potential for a phased implementation plan. Evaluate the possibility to generate benefits for all stakeholders in a reduced time frame.

(4) Pursue opportunities to refine project scope and costs. The options identified in this Study were developed for a cost-unconstrained project scope for each option. However, only minimal engineering was performed to develop the cost estimates. As such, these cost estimates represent "aspirational" approaches to addressing CCJPA's goals and stakeholder considerations. There may be opportunities to refine the cost estimates for these options, either as initially scoped in this Study or with further refinements based on additional engineering information and additional stakeholder engagement.

(5) Identify funding strategies. Because the minimum anticipated cost to increase rail line capacity and improve resiliency is assumed to be several hundred million dollars, establishing a funding plan and identifying funding sources will be a critical component. Even if the entire project cannot be funded immediately, options can be identified for conducting subsequent outreach, planning, design, construction, and mitigation efforts in phases.

(6) Once funding for preliminary design and environmental documentation is secured, prepare CEQA and NEPA documentation. This process will provide an additional opportunity for stakeholder engagement. At this stage, there will be a formal process for seeking public comments and incorporating those comments into the project. Completion of the documentation process will be followed by permitting for specific construction activities and project impacts.

APPENDIX A
SPECIAL-STATUS SPECIES

APPENDIX A: SPECIAL-STATUS SPECIES

The San Francisco Bay Area provides habitat for a large number of special-status wildlife and plant species, including several that have the potential to occur in the Study area. Special-status species are wildlife and plants that are legally protected under the California Endangered Species Act, federal Endangered Species Act, or other regulations or rankings established by the scientific community. Special-status species include:

- Species that are federally listed or state-listed as endangered or threatened
- State-designated Species of Special Concern and Fully Protected Species
- California Native Plant Society–ranked rare species
- Bat species that are designated as "Red" or "High" by the Western Bat Working Group's Bat Species Priority Matrix

Some of the special-status species that are known to occur within three miles of the Study area are described below. A visual representation of all potential special-status wildlife and plant species known or with the potential to occur in the Study area can be found in *Figures A-1* and *A-2*, respectively.

Special-Status Animals

CALIFORNIA RIDGWAY'S RAIL

California Ridgway's rail (formerly known as California clapper rail) (*Rallus obsoletus obsoletus*) is federally listed and state-listed as endangered and is a California Fully Protected species. These birds inhabit tidal mudflats and sloughs in the San Francisco Estuary. The complex vegetative structure and channel networks of the tidal marshes in and surrounding the Study area provide habitat for Ridgway's rails. Optimal habitat for this species consists of tidal salt marsh with direct tidal circulation, an intricate network of tidal sloughs, pickleweed with cordgrass, gumplant, and other high-marsh plants, and abundant and dense high-marsh vegetation for cover during high tides.[1] Ridgway's rails are present in Coyote Creek and in the restored tidal marsh habitat in Pond A21, both of which intersect the Study area.[2]

CALIFORNIA BLACK RAIL

California black rail (*Laterallus jamaocensis coturnuculus*) is state-listed as threatened and is a California Fully Protected species. More than 90 percent of California black rails are located in the marshes of northern San Francisco Bay, primarily San Pablo Bay and Suisun Bay[3, 4]; however, they can be present in freshwater and brackish areas of the South Bay. Black rails prefer marshes that are close to water, large (interior more than 50 meters from the edge), away from urban areas, and saline to brackish with a high proportion of pickleweed, maritime bulrush (*Bolboschoenus maritimus*), and gumplant (*Grindelia stricta*), rush (*Juncus spp.*), and cattails (*Typha spp.*).[5]

BURROWING OWL

Burrowing owl (*Athene cunicularia*) is a California Species of Special Concern. This California resident prefers open annual or perennial grasslands and disturbed sites with existing burrows, elevated perches, large areas of bare ground or low vegetation, and few visual obstructions. Ground squirrel colonies often provide a source of burrows and are typically located near water and areas with large numbers of prey species, primarily insects. Breeding takes place between March and August, with a peak in April and May. Breeding burrowing owls are documented within the Don Edwards San Francisco Bay National Wildlife Refuge's (Refuge's) Warm Springs vernal pool unit.[6]

WESTERN SNOWY PLOVER

The Pacific coastal population of western snowy plover (*Charadrius alexandrinus nivosus*) is federally listed as threatened. These birds breed primarily on coastal beaches from southern Washington to southern Baja California, Mexico. Western Snowy Plover Recovery Unit 3 is located in San Francisco Bay and includes Alameda, Napa, Santa

1 Albertson, J., and J. Evans. 2000. California Clapper Rail. In *Bayland Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife*, ed. P. R. Olofson, 332–340. Prepared by the San Francisco Bay Area Wetlands Ecosystems Goals Project. Oakland, CA: San Francisco Bay Regional Water Quality Control Board.

2 Olofson Environmental, Inc. 2018. California Ridgway's Rail Surveys for the San Francisco Estuary Invasive *Spartina* Project 2018.

3 Manolis, 1978

4 Evens et al., *in* Spautz et al., 2005

5 Spautz et al., 2005

6 California Natural Diversity Database. 2019.

Clara, and Solano Counties, and the eastern portion of Marin, San Mateo, and Sonoma Counties.[7] Snowy plovers in this recovery unit nest almost exclusively in former salt evaporation ponds, on pond berms and levees, and in dry, degraded marsh habitat. Western snowy plovers are known to nest in several salt ponds in the Study area.[8]

CALIFORNIA TIGER SALAMANDER

California tiger salamander (*Ambystoma californiense*), specifically the Central California Distinct Population Segment that is located in the region of the Study area, is federally listed and state-listed as threatened. This species is found in grasslands and low foothills, where it has access to ponds or pools for breeding. Except when breeding, California tiger salamanders are found on land using underground structures like ground squirrel burrows for refuge. They migrate to and from breeding ponds and have been recorded as far as 2.2 kilometers from the nearest breeding pond.[9] California tiger salamanders are known to occur within the Refuge's Warm Springs vernal pool unit.[10]

VERNAL POOL TADPOLE SHRIMP

Vernal pool tadpole shrimp (*Lepidurus packardi*) is federally listed as endangered. This freshwater crustacean species is endemic to California and found primarily in vernal pool habitat. Vernal pool tadpole shrimp have been documented within the Refuge's Warm Springs vernal pool unit.[11] Federally designated critical habitat for this species exists in the Study area along the existing rail line.

SALT MARSH HARVEST MOUSE

Salt marsh harvest mouse (*Reithrodontomys raviventris*) is federally listed and state-listed as endangered, and is a California Fully Protected species. Two distinct subspecies are recognized: The northern subspecies (*R. r. halicoetes*), which inhabits the northern marshes of the bay, and the southern subspecies (*R. r. raviventris*), which lives in marshes in the East and South Bay areas. Both subspecies are endemic to San Francisco Bay and inhabit salt marsh habitat vegetated with pickleweed and other marsh plants. There are multiple records of this species occurring in the Study area.[12]

STEELHEAD CENTRAL CALIFORNIA COAST DISTINCT POPULATION SEGMENT

The Central California Coast Distinct Population Segment of steelhead (*Oncorhynchus mykiss irideus* pop. 8) is federally listed as threatened. Central California Coast steelhead are anadromous fish that use the San Francisco Estuary as a migratory route to spawning and rearing grounds, such as Coyote Creek.[13] The portion of Coyote Creek that flows through the Study area is federally designated as critical habitat for this species.

LONGFIN SMELT

Longfin smelt (*Spirinchus thaleichthys*) is state-listed as threatened and is a candidate species for listing under the federal Endangered Species Act. It is a small, slender-bodied pelagic fish that measures about 3 inches in length as an adult. The species generally lives for two years, although some three-year smelt have been observed. Longfin smelt reside as juveniles and pre-spawning adults in the more saline habitats of San Pablo Bay and the Central Bay during a majority of their life and actively avoid water temperatures greater than 20 degrees Celsius.[14] Longfin smelt have been recorded in low numbers in recent years in portions of south San Francisco Bay in the Study area,[15] including the tidal sloughs of the Alviso pond complex area.[16]

7 U.S. Fish and Wildlife Service. 2007.

8 San Francisco Bay Bird Observatory. 2019. *Western Snowy Plover Monitoring in the San Francisco Bay Annual Report 2018.*

9 Orloff, S. G. 2011. Movement Patterns and Migration Distances in an Upland Population of California Tiger Salamander *(Ambystoma californiense). Herpetological Conservation and Biology* 6(2):266–276.

10 California Natural Diversity Database. 2019.

11 *Ibid.*

12 *Ibid.*

13 National Marine Fisheries Service. 2009. *Biological Opinion and Essential Fish Habitat Consultation for South San Francisco Bay Salt Ponds Restoration Project, Phase I Actions* (Corps File No. 27703S). 10 Year Permit for Operations and Maintenance (Corps File No. 00103S). Southwest Region.

14 Moyle, P. B. 2002. *Inland Fishes of California.* Berkeley and Los Angeles: University of California Press.

15 Interagency Ecological Program for the San Francisco Bay Estuary. 2010–2014. San Francisco Bay Study, Unpublished Raw Mid-water and Otter Trawl Data.

16 Hobbs, J. 2011. *Semi-Annual Report (Quarter 2, 2011): South Bay Salt Pond Restoration–Fish Monitoring Summary Progress Report.*

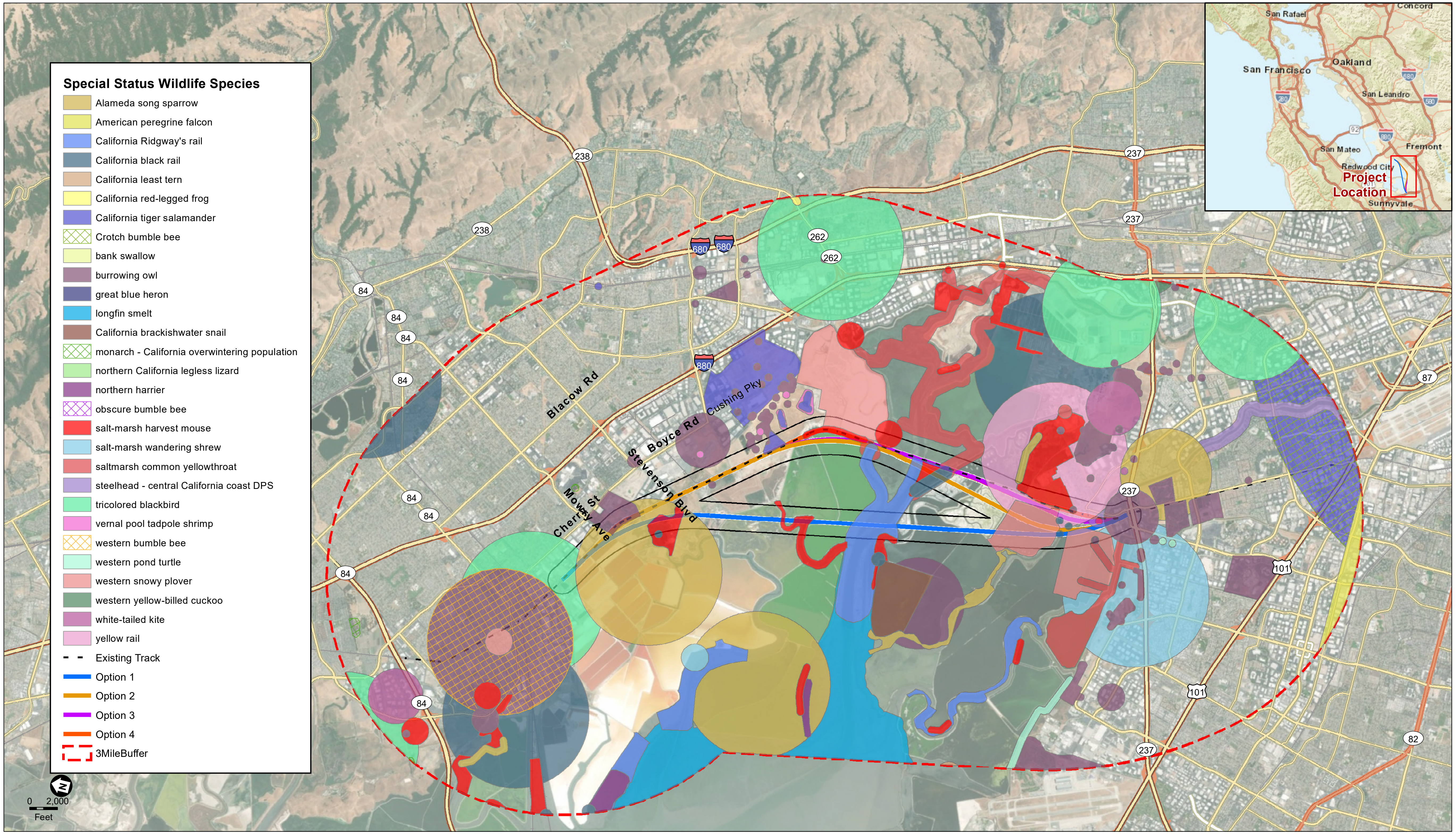
Special-Status Plants

CONTRA COSTA GOLDFIELDS

Contra Costa goldfields (*Lasthenia conjugens*) is federally listed as endangered. This species is an annual herb endemic to California. Contra Costa goldfields plants grow in vernal pools, swales, and other depressions in open grassland and woodland communities, often in alkaline soils. The species is known to occur within the Refuge's Warm Springs vernal pool unit.[17, 18] Federally designated critical habitat for Contra Costa goldfields exists in the Study area along the existing rail line.

17 California Natural Diversity Database. 2019.

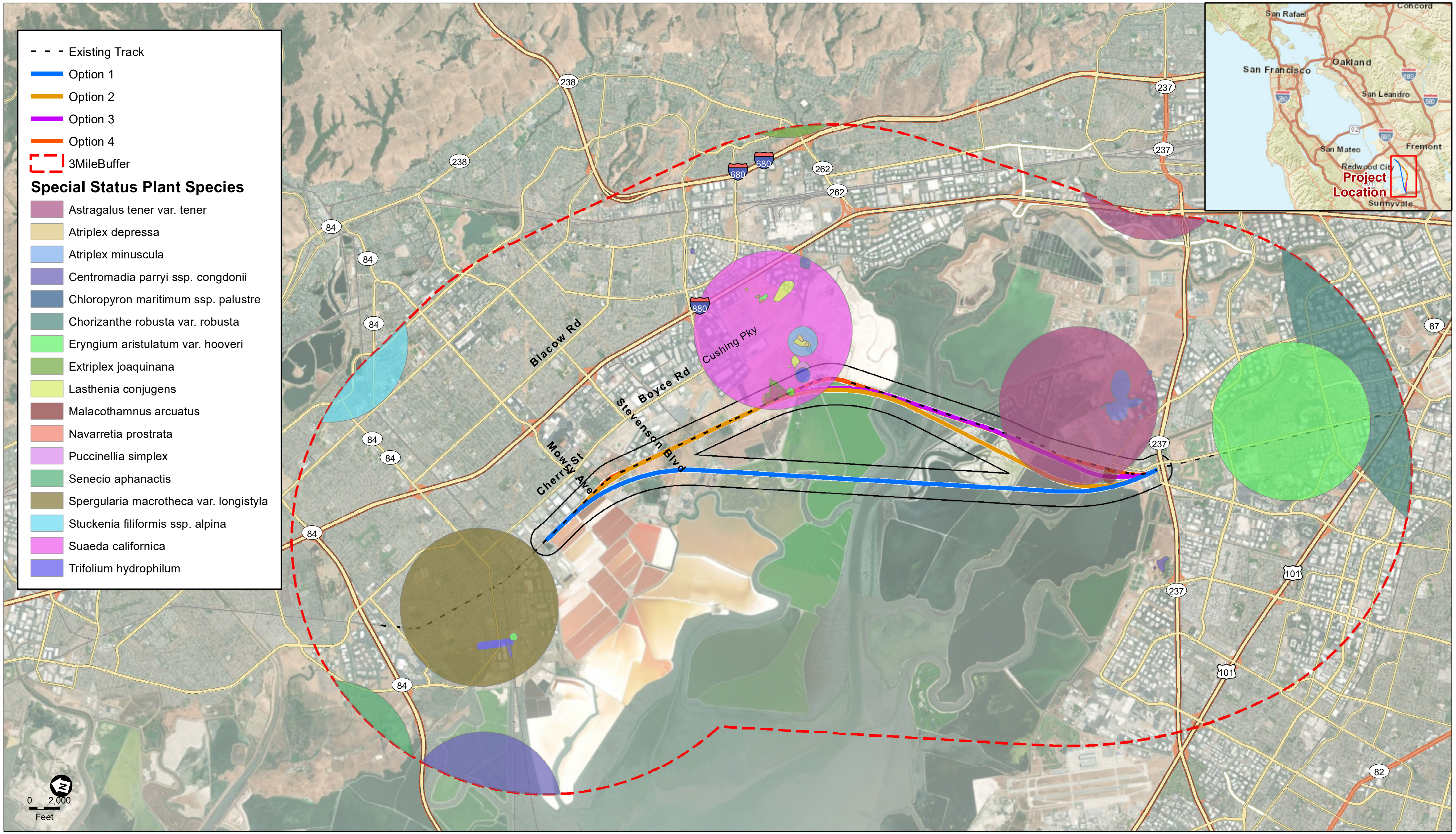
18 U.S. Fish and Wildlife Service. 2017. *2017 Annual Report, Warm Springs Seasonal Wetland Unit of the Don Edwards San Francisco Bay National Wildlife Refuge.*



Alviso Wetlands Railroad Adaptation Alternatives Study

Figure A-1

Special Status Wildlife Species within 3 Miles of the Study Area
Biological Resources



Alviso Wetlands Railroad Adaptation Alternatives Study

Figure A-2
Special Status Plant Species within 3 Miles of the Study Area
Biological Resources

APPENDIX B

RAILROADS 101 - RAILROAD TERMINOLOGY AND CONCEPTS

APPENDIX B: "RAILROADS 101" — RAILROAD TERMINOLOGY AND CONCEPTS

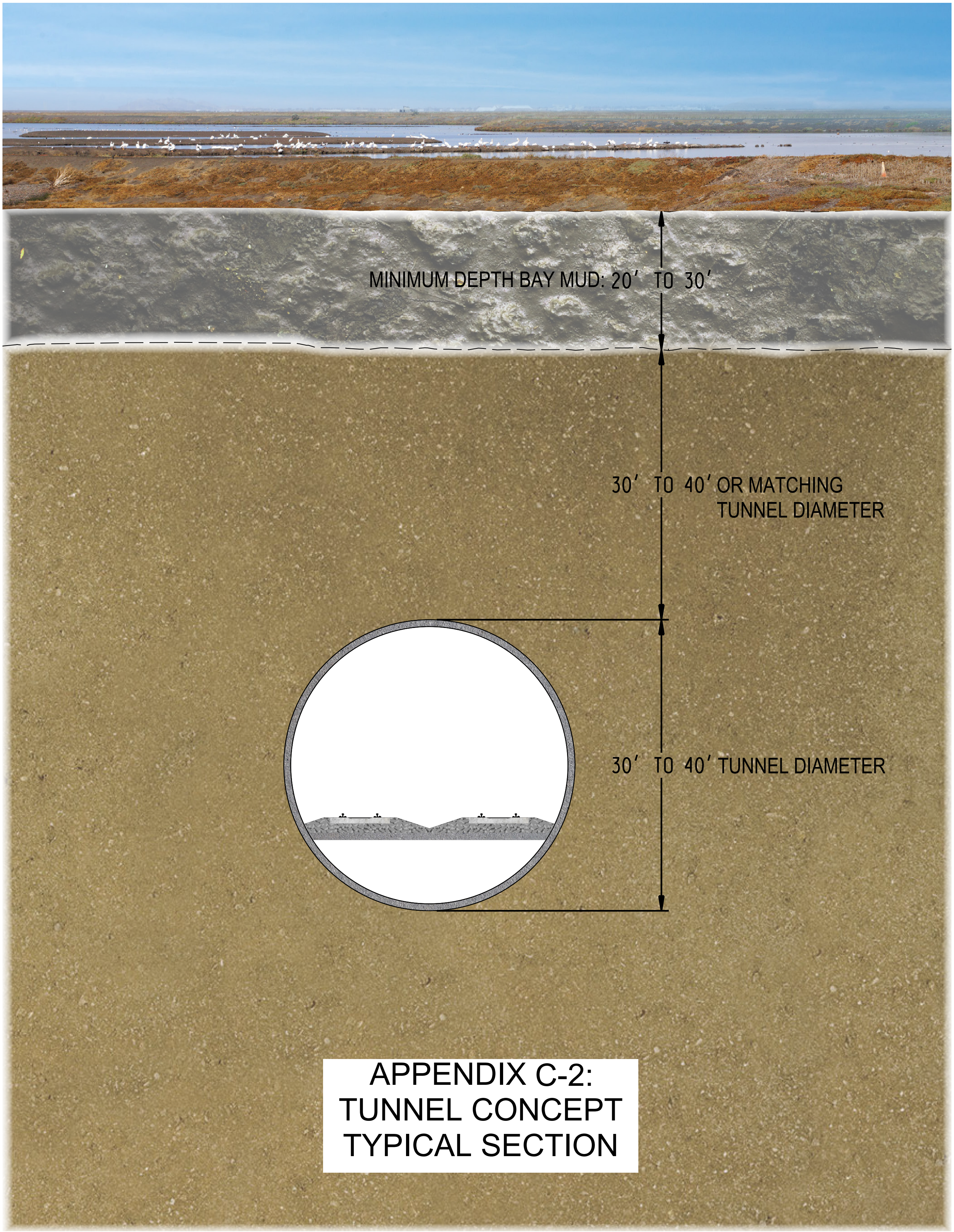
CONCEPT	DESCRIPTION
Train Speed Limits	Train ***speed limits*** (including those at curves) are set according to specific engineering parameters and in accordance with regulations established by the Federal Railroad Administration.
Capacity	The ***number and type of trains*** and ***speed of trains*** along a rail line relate directly to the rail line's ***capacity***, the ability of the line to handle a given number of trains. When train speeds vary (as with slower freight trains and faster passenger trains), the route's overall capacity decreases.
Number of Tracks	The number of tracks affects the capacity of the line. Two tracks (also called ***double track***) can accommodate more trains than one track (***single track***). More tracks offer more ***capacity*** and ***schedule reliability***.
Track Structure	Track structure has four elements: rails, ties, ballast, and sub-ballast. ***Rails*** are made of steel. ***Ties*** are typically made of wood or concrete and support the rails. ***Ballast*** is crushed rock used to support the ties and keep the track in correct alignment. ***Sub-ballast*** is a finer grade of crushed rock placed beneath the ballast to divert water from the track and distribute the weight of the track to the sub-grade below.
Grade (steepness of tracks)	The steepness of the track dictates the types of trains that can use the rail line. Typical ***grades*** for freight trains generally do not exceed 1 percent, while grades for dedicated, passenger-only tracks can be as steep as 3 percent.
Curves (often presented in degrees)	The tightness of the ***curve*** dictates the speed at which a train can travel. The higher the number of degrees, the tighter the curve, and the slower the allowable speed. The radius of a railroad curve is typically on the order of one mile.
Alignment	The specific path or route taken by a railroad.

APPENDIX C
OPTIONS CONSIDERED BUT NOT STUDIED FURTHER

APPENDIX C: OPTIONS CONSIDERED BUT NOT STUDIED FURTHER

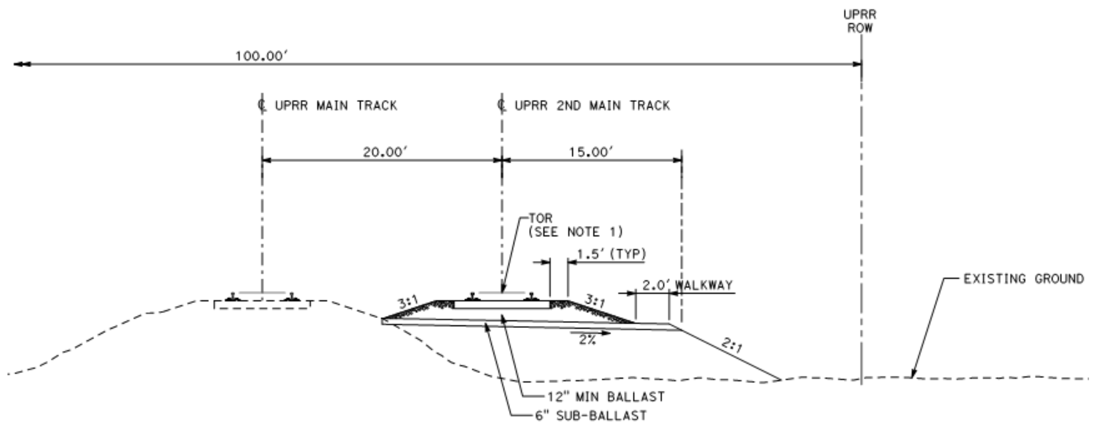
ACE ALTAMONT CORRIDOR EXPRESS

APPENDIX C-1:
ACE*forward* ALIGNMENT CONCEPT
EAST OF THE REFUGE
(from Figure 6-1, ACE*forward* Draft Environmental Impact Report)

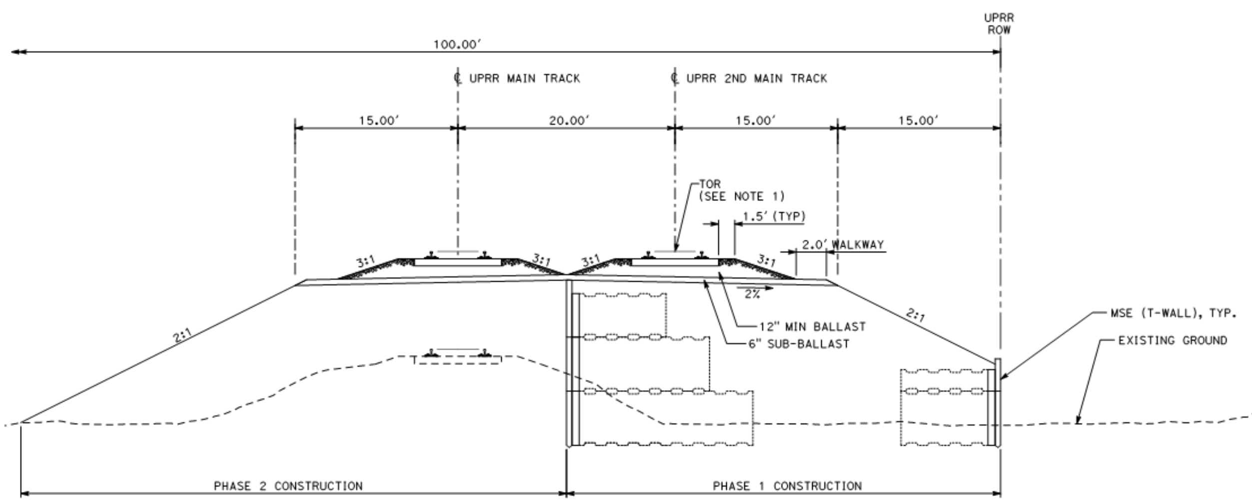


APPENDIX C-2:
TUNNEL CONCEPT
TYPICAL SECTION

Example Typical Sections from ACE*forward* Draft Environmental Impact Report



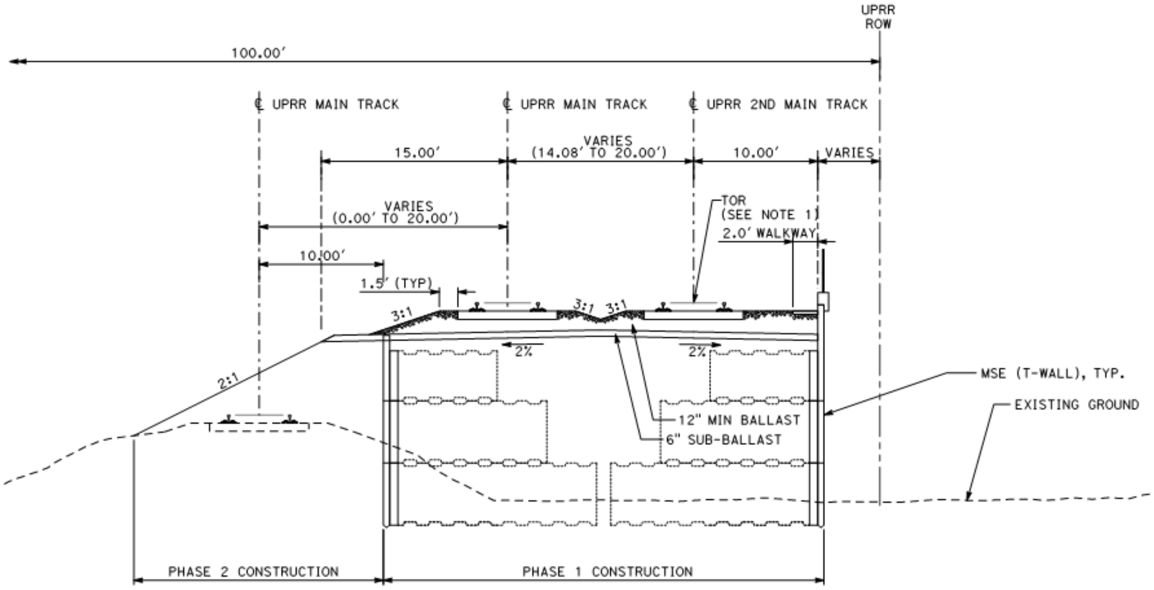
Typical Section Showing Addition of One Track on Low Fill Matching Elevation of Existing Track



Typical Section Showing Two Elevated Tracks on Fill, One Side Supported by Retaining Wall

Appendix C-3

Example Typical Sections from ACE*forward* Draft Environmental Impact Report



Typical Section Showing Two Elevated Tracks Supported by Retaining Walls

Appendix C-3

Example Typical Sections from ACE*forward* Draft Environmental Impact Report

CAPITOL CORRIDOR

PREPARED BY:

RAILPROS

Rail isn't a part of our business, it IS our business

ESA

50 YEARS 1969-2019