WCCTAC
West Contra Costa Transportation Advisory Committee

# West Contra Costa High-Capacity Transit Study

## FINAL TECHNICAL MEMORANDUM #8

## Preliminary Alternatives

**January 2016**

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**With**

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**RL Banks**

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# Document Review

| Revision Date | Updated By | Organization | Description of Revision |
|---|---|---|---|
| 12/28/15 | Tam Tran | WSP \| Parsons Brinckerhoff | Revisions to address feedback from TAC and Study Management Group |
| 12/31/2015 | Rebecca Kohlstrand | WSP \| Parsons Brinckerhoff | Review of revisions |
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# Document Sign-off

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# Acronyms and Abbreviations

| | |
|---|---|
| Alameda CTC | Alameda County Transportation Commission |
| AAR | Association of American Railroads |
| BART | San Francisco Bay Area Rapid Transit District |
| BNSF | Burlington Northern Santa Fe Railway |
| BRT | bus rapid transit |
| CCJPA | Capitol Corridor Joint Powers Authority |
| DMU | diesel multiple units |
| EMU | electric multiple units |
| EPA | Environmental Protection Agency |
| FRA | Federal Railroad Administration |
| FTA | Federal Transit Administration |
| GHG | Greenhouse gases |
| HCT | high-capacity transit |
| HOT | high occupancy toll lane |
| HOV | high occupancy vehicle lane |
| LRT | light rail transit |
| MTC | Metropolitan Transportation Commission |
| PTC | Positive Train Control |
| SJJPA | San Joaquin Joint Powers Authority |
| SP | Southern Pacific Railroad |
| SR | State Route |
| TCRP | Transit Cooperative Research Program |
| UPRR | Union Pacific Railroad |
| WCCTAC | West Contra Costa Transportation Advisory Committee |

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# 1 INTRODUCTION

## 1.1 West Contra Costa County Transportation Setting

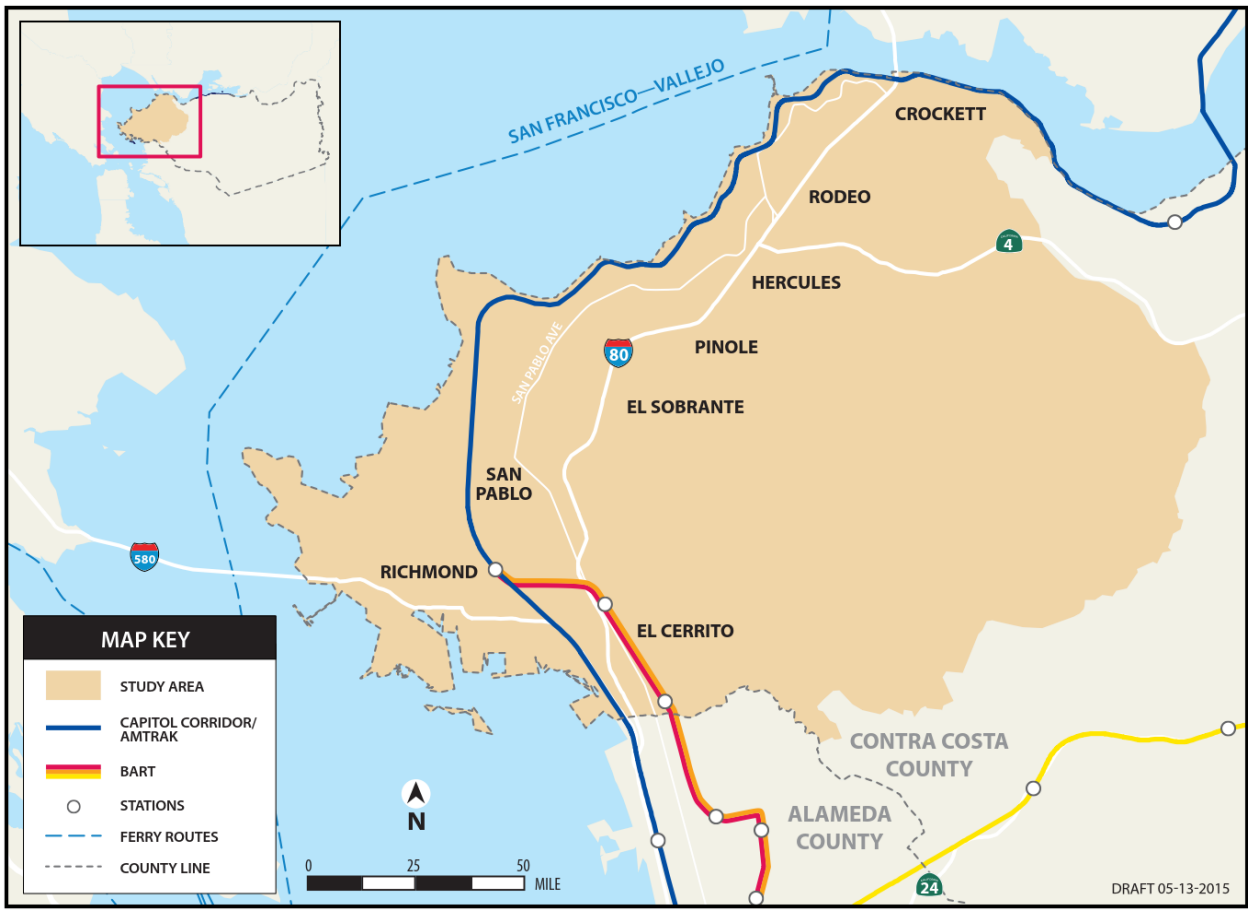
West Contra Costa County is a distinctive sub-region within the Bay Area set between the San Francisco Bay and the East Bay hills. Interstate 80 (I-80), the primary vehicular route running north-south through this sub-region, has major regional significance to Bay Area commuters, and is one of the most congested freeway corridors in the region. San Pablo Avenue, the former Highway 40, is a major arterial that runs roughly parallel and functions as a possible alternative to I-80 in some sections. It links each jurisdiction in West Contra Costa and is a key commercial thoroughfare for the sub-region. Interstate 580 (I-580), running perpendicular to I-80, connects travelers west to and from Marin County across the Richmond-San Rafael Bridge to I-80, and continues east through Alameda County and beyond.

The Study Area encompasses West Contra Costa County from the southern boundary at the Alameda County line north to the Carquinez Bridge and Solano County line. It essentially encompasses the Metropolitan Transportation Commission's (MTC) Superdistrict 20, which includes the Cities of El Cerrito, Hercules, Pinole, Richmond, and San Pablo and the unincorporated communities of Crockett, El Sobrante, and Rodeo. **Figure 1-1** displays a map of the core Study Area, which includes I-80 and I-580, SR 4, as well as major surface streets including San Pablo Avenue and Richmond Parkway. The West County High-Capacity Transit (HCT) Study will also include analysis of travel markets to the west of the Study Area along I-580, south along I-80 to Alameda County and the Bay Bridge, east along SR 4, and north along I-80 across the Carquinez Bridge to Solano County.

## 1.2 Study Purpose

The purpose of this study is to identify and evaluate the feasibility and effectiveness of high-capacity transit (HCT) options in West Contra Costa County for West Contra Costa Transportation Advisory Committee's (WCCTAC) consideration. Since its inception in 1988, WCCTAC's policy goals have included: facilitating the use of transit, encouraging transit projects aimed at congestion relief, and calling for participation in studies looking at transit capital investments.

**Figure 1-1: Study Area**




*Source: WSP | Parsons Brinckerhoff, Kimley-Horn, 2015*

West County Action Plans since that time have called for considering and prioritizing transit improvements such as: a BART extension, other types of rail improvements, express bus expansion, and ferry implementation. For example, the most recent 2014 Action Plan called for participation in a study of high-capacity transit options in the I-80 corridor.[1]

The investment strategy outlined by this study will be helpful in positioning WCCTAC to be competitive for transportation funds within the county and to leverage outside funding sources. The transit capital investments will also benefit a wide range of people and trip types in West Contra Costa County.

Establishing a transit investment strategy requires understanding existing travel markets and future demand for HCT in the area as part of the larger regional transit network, identifying and evaluating HCT options, and assessing the costs and potential funding sources for these options. Central to the study purpose is providing WCCTAC with the analyses necessary to

[1] Item #46 of the 2014 West County Action Plan.

determine and advance the most promising HCT alternative(s). The study will consider multimodal transit options including, but not limited to: freeway-based express bus, bus rapid transit (BRT), light rail transit (LRT), extension of BART service, commuter rail improvements, and ferry service. Study findings will guide future planning, investment priorities and funding strategies for WCCTAC.

## 1.3 Purpose of this Technical Memorandum

The purpose of this technical memorandum is to identify and define the most promising conceptual alternatives for the West Contra Costa HCT study. The initial identified conceptual alternatives are generally based on established technologies with reliable service records in operation in similar settings to the West County sub-region, and range from near-term to mid-term and long-term options. Alternatives span a variety of transit modes, including freeway-based express buses, arterial-based BRT and light rail, BART extensions, commuter rail, and ferry.

Support facilities have been identified for each alternative, including stations and other investments such as maintenance and storage facilities, multimodal access, and system performance. The development of alternatives considered the background information compiled for this study, including existing conditions, transportation plans and studies, existing socioeconomic and demographic conditions and forecasted changes in the Study Area, and current and future travel markets. Connectivity to existing transit service, local circulation, parking, and basic accessibility, including bicycle and pedestrian access were also considered to ensure optimization of transit ridership.

The initial HCT alternatives evolved from a combination of previous and ongoing studies, travel market analysis, real-world examples, project team expertise, and public feedback on the Countywide Transportation Plan (CTP), taking into account new information. At this point in the process designs have not been advanced, however, the conceptual design of key features has been considered to assess basic feasibility and develop preliminary order-of-magnitude cost estimates.

# 2 KEY TRAVEL MARKETS

A market analysis of trip origins, destinations, and socioeconomic characteristics of the Study Area and the nine-county region provided an indication of the corridors most suitable for future transit investments based on their transit suitability and how well they link to the demand for travel either from the Study Area or travelling through the Study Area.

## 2.1 Findings of Market Analysis

A market analysis was conducted for the Study Area and is more fully described in Technical Memo 7: Travel Markets. The market analysis utilized a Transit Suitability Index (TSI) and travel demand data for the region. The TSI is a planning tool that was used to identify the market locations that have the most suitable characteristics to support high levels of transit service in the Study Area and throughout the nine-county Bay Area. The TSI is based on population density, employment density, household income and vehicle ownership; four variables that have been determined to indicate a strong potential for transit ridership. The TSI combines these factors to create a single index by which to assess transit viability. When the findings of the TSI are overlaid with trip interchange tables that identify the combinations of trip origins and destinations that generate the highest trip densities, the results helps to define the corridors that are the most likely to support high capacity transit.

To conduct the market analysis, the San Francisco Bay Area was aggregated into 38 districts composed of multiple traffic analysis zones (noted as AirSage numbers in **Figure 2-1**). The Study Area consists of 15 districts and the rest of the Bay Area and Yolo and Sacramento counties comprise the remaining 23 districts. Daily person trip tables showing all trip purposes were created to summarize the origins and destinations of trips in 2013 and in 2040. The origins and destinations with the highest trip interchanges, i.e. trip densities, were identified for the following categories of trips:

- Trips internal to the Study Area (excluding trips that originated and ended in the same district);
- Trips originating in West County with destinations outside of the Study Area, and
- Trips originating outside of the Study Area with destinations in West County.

The findings of the TSI were compared with the highest demand travel markets, to determine the most viable transit markets for consideration of high-capacity transit investment.

**Figure 2-1: Study Area 38 Analysis Districts**


*Source: CCTA Model and MTC Regional Model*

The results are summarized in detail in Technical Memorandum #7, but the findings are summarized here.

### 2.1.1.1 Transit Suitability Index

Of the nine Bay Area counties, the existing locations that have the characteristics that suggest the greatest potential for transit use are in the cities of San Francisco, Oakland, Berkeley, San Jose, Emeryville, San Pablo, and Richmond. Within the Study Area, the most significant concentrations of activities that make for the most effective transit are in Richmond, El Cerrito, and San Pablo. These areas capture not only the concentrations of residential development, but also the concentrations of employment, including the Chevron refinery in West County.

While these areas may have the greatest potential for transit, the success of transit service relies on a combination of high transit suitability and a high level of travel demand between the point of trip origin and the trip destination. In addition, factors such as level of congestion on the routes between the origin and destination and the availability and cost of parking at destinations, all factor into the propensity to use transit. For example, Central Richmond has a high potential for transit, but also concentrated travel demand from this area to other parts of Richmond, El Cerrito, and San Pablo within the Study Area and to Oakland, San Francisco, and Berkeley/Emeryville outside of the Study Area. The combination of these factors indicates that there is a competitive transit market between these areas, particularly to Oakland, San Francisco, and Berkeley, where travelers experience both a high level of congestion and high parking charges. The existing and projected travel demand, both internal and external to the Study Area, is summarized below.

The future 2040 conditions project that the suitability for transit will continue to be San Francisco, Oakland, Berkeley, San Jose, Emeryville, San Pablo, and Richmond, but there are also growth areas within the Study Area. The future 2040 condition demonstrates that the significant population and employment concentrations that make for the most effective transit would continue to be located in Richmond, San Pablo, and El Cerrito. In the northern part of the Study Area, low to medium suitability areas start to emerge west of I-80 in Pinole and Hercules as growth occurs in these areas.

### 2.1.1.2 Travel Demand

The districts with the highest daily trip interchanges for all trip purposes are noted in **Table 2-1**. These origin and destination districts correspond well with the findings of the TSI. Collectively, Richmond and San Pablo have the greatest amount of daily trips, but the single highest daily trip demand originates in the Pinole/Hercules (District 5) and is destined for Richmond (District 12), where the Chevron Refinery is located. When looking at the overall trip matrix, it

shows that Richmond and San Pablo (Districts 10-14) and El Cerrito and Richmond (District 7) have the greatest overall trip activities, with Pinole and Hercules (Districts 5 and 6) also serving as a large trip generator.

**Table 2-1: Major Internal Trip Markets—2013**

| Rank | Origin District | Destination District | Daily Person Trips |
|---|---|---|---|
| 1 | 5 - Pinole, Hercules | 12 - Richmond | 12,610 |
| 2 | 13 - San Pablo, Richmond | 12 - Richmond | 12,500 |
| 3 | 10 - Richmond, San Pablo | 12 - Richmond | 10,620 |
| 4 | 14 – Richmond, El Sobrante | 12 - Richmond | 7,600 |
| 5 | 10 - Richmond, San Pablo | 13 - San Pablo, Richmond | 6,290 |
| 6 | 6 - Pinole, Hercules | 12 - Richmond | 5,920 |
| 7 | 11 - Richmond | 10 - Richmond, San Pablo | 5,810 |
| 8 | 10 - Richmond, San Pablo | 11 - Richmond | 5,760 |
| 9 | 13 – San Pablo, Richmond | 10 - Richmond, San Pablo | 5,750 |
| 10 | 12 - Richmond | 13 - Richmond | 5,660 |

*Source: CCTA Travel Demand Model—Unadjusted Trips, All Trip Purposes*

For trips originating in the Study Area and destined for locations outside the Study Area, the largest single destinations are Berkeley/Emeryville, Northeast San Francisco including downtown, and Oakland. For trips originating outside the Study Area, the largest trip generators are Berkeley/Emeryville, Vallejo/Benecia, Oakland, and Marin County.

The 10 highest trip interchanges for internal trips in 2040 are shown in **Table 2-2**.

**Table 2-2: Major Internal Trip Markets—2040**

| Rank | Origin District | Destination District | Daily Person Trips |
|---|---|---|---|
| 1 | 13 - San Pablo, Richmond | 12 - Richmond | 15,070 |
| 2 | 5 - Pinole, Hercules | 12 - Richmond | 14,750 |
| 3 | 10 - Richmond, San Pablo | 12 - Richmond | 13,300 |
| 4 | 14 – Richmond, El Sobrante | 12 - Richmond | 8,850 |
| 5 | 6 - Pinole, Hercules | 14 – Richmond, El Sobrante | 8,190 |
| 6 | 10 - Richmond, San Pablo | 13 - San Pablo, Richmond | 7,720 |
| 7 | 12 - Richmond | 13 - San Pablo, Richmond | 7,640 |
| 8 | 10 - Richmond, San Pablo | 11 - Richmond | 7,450 |
| 9 | 11 - Richmond | 10 - Richmond, San Pablo | 7,280 |
| 10 | 12 - Richmond | 10 - Richmond, San Pablo | 7,030 |
| 10 | 6 - Pinole, Hercules | 5 - Pinole, Hercules | 7,030 |

*Source: CCTA Travel Demand Model—Unadjusted Trips, All Trip Purposes*

Collectively, Richmond and San Pablo have the greatest number of trips, but Pinole/Hercules (Districts 5 and 6) also generate high trip volumes. When looking at the overall trip matrix, it shows similar to 2013 conditions, that Richmond and San Pablo (Districts 10-14) and El Cerrito and Richmond (District 7) have the greatest overall trip activities, with Pinole and Hercules (Districts 5 and 6) also serving as a large trip generator for trips destined within the Study Area.

For trips originating ending outside the Study Area, trip patterns are similar to 2013, with Berkeley/Emeryville, Northeast San Francisco, and Oakland being the largest trip destinations and Berkeley/Emeryville, Vallejo/Benicia, Oakland, and Marin County the most important destinations for West County.

This information suggests that an extension of transit service north to the Pinole and Hercules area, as well as enhanced transit service in the southern part of West County has the potential to generate robust transit ridership. The key markets to link to outside of the Study Area are in northern Alameda County—Berkeley, Emeryville, and Oakland—in addition to the San Francisco markets. As noted in Technical Memorandum #7, Oakland and San Francisco are also significant destinations for through trips originating in Solano, Yolo/Sacramento, Marin, and Sonoma counties. Though the aggregation of the external zones does not allow pinpointing the origin of these trips, it is likely that these trip origins are much more dispersed that those in the inner East Bay, within the Study Area and Alameda County.

# 3 DESCRIPTION OF ALTERNATIVES

## 3.1 Approach to Defining Alternatives

Numerous studies have identified the benefits of major transit enhancements in West Contra Costa County, for mobility, traffic congestion relief, development strategies and environmental improvements, and have proposed strategies to implement these enhancements. While a few of these studies have resulted in projects such as the planned Richmond ferry service and express bus service expansion, most have not lead to major transit investments.

The prior transportation studies reviewed for the WCCTAC Technical Memorandum #4, Summary and Evaluation of Prior Studies, considered a range of transportation modes for relieving congestion in West County. These modes included additional bus, commuter, and rail service, consolidating existing bus service, BART extensions, and ferry service. With the exception of a multi-modal study conducted by Metropolitan Transportation Commission (MTC), these prior studies generally focused on a particular mode of travel and did not provide comparative analysis of modal options. This study will provide a comparative assessment of alternatives across modes and will look at how improvements might be implemented across time. The integration of these transit services and how these modal options could complement each other to improve transit ridership and maximize connections throughout the county and to travel markets beyond West County will also be assessed.

The existing transportation conditions in the Study Area are documented in WCCTAC Technical Memorandum #5 and an assessment of the land use and travel demand markets is documented in WCCTAC Technical Memoranda #6 and #7. This information, when combined with a review of the past studies and with new information, provides the basis for developing the preliminary alternative investment strategies.

Funding has presented a major obstacle to implementation of previously recommended capital improvements, such as rail extensions or rail station additions, major park-and-ride lot improvements, and freeway improvements that would benefit transit. There has also been a lack of consensus, both within the general public and among decision-makers, on the preferred investments to be made. To date the investments have been less capital intensive transit, such as additional bus service. Resources to cover the additional operating and maintenance costs of, for example, new or expanded bus services and associated facilities have been lacking. Finally, in some instances, the requisite planning and design studies have not been completed, either for lack of funds or project sponsors or for other reasons.

For improvement strategies to gain traction and advance from this study there must be initial public and decision-maker consensus and the likelihood of funding availability. The increasing

commute and other transportation problems facing West County residents and businesses, as well as, the potential for generating new transportation revenues if a transportation sales tax measure is passed, give impetus to WCCTAC setting a future course of action.

### 3.1.1 New Information

In addition to the information from the previous studies, there are a variety of factors that will influence future land use patterns in the West Contra Costa Study Area and the corresponding travel demand and transit mode splits. These factors were considered as the alternatives from previous studies were evaluated and refined and new alternatives were developed for this study. These factors include large projects that are proposed in the Study Area, changing economic conditions within the Study Area, and also taking into account projects that are implemented outside of the Study Area, but may have an impact on the West County.

- The UC Global Campus, which will be located at the UC Richmond Field Station, will affect the demand for transit as it will include approximately 5.5 million square feet of research and development space. The Campus would become the highest concentration of employment in the Study Area, thereby requiring a fresh look at where transit services enhancements might be required. The exact timing of the Global Campus development remains uncertain, although the City of Richmond has undertaken the development of a specific plan for this portion of the city.

- The future of the oil industry and its impact on Chevron Corporation operations in the Study Area is uncertain. There is a potential for either expansion (due to refining increasing quantities of North American-sourced crude oil) or contraction (due to corporate restructuring and centralization of operations). Any significant changes to the industry could affect employment levels and related commuting patterns.

- Development of the 15 Priority Development Areas (PDA), as projected by the Association of Bay Area Governments (ABAG) and included in *Plan Bay Area,* represents substantial new development in the Study Area. While this development has been determined to be feasible over the next 25 years the actual level and timing of this development is uncertain. *Plan Bay Area* projects that by 2040, 60 percent of the growth in West Contra Costa County is expected to occur in the 15 PDAs, with Hercules, Richmond and the San Pablo Corridor PDAs experiencing the greatest amount of growth.

  The two largest centers for population and employment growth are projected to be Richmond and Hercules. Population in Hercules is expected to increase by 67 percent or 16,080 people, by 2040. The number of jobs in Hercules is expected to increase by 4,840

or 63 percent in the same period. In Richmond, the population is projected to increase by 35,740 people or 29 percent by 2040 and the job increase is projected to be 10,760 or 34 percent.[2] Transit-oriented development is under construction near the Richmond BART Station, with residential building occurring now and commercial development to follow.

- A major regional highway improvement, the Tri-Link Connector (SR 239), linking Brentwood to Tracy, could influence regional travel patterns, including increasing traffic flows on SR 4 leading into the Study Area and perhaps improving access to the I-5 Corridor in the Central Valley. Ongoing goods movement studies and travel demand analysis will help determine the potential effects of SR 239, should it be implemented.

- The agency that operates the majority of the San Francisco Bay ferry service, the Water Emergency Transportation Authority (WETA), is planning to expand ferry service to the Study Area in Richmond. The Ford Point Ferry service is expected to be operational by 2018. There is also a longer-term plan to implement ferry service from the Hercules Intermodal Transit Center, although this service poses greater technical, regulatory, and financial challenges. Technical Memorandum #5 reviews the opportunities and challenges associated with introducing ferry service to Hercules in more detail.

- The UPRR alignment, where Capitol Corridor and Amtrak operate, is expected to be subject to rising tidal waters due to global warming in the near future, which would render the alignment infeasible for long-term use without significant upgrades. During severe storm events today, the railroad already experiences water inundation and the existing track beds, while raised, were not designed to serve as water barriers.

- Diesel Multiple Units (DMUs) offer alternative rail vehicle technology to standard diesel commuter rail or BART technology and was considered in a previous study.[3] To operate on rail corridors supporting freight rail, rail cars must meet Federal Railroad Administration (FRA) standards for crashworthiness or provide either temporal or physical separation. There have been market changes, resulting in the availability of crashworthy Diesel Multiple Unit (DMU) trains that meet the FRA standards, since BART's 2003 study. The Sonoma Marin Area Rail Transit (SMART) corridor, which is now in the testing phase, has new DMU trains that meet these FRA standards. The technology is likely to continue to improve and be available when these alternatives are

[2] ABAG projections, 2013; MTC Regional Travel Analysis Zone Calculations; Economic Planning Systems

[3] BART Contra Costa –Solano Rail Feasibility Study, 2003.

ready for construction. Thus, a commuter rail option may now be a more realistic option than it has been in the past, given that appropriate vehicles are potentially available.

## 3.2 Alternatives Identified

The most promising alternatives identified for preliminary analysis are summarized in **Table 3-1** and discussed in greater detail in the following sections of this technical memorandum. They include three bus alternatives, two commuter rail alternatives, and three BART alternatives.

The three bus alternatives under consideration in West County are for express bus (one alternative) and bus rapid transit (BRT- two alternatives) services. These services can provide moderate to high capacity corridor service depending upon the type of vehicle and frequency operated, carrying 285 to 850 passengers per hour per direction.[4] This capacity range may be appropriate for certain travel corridors in West County and/or as a short- to mid-term transit alternative to a very high capacity rail service, which may be more appropriate as a long-term option as the area continues to grow.

Understanding the characteristics of existing bus service, including travel patterns and ridership, helps to identify promising corridors for HCT. New HCT alternatives could supplement or replace existing bus services in some areas.

### 3.2.1 Recommendations from Prior and Other Current Studies

The challenges facing bus travel in West County have been recognized in other studies. These studies each share the same premise: already-strong bus transit ridership can be significantly enhanced through targeted infrastructure improvements to make transit travel times more competitive with private auto travel times and provide a more convenient transit trip. The findings and recommendations of previous studies help to establish context for alternatives to include in the West Contra Costa High-Capacity Transit Study. They also provide insight into why certain improvements have yet to be implemented, and the challenges any major transit improvements recommended in this study would face.

[4] WestCAT's 45-foot MCI over-the-road coach has a seated capacity of 57 passengers. Assuming a corridor express service offering five buses per hour, the service could carry 285 passengers per hour. A double-decker bus was recently tested by WestCAT and AC Transit, would provide a seated capacity of 80 passengers, and with five buses per hour, the service could carry 400 passengers per hour. An arterial corridor service operated with higher capacity articulated buses could provide triple this capacity. The new AC Transit 60-foot Xcelsior bus has a seated capacity of approximately 60. With 15 percent to 20 percent standees and assuming service offering 12 buses per hour (5-minute frequencies), as planned on AC Transit's new East Bay BRT line, buses could carry around 850 passengers per hour at the peak load point.

**Table 3-1: West County High-Capacity Transit Alternatives**

| Alternative | Description | Recommended Technology | Markets Served | |
|---|---|---|---|---|
| | | | West County | External |
| 1—Express Bus Service | Express Bus service on I-80 from Hercules Transit Center and on I-580 from Marin County to Alameda County via I-80 | Over-the-road coaches | Richmond, El Cerrito, San Pablo, Pinole, Hercules via Park-and-Ride | San Francisco, Oakland, Emeryville, Berkeley, San Rafael with transfer connections to BART and Capitol Corridor |
| 2—San Pablo Avenue/Macdonald Avenue BRT | BRT from El Cerrito BART station to Richmond Parkway Transit Center on San Pablo Avenue and to Tewksbury Turnaround and serving the Richmond BART/Capitol Corridor station on Macdonald Avenue. Potential extension to Hercules Transit Center and Hercules Intermodal Center in the future | Articulated buses | Richmond, El Cerrito, San Pablo, Pinole, Hercules | Oakland, Emeryville, Berkeley, Albany with transfer connections to the BART and Capitol Corridor |
| 3—23rd Street BRT | BRT from proposed Richmond Ferry Terminal at Ford Point to Richmond BART/Capitol Corridor station along 23rd Avenue and north along San Pablo Avenue to Hercules | Articulated buses | Richmond, San Pablo, Pinole, Hercules | Transfer connections to BART and Capitol Corridor_ |
| 4—UPRR Corridor Commuter Rail | Commuter Rail from Richmond BART/Capitol Corridor station to Martinez on existing UPRR alignment with a possible extension to Oakland | Conventional commuter rail or Diesel Multiple Unit (DMU) vehicles | Richmond, Hercules | Oakland, Emeryville, Berkeley, and Martinez, with connections to Capitol Corridor system |
| 5—UPRR-BNSF Corridor Commuter Rail | Commuter Rail from Richmond BART/Capitol Corridor station to Martinez with a possible extension to Oakland | Conventional commuter rail or DMU vehicles | Richmond, Hercules | Oakland, Emeryville, Berkeley, and Martinez, with connections to Capitol Corridor system |
| 6—BART Extension from Richmond Station to Hercules | BART extension from Richmond BART/Capitol Corridor station along the UPRR alignment, transitioning to 13th Avenue, and Rumrill Boulevard, tunneling under Hilltop Mall and following the I-80 alignment north to Hercules Transit Center | Standard BART technology | Richmond, El Cerrito, San Pablo, Pinole/Hercules | Connects to the BART system |
| 7.1—BART Extension from El Cerrito del Norte Station to Hercules | BART extension from El Cerrito del Norte station to Hercules Transit Center following the I-80 alignment | Standard BART technology | Richmond, El Cerrito, San Pablo, Pinole/Hercules | Connects to the BART system |
| 7.2—BART/DMU Extension from El Cerrito del Norte Station to Hercules | BART extension from El Cerrito del Norte station to Hercules Transit Center following the I-80 alignment | DMU vehicles | Richmond, El Cerrito, San Pablo, Pinole/Hercules | Connects to the BART system |

*Source: WSP | Parsons Brinckerhoff*

Three ongoing studies and one pilot project warrant mention for their potential to inform this study and help build consensus for future high capacity bus service improvements.

- AC Transit's Major Corridors Study is in progress and will identify one or more arterial corridors for upgrade to Rapid or bus rapid transit (BRT) service. Preliminary recommendations include upgrades to the existing San Pablo/Macdonald Avenue Rapid Bus service.

- The Contra Costa Express Bus Study update is also in progress and includes West County. That study is expected to propose expansion of express bus service along I-80 and possibly to new East Bay destinations.

- The Metropolitan Transportation Commission is currently studying converting I-80 HOV lanes to HOV/high occupancy toll (HOT) lanes. Measures to ensure the lanes operate at a high level of service would be necessary elements of any HOV/HOT "managed lane" project so the express buses can move more quickly. Advanced technology to monitor performance of HOV/HOT lanes is now available, and systems have already been installed as part of other projects. For instance, for the I-80 Integrated Corridor Management project, traffic monitoring and driver advisory systems are now in place. These systems, plus other equipment, could be leveraged to improve enforcement of HOV/HOT lane occupancy requirements and to maintain HOV/HOT lane traffic flow even when adjacent mixed-flow lanes have reached capacity. This would also improve the attractiveness of express bus service on I-80.

- Golden Gate Transit will be implementing a nine-month demonstration of an I-580 bus route providing direct service between San Rafael and Albany, Berkeley, and Emeryville. Service will be provided during the peak periods—five trips westbound trips in the morning and five-eastbound trips in the afternoon every 30-minutes. While this service would not directly serve West County, it could have a positive benefit for the increasing congestion on I-580 between Marin County and its convergence with I-80 in Albany.

With the exception of the demonstration program proposed by Golden Gate Transit, no BRT, express bus, or HOV/HOT lane improvements proposed or under consideration in other studies are yet programmed for implementation. The West Contra Costa High-Capacity Transit Study provides an opportunity to build upon the groundwork laid by these other studies, and by generating public and stakeholder support for practicable solutions to the worsening commute and congestion problems experienced in West County, for example by advancing high capacity bus improvements for funding consideration. Key to this will be recommending solutions that

align with potential funding; including funding that may become available with public approval of an extension of Contra Costa County's Measure J sales tax in 2016.

## 3.3 Bus Alternatives

### 3.3.1 Overview of Existing Bus Services in West County

#### Existing Bus Service and Ridership

Bus service currently represents the primary form of transit service, in terms of number of trips, for the majority of the West County residents and is shown in **Figure 3-1**. Bus service is currently provided primarily by AC Transit and WestCAT and consists of a network of local, express and one Rapid service. AC Transit serves the El Cerrito, Richmond, San Pablo, and El Sobrante areas, while WestCAT primary serves the Pinole, Hercules, Rodeo, Crockett, and unincorporated areas. Existing AC Transit bus services are used by over 25,500 riders per day, providing access between both western Contra Costa County and surrounding counties and within the Study Area. Existing WestCAT services carry approximately 5,000 trips per day.

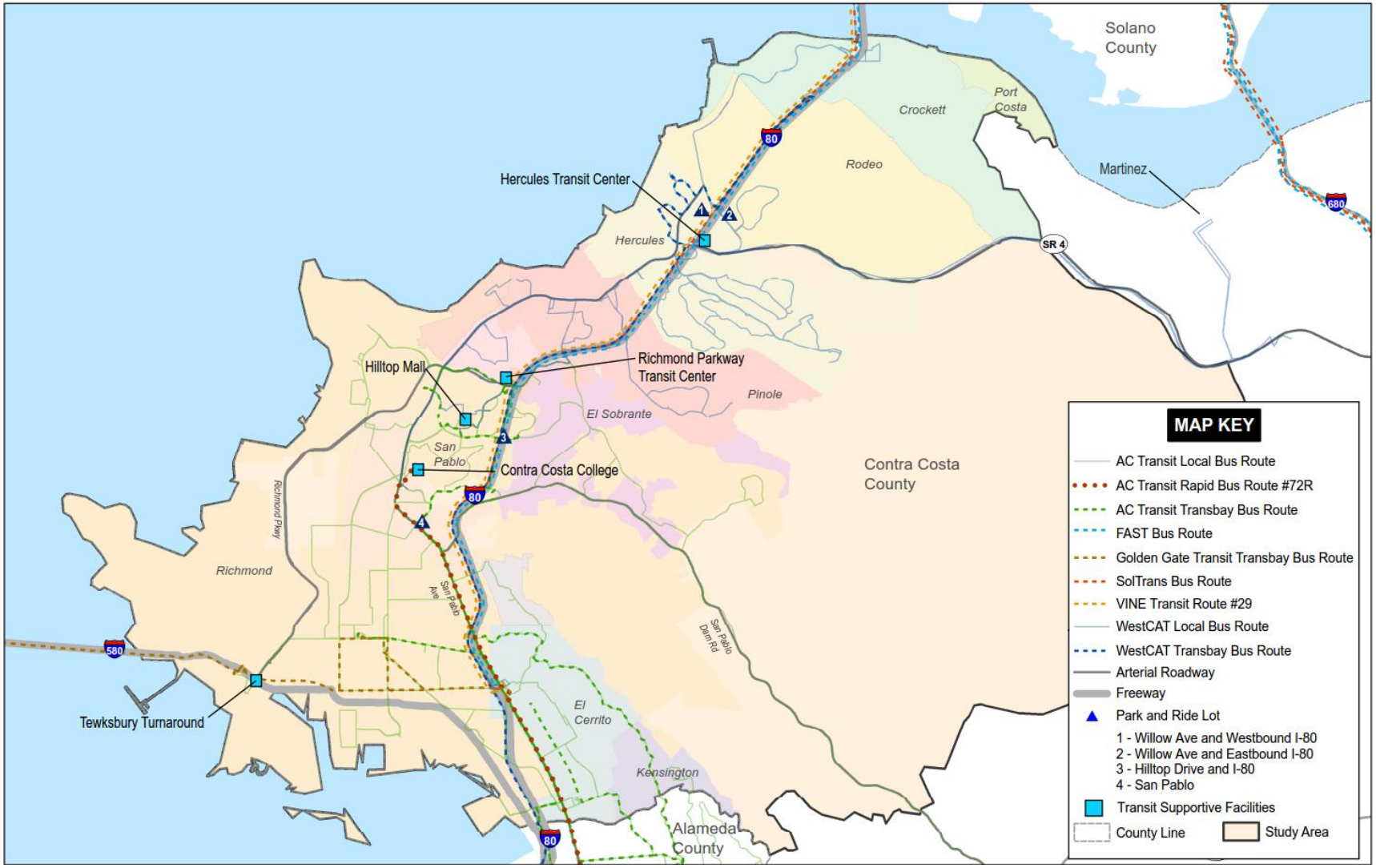
Express service is provided by WestCAT on Route J from north Rodeo, Hercules, Pinole and north Richmond along I-80 to the El Cerrito del Norte BART station and on Lynx from Rodeo and Hercules to downtown San Francisco. The J Express routes (J, JX, and JPX) carry approximately 2,400 passengers a day and Lynx carries approximately 1,000 passengers a day.[5]

AC Transit provides express bus service to downtown San Francisco in the I-80 corridor on transbay Route L, which serves the Richmond and San Pablo areas and a portion of El Sobrante. The L and LC route variations follow San Pablo Avenue from approximately El Cerrito Plaza BART to the Hilltop area; the LA route follows I-80 to Hilltop Mall and surrounding communities. Combined, these routes carry approximately 1,200 daily passengers). AC Transit also provides Rapid Bus service, Route 72R, along San Pablo Avenue between Contra Costa College and downtown Oakland. The 72R carries about 6,140 daily riders.[6] Local service is provided along the major arterials, with a higher level of coverage, including frequency of service, in the El Cerrito, Richmond and San Pablo areas, which have higher population and employment densities and therefore support higher transit ridership.

[5] See WCCTAC West Contra Costa High-capacity Transit Study Draft Technical Memorandum #5 Existing and Planned Transportation Network, Appendix A, July 2015 for transit ridership numbers.

[6] Ibid.

**Figure 3-1: Existing Bus Services in Study Area**




*Source: Kimley-Horn, 2015.*

Other agencies operate through bus service in West County to connect to major transit stations (e.g. BART), but generally service is not directly provided to West County residents. Golden Gate Transit operates service from Marin County over the Richmond-San Rafael bridge to the Richmond BART and El Cerrito del Norte BART stations on Route 42 to both stations and on Route 40 to El Cerrito del Norte only. Intermediate connections to the Point Richmond area and the nearby employment centers are provided on certain trips. Combined, the two routes serve approximately 840 riders on an average weekday.[7] SolTrans in Solano County and Vine Transit in Napa County Count provide service across the Carquinez Bridge along I-80 to the El Cerrito del Norte BART station.

## Why Expanded Bus Service

Both new BRT and expanded express bus services are proposed for evaluation in this study. The BRT and Express Bus alternatives were identified by evaluating ridership performance of existing arterial transit routes and assessing spatially which corridors connect, or will connect, the major activity centers in the Study Area that can be well served by transit. These modes were determined to offer the best potential for bus HCT in West County for the reasons enumerated below.

- Existing express bus service in the form of WestCAT Lynx and Route J, AC Transit Transbay Route L, and Golden Gate Transit Routes 40/42 demonstrates there is strong demand for such service.

- Also, based on the study team's assessment of existing and future travel markets, there is likely increasing future demand for express bus service oriented towards longer commute trips to major employment centers. Market analysis has identified Berkeley, Emeryville, and Oakland in the East Bay as markets that currently do not have high capacity, fast bus connections from West County, but are major destinations for West County residents. While BART currently provides direct service to and from West County to the East Bay on the Richmond-Fremont and Richmond-San Francisco lines, BART is reaching its capacity during peak periods and a transfer is required for destinations that are not in the immediate vicinity of the stations. Also, existing BART service has limited potential to divert auto travelers from I-80 and I-580 in West County to BART's East Bay and transbay trains because this requires exiting the freeway and following local,

[7] See WCCTAC West Contra Costa High-capacity Transit Study Draft Technical Memorandum #5 Existing and Planned Transportation Network, Appendix A, July 2015 for transit ridership numbers. In December 2015, Route 42, which provides more local stops in West County and connects with Richmond BART, will be combined with Route 40 to create more express-oriented service. This will allow the creation of an I-580 express bus route between San Rafael and northern Alameda County.

typically congested, streets to reach BART parking areas. Parking is fee based and often at capacity.

Express bus service offering home to work (and vice versa) connections without transfer and fare penalties will have greater ridership potential and provide a better level of service than services requiring intra- or intermodal transfers.

- Existing facilities can be used by express service and low- to moderate cost investment in new facilities appears feasible to significantly enhance the convenience and attractiveness of the service. This facilitates implementation in the near to mid-term.

- Current on-time performance is poor, in the 56 percent to 63 percent range, for the major bus lines (72, 72M, 72R, and 74) operating on San Pablo Avenue and 23rd Avenue. The 72R line is the single highest ridership bus line in West County and combined the 72, 72M, and 72R lines account for 14,800 average daily riders, approximately 58 percent of the all AC Transit riders in West County. By providing transit preferential treatments on surface streets, as recommended for the BRT alternatives, not only will service be improved for current patrons, but it will also have greater potential to attract riders in the strongest transit markets in West County.

- The existing Rapid Bus service on AC Transit Line 72R has proven to be successful and is often the preferred alternative to local bus service along San Pablo Avenue. BRT is proving to be a relatively low cost means for moving moderate to high volumes of riders through a corridor and service can be implemented incrementally with treatments varying along the corridor, ranging from mixed-flow to exclusive transit lanes, depending on the best fit given transit demands and the local conditions.

- BRT service levels can be scaled to meet demand and facilities designed to fit within the existing urban environment, for example a combination of BRT and Rapid Bus service improvements. BRT, due to its lower costs and scalable characteristics, may also have the potential to be implemented in the near to mid-term. See **Table 3-2** for a summary of Rapid Bus versus BRT types of investments. These represent the assumptions that AC Transit is using in evaluating the types of investments for their Major Corridors Study. Similar to express bus, BRT can take advantage of existing facilities (such as public roadways and transit centers, existing traffic controls) and the level of investment in new facilities can generally be scaled to match available funding.

BRT serves travel markets are not well served by other HCT modes, including express bus. BRT in the context envisioned for West County would provide enhanced arterial corridor service for local travel within the Study Area and provide connections to desired destinations in northern Alameda County. This is important, for the transportation problems of West County residents and businesses are not limited to long distance travel in and out of the area mainly along the freeways, but include commuting to and from work within West County. BRT is well suited to serving such markets and warrants consideration as a complement to other proposed HCT modes.

**Table 3-2: Features of Rapid Bus and BRT**

| Features | Rapid Bus | BRT |
|---|---|---|
| *Bus stops and stations* | | |
| Stop relocations or consolidations | X | X |
| Longer stops or stations | X | |
| Curb extensions or bus bulbs | X | |
| Enhanced bus stops or stations | X | X |
| *Intersections and signals* | | |
| Queue jump signals | X | X |
| Transit signal priority | X | X |
| Signal modernization and coordination | X | X |
| *Running way* | | |
| Queue bypass lane | X | X |
| Semi-exclusive transit lane | X | X |
| Dedicated transit lane | | X |
| *Other* | | |
| Real-time information | X | X |
| Branding | X | X |
| All-door boarding | X | X |
| Signage and wayfinding | X | X |
| Proof of payment | | X |

*Source: AC Transit, Major Corridors Study, Alternatives Development Technical Memorandum, October 2015.*

Three bus alternatives—one express bus and two BRT—have been developed at a conceptual level and are described in this section. They are proposed for further refinement and screening for performance relative to the study goals and objectives during the next steps of this study.

### 3.3.2 Alternative 1: Express Bus Service

#### Markets Served

Several options for expanding existing or adding new express bus service in West County were initially considered. Based on the potential to capture a significant segment of travelers in the most congested roadway corridors, express operations that would expand freeway flyer service, i.e. express bus service on the freeway, were determined to be the best candidates for further evaluation. Freeway flyer service would be similar to the existing express bus services outlined above, however, the proposed express bus service would include several important differences; it would be oriented at the origination end (i.e. the home-based trip end) on park-and-rides along the freeway and serve new destinations in the East Bay (the work trip end) and Marin County, as well as San Francisco.

An express bus alternative that connects high capacity park-and-ride facilities in West County with the major the employment centers in the East Bay using the I-80 and I-580 interstates would serve new markets that aren't currently being served by express buses that deliver riders to the El Cerrito del Norte BART Station or downtown San Francisco. By following existing freeways and taking advantage of existing transit-supportive facilities, including park-and-ride lots and HOV lanes, along I-80, and potentially adding new facilities along I-580, the express bus alternative would offer a relatively low cost, near term improvement to existing express bus services potentially expanding the San Francisco market and adding direct service to Marin County and northern Alameda County [8].

Freeway express service connecting to East Bay employment locations is proposed because (1) the downtown commercial districts of Berkeley, Emeryville and Oakland are major work trip generators that are relatively untapped direct bus service markets (currently many of these trips require a transfer to BART from West County to get to these destinations) and (2) other Bay Area employment areas, which travel market data indicate are major trip destinations for West County residents, do not yet have the densities to support high ridership, high frequency transit service. Express bus service to San Rafael via the Richmond-San Rafael Bridge and I-580 is also being proposed as the demand in this corridor seems to be growing and the potential for

[8] The San Francisco market will continue to offer potential for expansion of transbay service since it is the largest, most concentrated central business district in the Bay Area and is projected to grow substantially. To support continued growth will require increased transit service from residential communities throughout the Bay Area, including from West County. As part of alternative evaluations for this study, the future demand and the corresponding need to expand transit to San Francisco will be assessed and shared with WestCAT and AC Transit, among others, to support the planning for future transbay service.

making direct transit service connections from Marin County to West County and Alameda County warrant further exploration.[9]

While there are significant numbers of West County residents traveling north over the Carquinez Strait, for example, many proceed to scattered destinations, which are difficult to serve with transit. Silicon Valley attracts a sizeable number of commuters along the I-80 corridor through the East Bay but they may be destined to locations in northern Santa Clara County, San Mateo County or southern Alameda County. For any single location the demand is not sufficient to justify more than limited bus service. In eastern Contra Costa County, the same challenge exists: most locations (including Martinez, Pittsburg and Antioch) lack dense employment centers that can be efficiently served by transit. The one downtown commercial district that is large and relatively dense is in central Walnut Creek. However, travel market data does not show the number of West County trips destined there to be high.

## Project Description

The route for the proposed West County Express Bus Alternative is shown in **Figure 3-2**.

Freeway-flyer express service would operate on both I-580 and I-80 in West County, converging where they join in Albany in Alameda County. Trips on the I-80 branch service would originate (e.g., in the morning) in Hercules at the Hercules Transit Center, with the potential to start the route at Willow Avenue.[10]

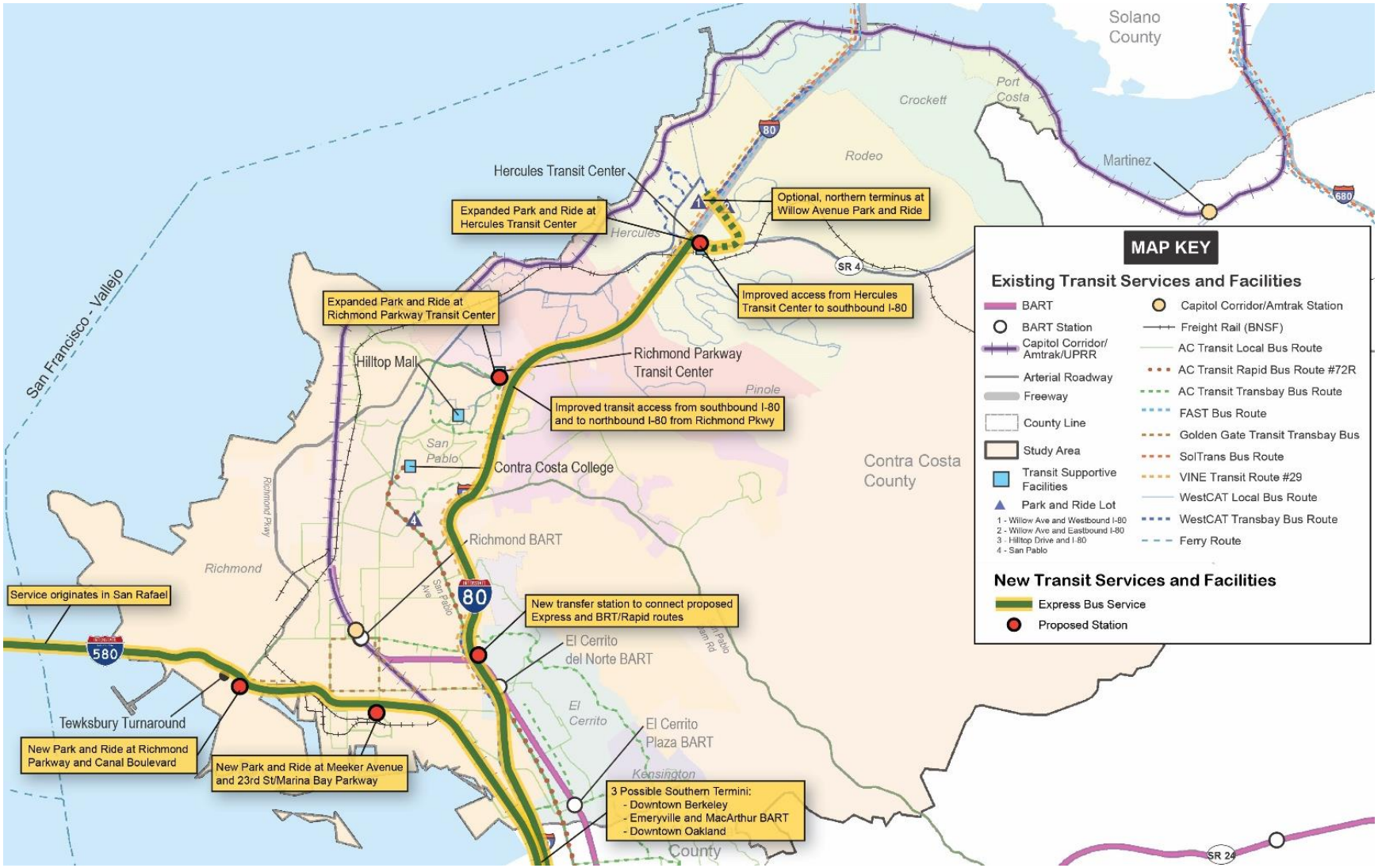
### *I-80 Express Bus*

This alternative would operate along I-80 between the Hercules Transit Center and downtown Oakland. Multiple potential stops are identified for evaluation, but may be refined if this alternative is carried forward for further evaluation. Buses would access I-80 westbound and enter the median HOV lanes. The current routing in and out of the Hercules Transit Center is shown in **Figure 3-3**. Currently buses must travel out of direction to access I-80 westbound. A new HOV-only, connector to I-80 westbound, or to SR 4/I-80 westbound, would be evaluated for feasibility and cost. Eastbound I-80 access to the Hercules Transit Center is more direct and would not require major improvement.

[9] Richmond-San Rafael Bridge Access Improvements, Bay Area Toll Authority, December, 2015, http://www.mtc.ca.gov/our-work/plans-projects/major-regional-projects/richmond-san-rafael-bridge-access-improvements

[10] An option would have buses start their route at the Willow Avenue interchange with I-80 and then proceed to the Hercules Transit Center if demand warrants and it does not substantially increase peak vehicle requirements. A detailed operations study could determine the feasibility of the option.

**Figure 3-2: Alternative 1—Express Bus Service**




*Source: Kimley-Horn, 2015.*

**Figure 3-3: Hercules Transit Center and Park-and-Ride**


*Source: Kimley-Horn, 2015*

Buses would proceed to the Richmond Parkway interchange near Hilltop Mall, exiting the freeway using new HOV direct access ramps, stopping at a new bus stop incorporated into the access ramps, and then return to the freeway median again using the existing direct HOV lane access ramps on the south side of the overcrossing. The bus stop would serve the existing, nearby park-and-ride lot at the southwest quadrant of the Richmond Parkway and I-80 Interchange. Pedestrians would walk from the park-and-ride facility on the freeway overpass to the express bus stop in the median. An aerial view of the I-80/Richmond Parkway area is provided in **Figure 3-4**.

A third off-freeway stop would be evaluated at the San Pablo Avenue/Barrett Avenue interchange. This location is convenient for connections to the proposed BRT/Rapid Bus service improvements on Macdonald and San Pablo Avenues. While mainly a multimodal transfer facility, this location may be attractive for transit users that access BART at the El Cerrito del Norte BART Station, where parking capacity is limited. The City of El Cerrito staff has also indicated a desire to reduce single-occupant auto usage at the El Cerrito del Norte park-and-ride facility in order to accommodate future transit-oriented development. Potential sites for a park-and-ride facility would be identified.

**Figure 3-4: Richmond Parkway (at I-80) Transit Center and Park-and-Ride**


*Source: Kimley-Horn, 2015*

Express buses would return again to the I-80 freeway median and not exit until reaching the interchange designated for access to (1) University Avenue for buses proceeding to downtown Berkeley to connect with the Berkeley BART Station; (2) Powell Street for buses serving central Emeryville with buses continuing to a terminus at MacArthur BART Station in Oakland; and (3) the I-980 and 27th Street exit/entrance ramps for access to Grand Avenue in Oakland, where buses could follow Grand Avenue to Broadway to a terminus in downtown Oakland, potentially at 14th and Broadway, and connecting with the 12th and 19th Street BART Stations. A limited number of stops between the freeway and the destination BART stations would be provided as identified in the Stations discussion.

Service on the I-580 branch of the Express Bus Alternative would begin in Marin County at the downtown San Rafael Transit Center and cross over to West County via the Richmond-San Rafael Bridge. Two freeway park-and-ride stops are proposed in Richmond: the first at the Richmond Parkway/Canal Boulevard interchange and the second at the 23rd Street/Marina Bay Parkway interchange.

- **Richmond Parkway/Canal Boulevard interchange.** This location is surrounded by mixed use development - industrial, office, retail, and residential (near the harbor). This stop would be accessible from the Point Richmond residential neighborhoods to the south and to commuters using the Richmond Parkway to the north. Several of the low-rise industrial and commercial land uses may be suitable for redevelopment, generating future transit demand.

- **23rd Street/Marina Bay Parkway interchange**. This location includes residential uses north of the freeway and a mix of retail/commercial and office uses south of the freeway. The latter are concentrated along Meeker Avenue and include the California Department of Public Health. The expanding residential areas generally between Meeker Avenue and Richmond Marina Bay/San Francisco Bay suggest this site as a good park-and-ride location. The mix of single and multi-family units supports a growing population of commuters.

At both locations new facilities would need to be constructed. While originally HOV lanes existed along the newer segment of I-580 when it was constructed in the early 1990s, currently no HOV lanes extend along I-580, except through the bridge toll plaza in the westbound direction. Express buses would therefore use one of the mixed-flow traffic lanes on I-580. No new dedicated ramps to the freeway for buses and HOV vehicles are proposed.[11]

An I-580 express bus service could also serve the Chevron and surrounding office/industrial park by providing a stop near the Tewksbury Turnaround in Point Richmond. Currently, Golden Gate Transit Routes 40/42 stop at Tewksbury Avenue and Castro Street, a location right next to the freeway and accessible from the Canal/Castro Street at I-580 interchanges and frontage roads. The stop would not involve significant out-of-direction travel or add more than two to three minutes to bus trip time. The benefits of serving Chevron would appear to outweigh the cost in travel time for other users of the service, and thus should be evaluated. No park-and-ride facility is proposed at this location as there is limited space and the existing park-and-ride at Canal Boulevard is less than a mile distant.

After stopping at the I-580 and 23rd Street/Marina Bay Parkway park-and-ride lot, eastbound buses would continue on I-580 to the merge with I-80. The destinations in downtown Berkeley and Oakland that connect with the BART stations and central Emeryville would be served by following the same routes as the I-80 express service.

[11] In Contra Costa County, HOV lanes once ran eastbound from Marine Street to west of Central Avenue, for 4.5 miles. They ran westbound from E of Central Avenue to Marine Street for 5.3 miles. They were opened in 1989, extended in 1992, and were closed through Richmond by February 2000. (Source: http://www.cahighways.org/466-740.html#580)

## Service Characteristics

Express bus service can be viewed as an independent, long-term transit investment or as an initial investment that could be transitioned at some point to a higher capacity transit improvement, such as rail, if demand warrants. For example, express bus service upgrades along I-80 can help to build up ridership along this corridor potentially supporting higher capacity rail services in the future if intensification of land uses continues to occur along the transit corridor as currently envisioned. Parking facilities and other transit center improvements for the Express Bus Alternative would be designed and located to serve a future rail transit alternative, although new right-of-way would likely need to be acquired for the rail corridor itself.

One key characteristic that makes express bus service more attractive than auto use is high frequency service. Frequencies of every 10 to 12 minutes are necessary to get drivers to shift to express buses without experiencing a significant auto-to-transit transfer penalty. To support this high frequency service, demand must also be substantial. Transit preferential treatments are needed for optimal express bus performance. Express service travel times are competitive with the auto when operating with limited or no stops on freeways. However, at the trip origin and destination ends they will typically operate on local arterials, collecting passengers at arterial stops and park-and-ride lots and then dropping off passengers along arterial stops in commercial/employment districts. To retain the travel time benefits, express buses would benefit from transit priority on local roadways as well as on freeways.

Concentrating demand in a few key locations is preferred. Higher capacity park-and-ride facilities, readily accessible from express bus riders' communities of residence, offer the most practical means for generating demand that supports more frequent service. Structured parking is probably viable, or at least to be considered, due to the high cost of right-of-way for land acquisition and the less desirable land use that results from large surface parking lots. Examples can be found in Seattle and Los Angeles, among other metropolitan areas, where high-capacity transit centers/park-and-ride lots (typically with structured parking next to the freeway) focus demand from low density communities. Service frequencies are provided that could not otherwise be justified by buses circulating along local arterials to collect passengers. See **Figure 3-5** for an example of a high-capacity park-and-ride facility next to a freeway with median HOV lanes in metropolitan Seattle.

**Figure 3-5: Eastgate Park-and-Ride in Bellevue, WA**


*Source: Kimley-Horn, 2015*

Several of the local roadways on which express buses are proposed to operate already include transit priority treatments that facilitate bus movement through congested commercial districts. However, should this study recommend the Express Bus Alternative for implementation, an important element of the implementation program should be coordination with East Bay cities and the local transit operator to ensure transit priority treatments are provided along the express bus route.

For planning purposes, service frequencies of 10 minutes or less during peak periods and 30 minutes during the off-peak would be provided on the I-80 branch, and 15 minutes peak-periods only on the I-580 branch. Weekend service could also be introduced if demand

warrants, though currently weekend service is less peaked. If this alternative is advanced for further study, the feasibility of serving three Alameda County terminus points would need to be further evaluated, although combining two or more of the destinations could concentrate trip activity to one location.

Initially, weekend congestion will likely increase demand for Lynx-type service to San Francisco. Currently it is operated weekdays only. Also demand for expanded weekend WestCAT Route J service to El Cerrito del Norte will likely increase. The facilities constructed for the West County Express Bus alternative would be available to other services that operate on weekends.

### Transitway Improvements

A major advantage of express bus service is that it can use existing roadways and not require extensive improvements to either I-580 or I-80, except at two locations. The existing I-80 HOV lanes and the traffic management systems installed as part of the I-80 Integrated Corridor Mobility project can be used by the proposed West County Express Bus Alternative. The use of these ramps will reduce the overall travel time for the express buses, by eliminating approximately three to five minutes of surface street travel at each location. This will also improve the reliability of service by reducing the potential for encountering surface street congestion at the ramp access and egress points.

In the I-80 corridor, additional freeway improvements are recommended at two locations:

- An access ramp from the Hercules Transit Center to the State Route (SR) 4 connector ramp to I-80 is proposed for evaluation. This ramp would improve express bus access to westbound I-80 from the Hercules Transit Center.

- New direct access express bus/HOV ramps to the freeway median are proposed on the north side of the I-80 and the Richmond Parkway interchange. These new ramps would allow buses to stay within the I-80 alignment to pick up and drop off passengers rather than having to circulate through the park-and-ride facility west of the interchange (current access to the park-and-ride facility is from Blume Drive, which interconnects with the Richmond Parkway). There is adequate right-of-way in the I-80 median north of the overcrossing to construct ramps to and from the Parkway overcrossing, mirroring the existing direct access ramps on the south side of the interchange.

- Bus stations are proposed to be constructed on the new ramps, reducing travel times for buses that currently have to divert to Blume Drive. Express bus passengers would be required to walk to and from the station on the access ramps from the park-and-ride facility, but the distances are not great (from 400 to 1,200 feet depending upon where

riders park). Pedestrian pathway improvements are recommended as part of this alternative.

Additional improvements may be considered during the implementation of managed lanes on I-80, as part of an MTC program. MTC has targeted the I-80 HOV lanes from Emeryville to the Carquinez Bridge for conversion to express HOV/HOT lanes around 2020. Though the improvements are currently planned and funded separately from a West County high-capacity transit improvement project, close coordination with the Express Bus Alternative would be warranted, should it be selected for implementation.

I-580 does not include HOV lanes currently except in the westbound direction through the Richmond-San Rafael Bridge toll plaza. Freeway congestion is not yet severe enough to justify the dedication of lanes for HOVs and public transit vehicles. I-580 is not currently listed for inclusion in MTC's managed lanes program.

### Vehicles

Over-the-road type buses, such as AC Transit uses on some of its transbay routes and WestCAT operates on Lynx service, are the preferred vehicle for longer bus routes like the Express Bus Alternative due to their passenger comfort and suitability for higher speeds. These vehicles are similar to buses used for inter-city service by private operators.

Existing over-the-road buses are single level, typically 40- to 45-feet long, and seat approximately 57 passengers (or less depending on the space reserved for wheelchairs). Both AC Transit and WestCAT have recently tested double-decker buses that could also operate similar to over-the-road coaches on express service routes. The tested vehicles were 42-feet in length, low-floor, and seated 80 passengers. The AC Transit Board has decided to move ahead with procurement of double-decker buses, although the number is still undetermined.

One challenge of existing single level high-floor coaches is accessibility by the mobility impaired, which is now much easier on the standard low-floor transit bus than high-floor over-the-road coaches. The traditional wheelchair lifts on high floor buses are located towards the center, right side of the bus and extend several feet to lift wheelchair passengers onto the bus. Low-floor buses, such as the double-decker coaches being procured by AC Transit are more accessible, the bridging ramp easier to deploy and the bus interior more accommodating and may be a good choice for Express Bus service in the West County corridors.

### Stations

Stops or stations for express bus service would be integrated into existing and proposed park-and-ride facilities for West County. Bus stops or stations at these facilities would include

passenger canopies, off-vehicle fare (ticket) vending, lighting and safety and security monitoring.

Substantial park-and-ride facilities currently exist at the Hercules Transit Center refer to **Figure 3-3**) and the Richmond Parkway Transit Center (refer to **Figure 3-4**). Accommodation of new transit capacity would, however, require expanded park-and-ride facilities. This could be accomplished through the construction of structured parking on the current lot footprints, thereby avoiding expensive land acquisition and sprawling lots that increase walking distances to bus loading zones. Each location's capacity could be expanded by several hundred spaces. Capacity requirements would ultimately be established by travel demand forecasts of current and future park-and-ride activity.

One new park-and-ride of more limited capacity is proposed at the I-80/San Pablo Avenue interchange. As noted previously, this site was selected primarily for potential intra- and possibly intermodal connections, and would serve as a new transit hub in West County.

Along I-580, two new park-and-ride lots are proposed to serve West County residents: I-580 at the Richmond Parkway/Canal Boulevard interchange and I-580 at the 23rd Street/Marina Bay Parkway interchanges to serve the mixed industrial, office, retail, and residential uses at these locations. There is also potential for intensification of uses in these areas.

Surface lots would be provided at these three locations unless 2040 forecasts indicate substantial park-and-ride demand would support higher capacity structured parking.

On surface streets at major employment destinations in the East Bay, buses would use existing or new curb bus stops. Buses would make three to five stops at each destination end. The preferred locations would be established in cooperation with local cities and AC Transit. The following preliminary list of stops has been identified for further evaluation.

### *Berkeley:*

- University Avenue at 4th Street
- University Avenue at San Pablo Avenue
- University Avenue at MLK Jr. Way
- Shattuck Avenue at Center Street
- Shattuck Avenue at Durant Avenue

### *Emeryville:*

- Powell Street at Christie Avenue
- Powell Street at Hollis Street
- Hollis Street at Park/40th Street
- MacArthur BART Station

### *Oakland:*

- 27th Street at Telegraph Avenue
- Grand Avenue at Broadway
- Broadway at 20th Street
- Broadway at 14th Street

## Potential for Intermodal Connectivity

Transfers to and from other transportation modes would be possible at the major park-and-ride locations along I-80, including the Hercules Transit Center and the Richmond Parkway Transit Center. Limited connections to arterial bus services would also be possible at the proposed new park-and-ride on I-80 at San Pablo Avenue and on I-580 at proposed new park-and-ride lots at the Richmond Parkway/Canal Boulevard and at 23rd Street/Marina Bay Parkway. In Berkeley and Oakland, the proposed southern termini of the Express Bus Alternative, intermodal connections to bus and BART would be convenient at the potential stop locations identified above. In Emeryville, intermodal connections to AC Transit arterial bus and EmeryGoRound local shuttle service would be possible. With a limited number of stops, however, the opportunities for intermodal connections are limited as well.

## Phasing of Improvements

The Express Bus Alternative lends itself to phasing both the level of capital investment and level of bus service over time. Express bus service to East Bay employment and activity centers could be implemented in the near-term using existing park-and-ride facilities. The expansion of existing lots, the construction of new lots, and the proposed bus priority capital improvements at the Hercules and Richmond Parkway transit centers can be undertaken as funding becomes available. Service frequencies can be steadily increased as demand grows.

## Constraints

Several challenges would need to be addressed for the successful implementation and operation of the proposed Express Bus Alternative. These challenges have both cost and implementation phasing implications and will require further study.

- **Trade-offs between adding structured parking and expanding or adding surface lots as a strategy for increasing park-and-ride capacities and access to transit in the I-80 and I-580 corridors.** The preliminary assumption is structured parking on existing publicly owned sites is the preferred means to expand capacity due to high land costs, limited land availability in many locations, and sound planning practices. However, the cost-benefit of each strategy should be further examined and the potential for phased implementation in conjunction with repurposing surface lots for transit oriented development considered.

- **Additional pedestrian travel to access freeway median bus stops.** Though the freeway median stops reduce the travel time for buses, they do require additional walk time for pedestrians along heavily travelled streets to access the stop.

- **Extent of improvements needed to provide priority bus access to and from park-and-ride facilities.** Circuitous access to park-and-ride facilities increases in-vehicle time for passengers. At the Hercules Transit Center at Willow Avenue and SR 4, a preliminary proposal to provide a more direct access to westbound I-80 for buses by constructing a dedicated bus access ramp to westbound SR 4 just prior to the interchange with I-80 would reduce travel time. This would allow buses to exit the transit center and quickly access the SR 4 ramp to SB I-80. Currently buses must go out of direction to enter the freeway, following a route along Willow Avenue to Sycamore Avenue, to San Pablo Avenue and the SR 4/John Muir Parkway interchange with I-80. The feasibility and cost of a direct access to SR 4 or I-80 and potentially at other proposed park-and-ride locations access improvements will require additional study.

- **Cost of constructing direct HOV/median lane access ramps on the north side of the I-80 and Richmond Parkway interchange**. Although right-of-way for direct access ramps is provided, the facility is yet to be designed. The Express Bus Alternative proposes adding bus stations on the ramps, which would increase the complexity and cost of the ramps. Pedestrian facilities would also be required for safe access to the bus stations.

Certain operational issues also need to be evaluated as this study proceeds:

- **Ensuring fast operation of express buses on increasingly congested freeways**. On I-80 buses would use the median HOV lanes, which are experiencing degradation in speeds and reliability as the number of carpools and alternative-fuel vehicles increases and HOV lane violations rise. When conditions in the mixed-flow lanes break down, single occupant autos then use the HOV lane. Express buses must weave through the mixed-flow lanes to enter or exit the HOV and transit priority median lanes. This can substantially slow bus travel times. The direct access ramps at I-80 and the Richmond

Parkway are an attractive way to avoid this problem, but there is not enough existing right-of-way, for these improvements elsewhere.

Similar problems would be experienced when express buses exit or enter the I-80 freeway at interchanges serving Berkeley, Emeryville and Oakland in the East Bay. In these areas freeway operations during peak periods, both in the mixed-flow and HOV lanes, are the most congested. Measures to improve the operation of HOV lanes, or proposed HOV/HOT lanes, will require regional collaboration of Caltrans, corridor cities, and transit agencies.

- **Limited intermodal connectivity because of the limited number of stops and limited access to the stops**. Feeder bus and local circulator shuttles can be planned to serve expanded or new lots, thereby improving connectivity with local transit.

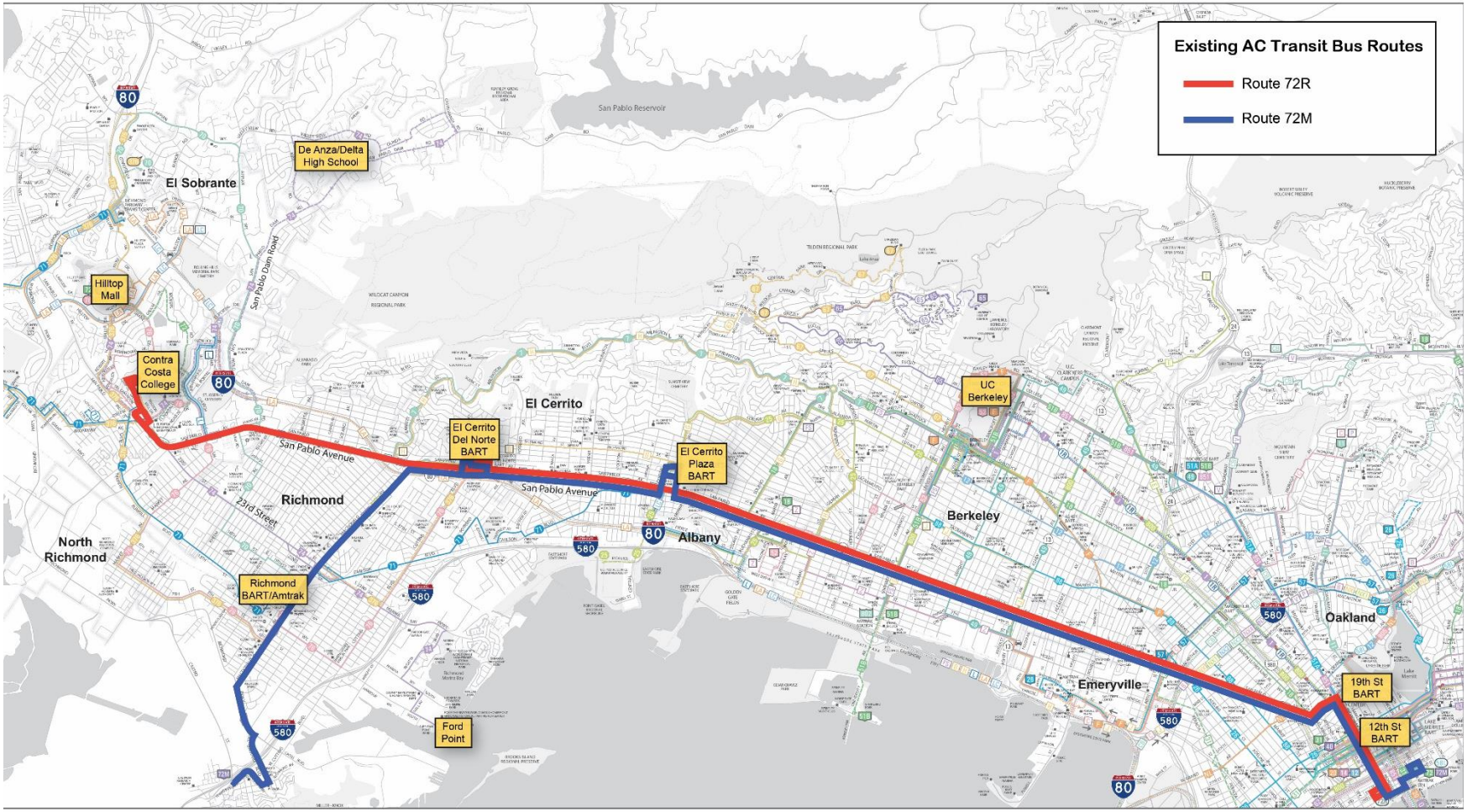
### 3.3.3 Alternative 2—San Pablo Avenue/Macdonald Avenue BRT

#### Markets Served

The San Pablo Avenue/Macdonald Avenue BRT alternative approximates the well-utilized existing AC Transit Route 72 services along San Pablo and Macdonald Avenues, shown in **Figure 3-6**, and WestCAT Route C-3 shown in **Figure 3-18**. Alternative 2 would, however, extend BRT service from the current Route 72 terminus at Contra Costa College Transit Center north to Hercules along the heavily traveled San Pablo Avenue and Hilltop Drive corridors. This extension would introduce high capacity and high frequency transit services to areas within the Study Area that are currently not served by the existing Rapid Bus service.

AC Transit Routes 72 and 72R currently extend from the Oakland Capitol Corridor/Amtrak station at Jack London Square north to Contra Costa College. Route 72R, a Rapid overlay service, currently provides limited stop service along this segment, providing faster travel times compared to the local service. Amenities currently part of 72R service along portions of this segment include enhanced stations, limited stops, real-time arrival information, and transit signal priority. Major destinations served by this service include the El Cerrito Plaza BART Station, the El Cerrito del Norte BART Station, the San Pablo Civic Center and Contra Costa College. Route 72M provides service along San Pablo Avenue to Macdonald Avenue, then uses Macdonald Avenue to access the Point Richmond Area, terminating at the Tewksbury Turnaround, a small transit terminal along I-580. Major destinations served by this service include El Cerrito Plaza BART Station, the El Cerrito del Norte BART Station, the Richmond BART Station, and the Richmond Civic Center.

**Figure 3-6: AC Transit Existing Bus Routes 72R and 72M**




*Source: AC Transit, 2015*

The proposed BRT service, while providing access to Berkeley, Emeryville, and Oakland, which have been identified as having both high demand and high transit suitability, is also providing a high level of transit accessibility along the San Pablo and Macdonald Avenue corridors. The service would accommodate the West County internal trips that have also been identified as having high demand and high transit suitability. These include most areas of Richmond, El Cerrito, and San Pablo. It would also serve the emerging markets in Hercules and Pinole. It would link the high activity centers including commercial districts and transit hubs, such as existing BART stations (Richmond, El Cerrito del Norte, and El Cerrito Plaza), Contra Costa Community College, Hilltop Mall, the Richmond marina and harbor districts, the Richmond Parkway and Hercules Transit Centers, and downtown commercial districts in Richmond, El Cerrito, San Pablo, Pinole and Hercules, among other centers.

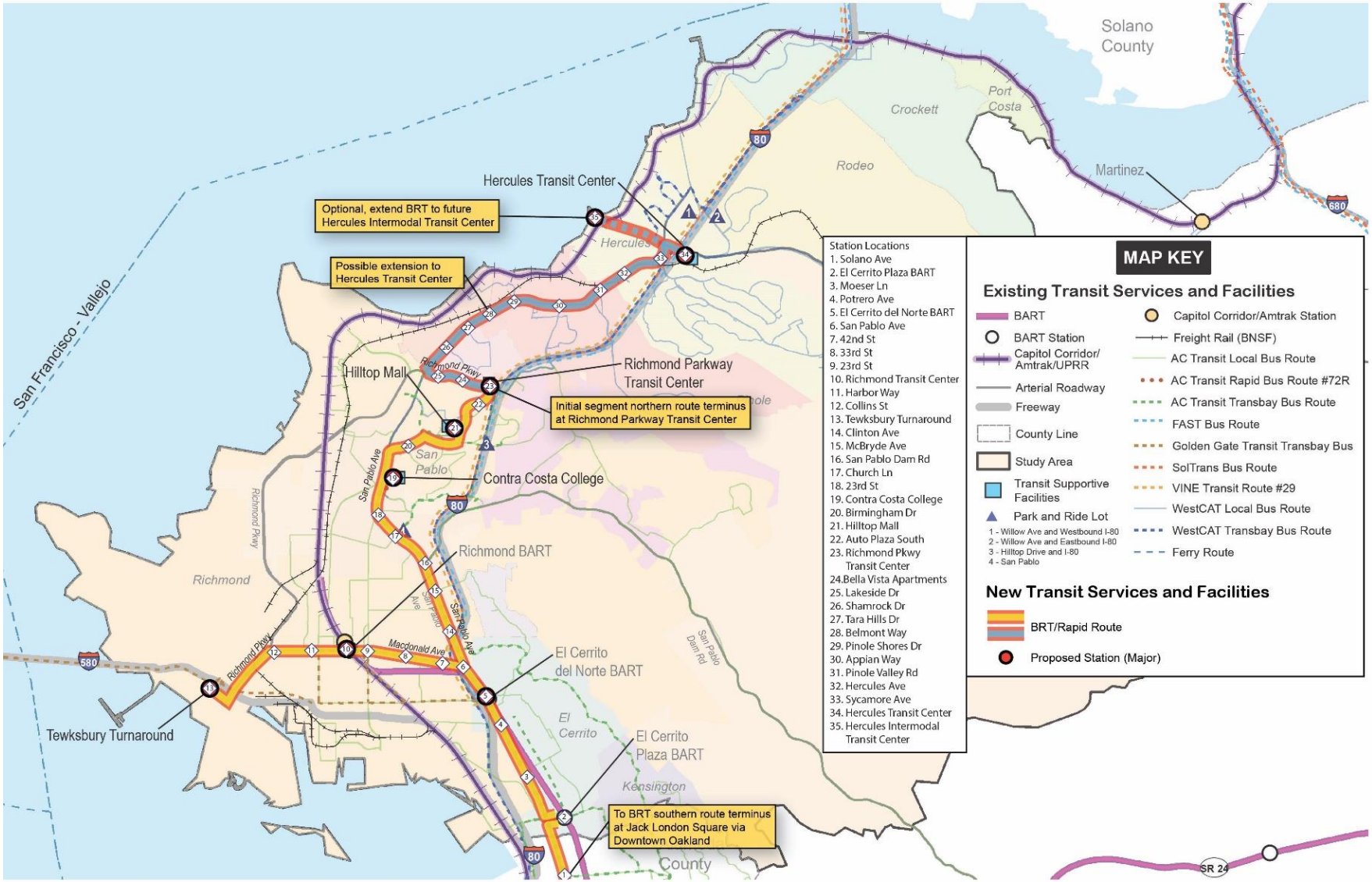
The San Pablo Avenue/Macdonald Avenue BRT alternative would improve transit travel times and capacity along an extended Route 72R and 72M corridor to better serve intra-county and inter-county trips. It would provide a stronger north-south transit spine within West County and enhance connectivity to major regional transit hubs, including the two BART stations in El Cerrito and to downtown Oakland. The Macdonald Avenue service would provide a strong east-west spine through downtown Richmond and improve connectivity to a variety of land uses and the regional transit network for the low-income housing and commercial uses in Richmond. The BRT alternative includes upgraded facilities and amenities along this corridor to improve transit travel time and increase the capacity of this corridor.

## Alternative Description

The San Pablo Avenue/Macdonald Avenue BRT would provide BRT service from Alameda County to the Hercules Transit Center and Richmond BART station via enhanced bus facilities on San Pablo Avenue and Macdonald Avenue. See **Figure 3-7** for a depiction of the two corridors. This alternative is consistent with the BRT alternative AC Transit is recommending for the San Pablo Avenue/Macdonald Avenue corridor in its Major Corridors Study, currently underway, although AC Transit's recommended improvements stop at the Richmond Parkway Transit Center.

One branch of the line would operate from Downtown Oakland to the Hercules Transit Center via San Pablo Avenue. It would deviate from San Pablo Avenue to serve the Hilltop Mall and Richmond Parkway Transit Center. A second branch would operate from downtown Oakland to the Tewksbury Transit Turnaround in Point Richmond, diverging from San Pablo Avenue to Macdonald Avenue north of the El Cerrito del Norte BART station. This also conveniently serves the Richmond BART station.

**Figure 3-7: Alternative 2—San Pablo Avenue/Macdonald Avenue BRT**




*Source: Kimley-Horn, 2015*

As shown in **Figure 3-7**, the San Pablo Avenue/Macdonald Avenue BRT Alternative follows a single alignment along San Pablo Avenue south of El Cerrito del Norte BART and then branches into two alignment options north of the BART station, one proceeding north towards Hilltop Mall and the other proceeding west through downtown Richmond. The northern alignment includes two possible termini for BRT service: the Hercules Transit Center and the Hercules Intermodal Transit Center.

### *North Branch along San Pablo Avenue*

The proposed San Pablo Avenue branch service would begin in Oakland in Jack London Square at the Amtrak station, extend north along Broadway through downtown Oakland to 20th Street and then west to connect to San Pablo Avenue. It would continue along San Pablo Avenue to West County, providing service to the El Cerrito Plaza and El Cerrito del Norte BART stations, and follow San Pablo Avenue across I-80 north to the Contra Costa College area. It would exit San Pablo Avenue to provide service to the Contra Costa College Transit Center, just as AC Transit Route 72R does today. However, unlike the existing Route 72R, it would return to San Pablo Avenue and continue to travel north before veering east at Robert Miller Drive. Robert Miller Drive will provide access to Hilltop Mall Road, where the existing transit center near Wal-Mart would be a major stop.

After departing the transit center, the alignment would continue along Hilltop Mall Road east to Klose Way. From Klose Way it would utilize Blume Drive to access the Richmond Parkway Transit Center. After departing the Richmond Parkway Transit Center, it would use Richmond Parkway to travel back to San Pablo Avenue and head north. It would travel along San Pablo Avenue to Sycamore Avenue to Willow Avenue where it would enter the Hercules Transit Center.

An optional extension in Hercules would proceed west from the Hercules Transit Center along the John Muir Parkway to the planned Hercules Intermodal Transit Center.

### *West Branch along Macdonald Avenue*

The Macdonald Avenue service would branch from San Pablo Avenue just south of I-80, follow Macdonald Avenue west past the Richmond Civic Center and Richmond BART Station and continue through Downtown Richmond. It would remain on Macdonald Avenue west to Richmond Parkway. Traveling south on Richmond Parkway, it would then turn west on Cutting Boulevard, a slight variation from the existing 72M line, which crosses over on South Garrard Boulevard. From Cutting Boulevard it would turn at Garrard Boulevard, West Richmond Avenue, and Railroad Avenue, which then becomes Tewksbury Avenue. It would terminate at the Tewksbury Turnaround, a small transit facility adjacent to I-580. Driver facilities are provided at the Tewksbury Turnaround, making it a desirable layover and end-of-line location.

This alignment is generally consistent with AC Transit's recommendation for BRT improvements in its Major Corridors Study, though the alignment varies modestly in the Garrard Boulevard/Cutting Boulevard area to take advantage of land uses and development patterns on Cutting Boulevard that appear to be more conducive to transit.

### Vehicles

BRT service is expected to generate higher ridership in the corridor by providing more reliable service with a broader service span and higher service frequencies. Use of larger buses (e.g., articulated vehicles) would be recommended to provide adequate capacity to accommodate the anticipated increase in passengers.

### Service Characteristics

Existing service frequencies along San Pablo Avenue are every 12 minutes (each direction), peak and midday, on the 72R Rapid and approximately every 30 minutes on the 72 local bus route. On Macdonald Avenue service is every 30 minutes peak and midday. Other routes (Lines 71 and 76) operate on limited segments of Macdonald Avenue through mainly downtown Richmond and increase the overall frequency of service in those areas to closer to 10 minutes both peak and midday. For evaluation purposes, 10 minute BRT frequencies are assumed.

BRT service, which operates almost entirely along local roadways, relies on transit preferential treatments to improve transit travel times. Because BRT buses make periodic stops along a route for passenger boarding and alighting and thus incur more stopped delays than autos, priority treatments needs to be provided for buses. BRT buses can be very competitive with auto in terms of travel times, if dedicated transit lanes and priority at signalized intersections, such as queue jumps and/or transit signal priority, are provided.

### Transitway Improvements

#### *North Branch along San Pablo Avenue*

The San Pablo Avenue corridor between Alameda County and roughly 23rd Street in San Pablo is a four-lane, highly-trafficked corridor that is fronted by low and medium density commercial uses. South of Macdonald Avenue in El Cerrito and north of Glenn Avenue in San Pablo (except for a short stretch in downtown Pinole) there is a raised median with left-turn lanes. North of Macdonald Avenue in Richmond there is a center two-way left-turn lane. The corridor includes numerous signalized intersections with dedicated left-turn lanes. The majority of the corridor has on-street parallel parking on both sides of the street. Corridor right-of-way along this section varies from 90 feet to greater than 120 feet. Much of the corridor has a right-of-way of

approximately 90 feet to 100 feet, which exceeds the Transit Cooperative Research Program (TCRP) of the Transportation Research Board's minimum guidelines for BRT implementation.[12] In most locations sidewalks are wide. See **Figure 3-8** for a depiction of the corridor right-of-way and average daily traffic volumes.

The corridor in the south is at times congested during peak periods. It includes numerous driveways and left-turn movements that slow traffic. Directional traffic volumes along the southern portion of the corridor are in excess of 1,100 vehicles per hour in highly trafficked segments. North of San Pablo Dam Road, directional peak hour traffic volumes drop to under 900 vehicles. Given the high traffic volumes, particularly south of San Pablo Dam Road, providing dedicated transit-only lanes along this segment would be difficult. However, dedicated transit-only lanes may be feasible for several segments along this corridor.

**Figure 3-9** provides the study team's preliminary recommendation of where dedicated BRT lanes in a center guideway may be feasible and where BRT buses would preferably operate next to the curb or parking lane, as side-running BRT. Existing and future conceptual roadway cross-sections of San Pablo Avenue (with and without BRT lanes) are shown in **Figure 3-10** through **Figure 3-14**. For a key to the location of the section, refer back to **Figure 3-9**.

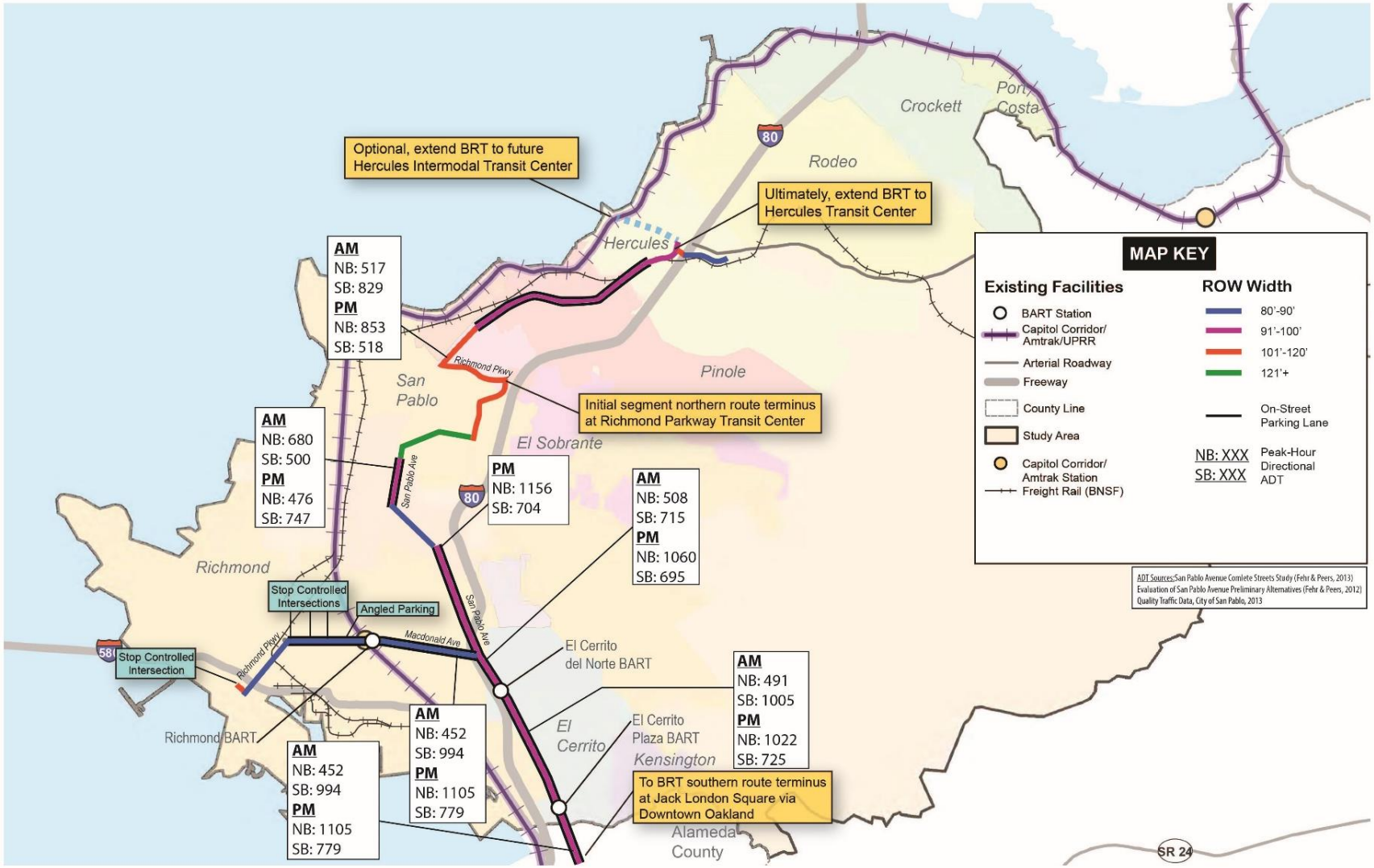
The location and configuration of transit-only lanes will be determined after further analysis of the corridor and taking into account existing and proposed roadway plans. This includes the plans for either Class II or Class III bicycle routes along San Pablo Avenue between Barrett Avenue in Richmond to the Hercules Transit Center and a Class III bicycle route on Macdonald Avenue between Garrard Boulevard and the El Cerrito BART Station. The analysis will assess the impacts of removing a general purpose (i.e., mixed-flow traffic) lane in each direction and possible displacement of curbside parking.

### *West Branch along Macdonald Avenue*

This corridor is a four-lane commercial corridor between San Pablo Avenue and the Richmond BART Station. For the few blocks between 41st Street and San Pablo Avenue there is a raised median. Between 41st Street and the Richmond BART Station, there are four-lanes without a raised median or center turn lane. The roadway passes beneath the BART and Amtrak/Capitol Corridor tracks in an underpass east of the Richmond BART Station.

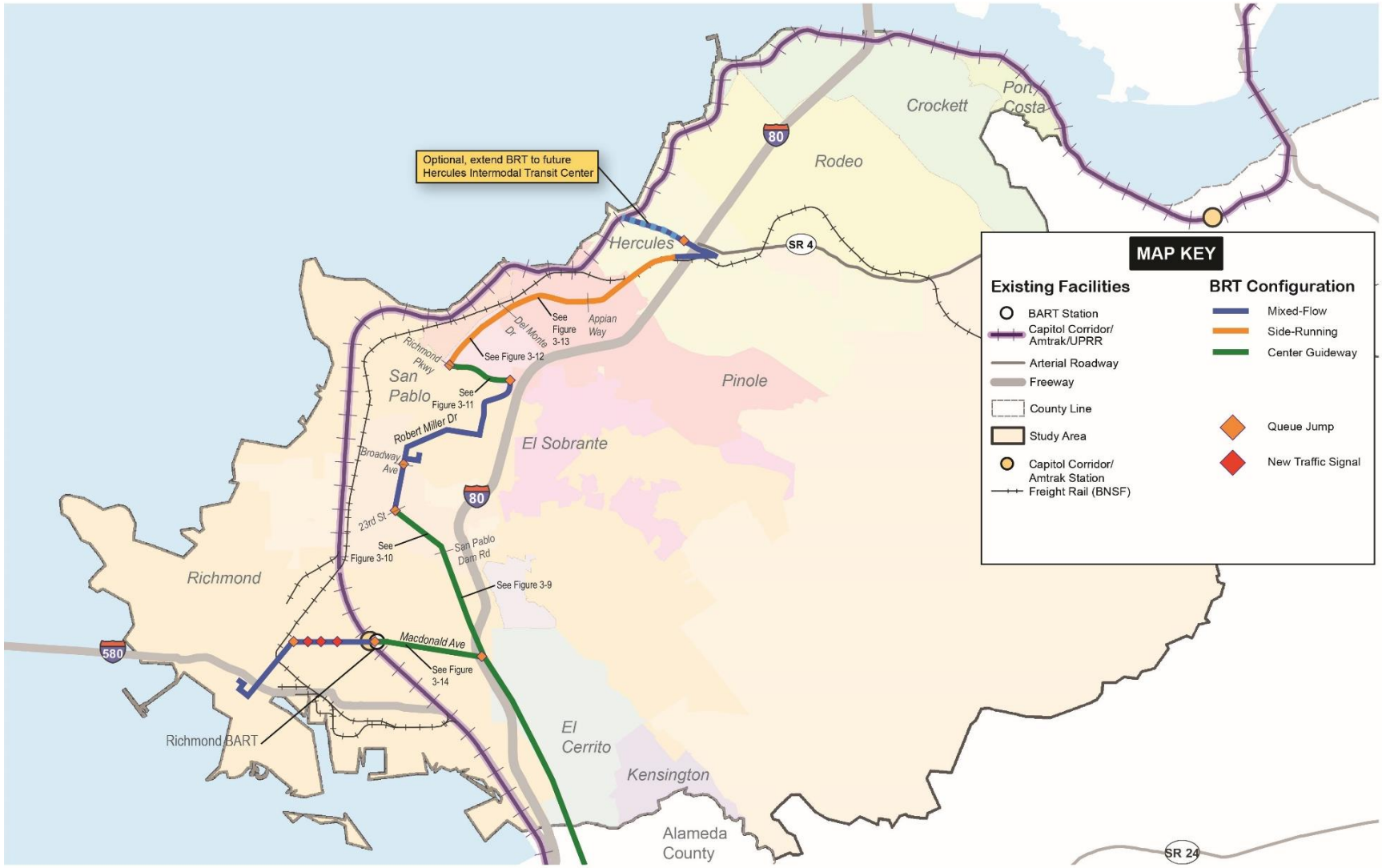
[12] TCRP, Bus Rapid Transit Practitioner's Guide. A 70' right-of-way is needed for median-running, dedicated transit lanes. Curbside, semi-dedicated transit lanes require less right-of-way.

**Figure 3-8: San Pablo Avenue/Macdonald Avenue Right-of-Way and Peak Hour Traffic Volumes**



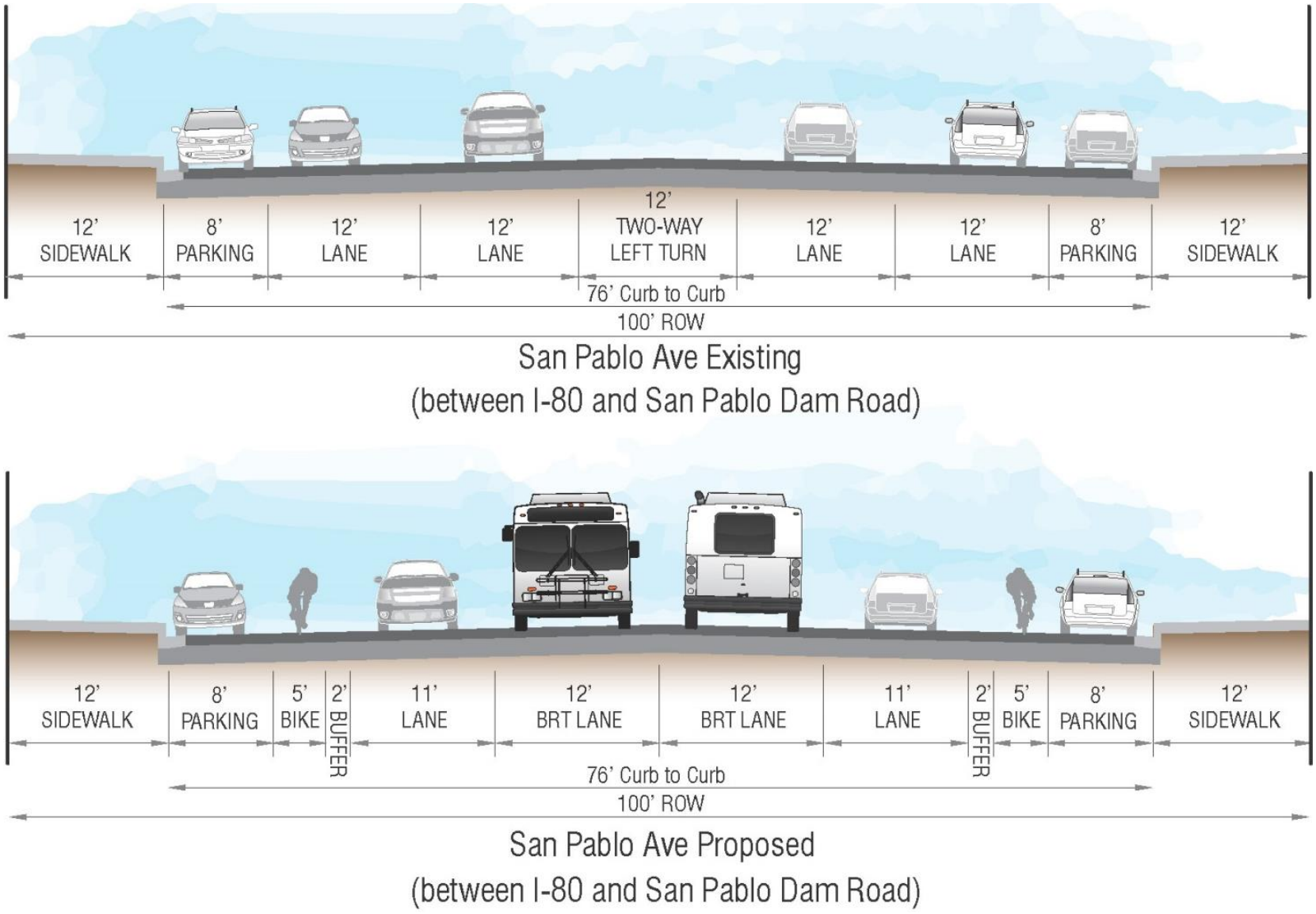

*Source: Kimley-Horn, 2015*

**Figure 3-9: Preliminary Configuration of BRT Lanes in San Pablo Avenue Corridor**



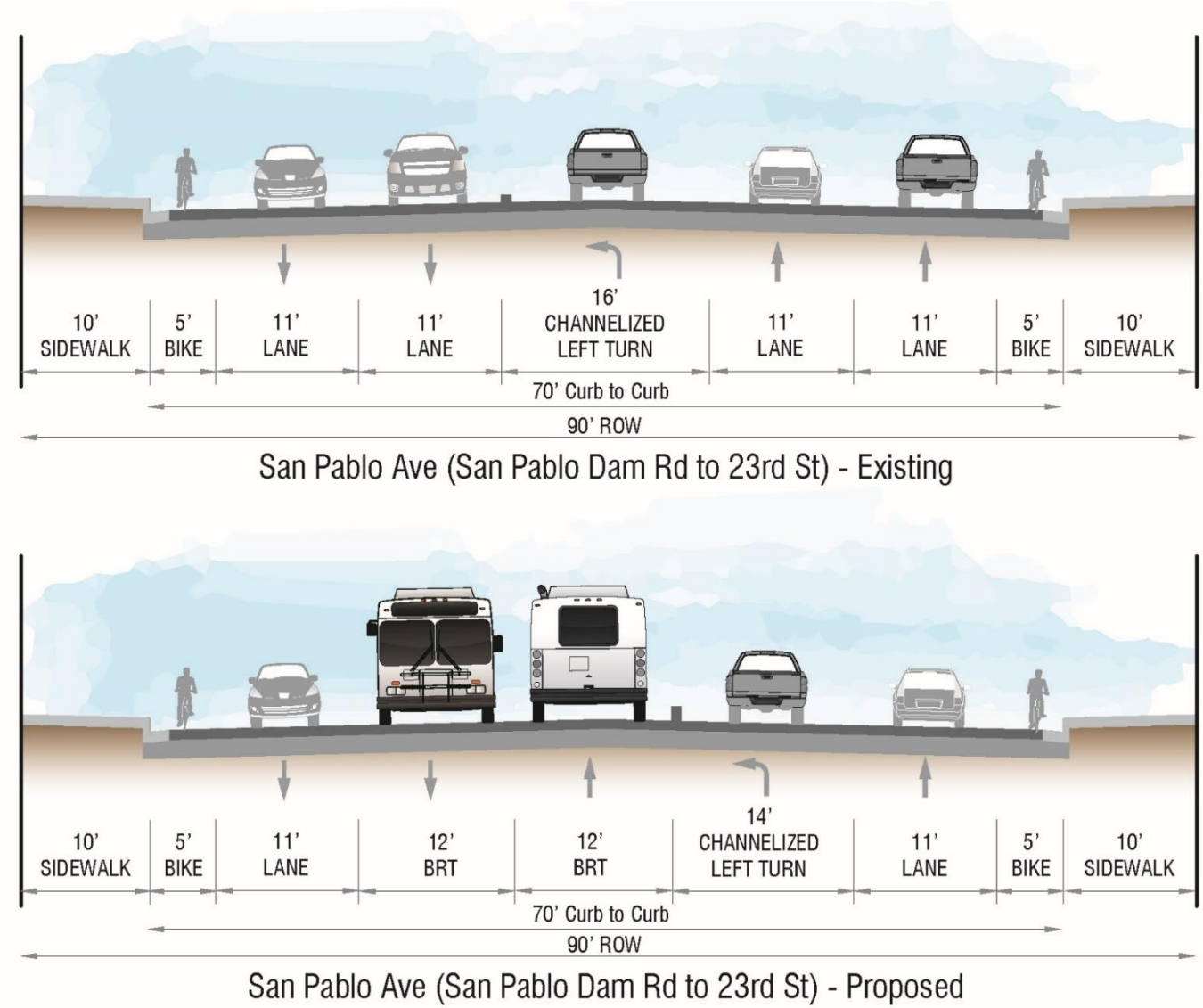

*Source: Kimley-Horn, 2015*

**Figure 3-10: San Pablo Avenue Cross-Section 1 between I-80 and San Pablo Dam Road**



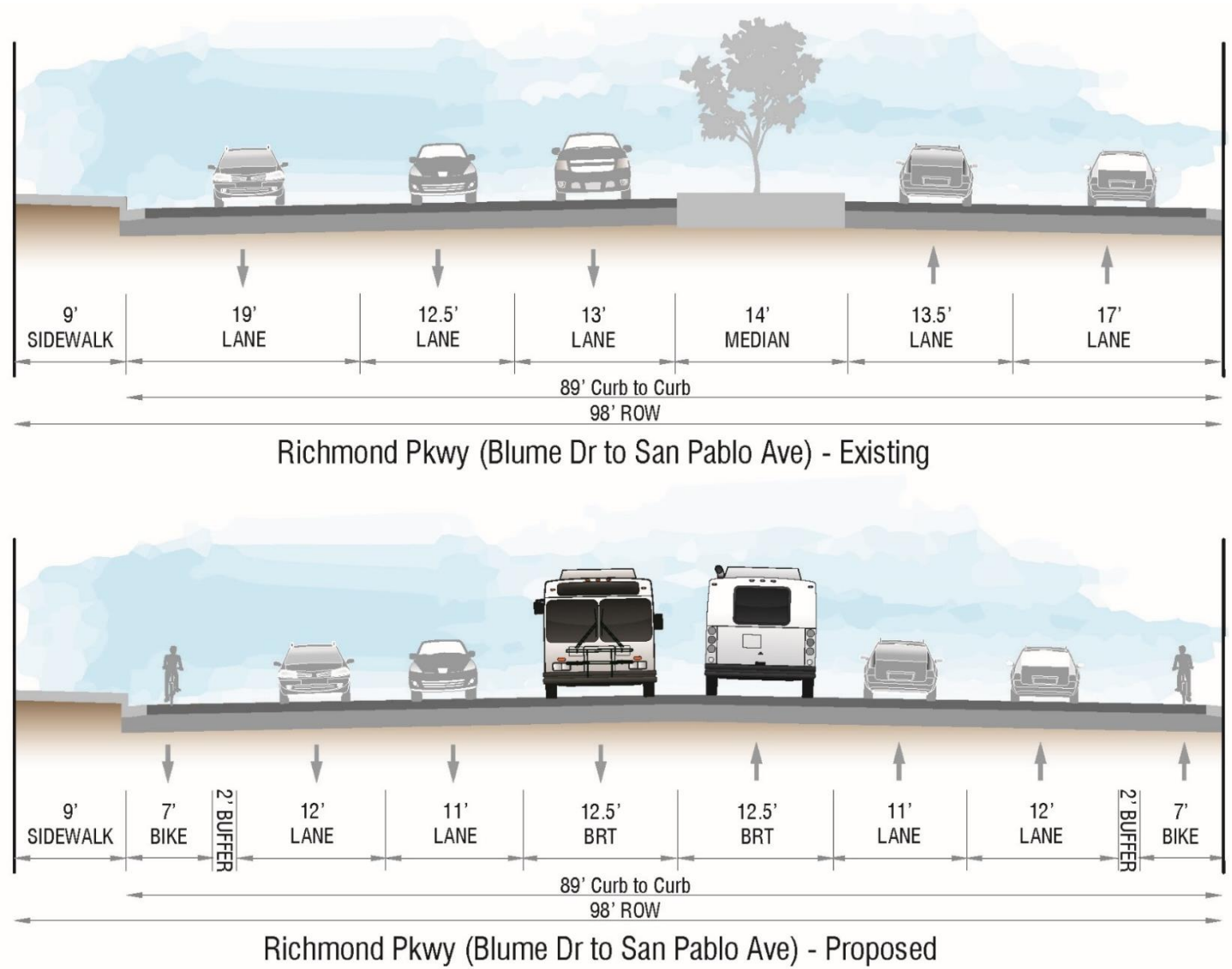

*Source: Kimley-Horn, 2015*

**Figure 3-11: San Pablo Avenue Cross-Section 2 between San Pablo Dam Road and 23rd Street**



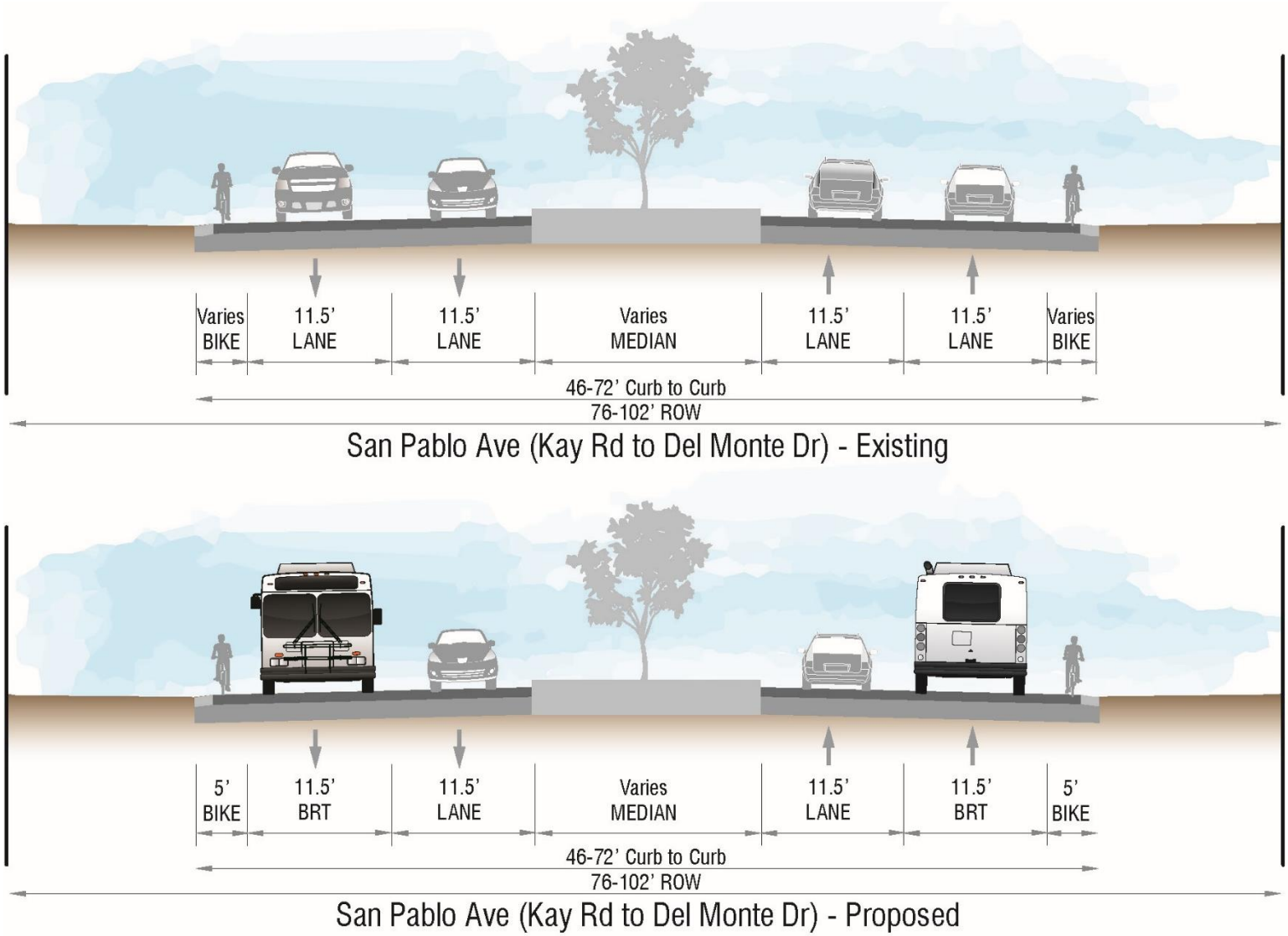

*Source: Kimley-Horn, 2015*

**Figure 3-12: Richmond Parkway Cross-Section 3**



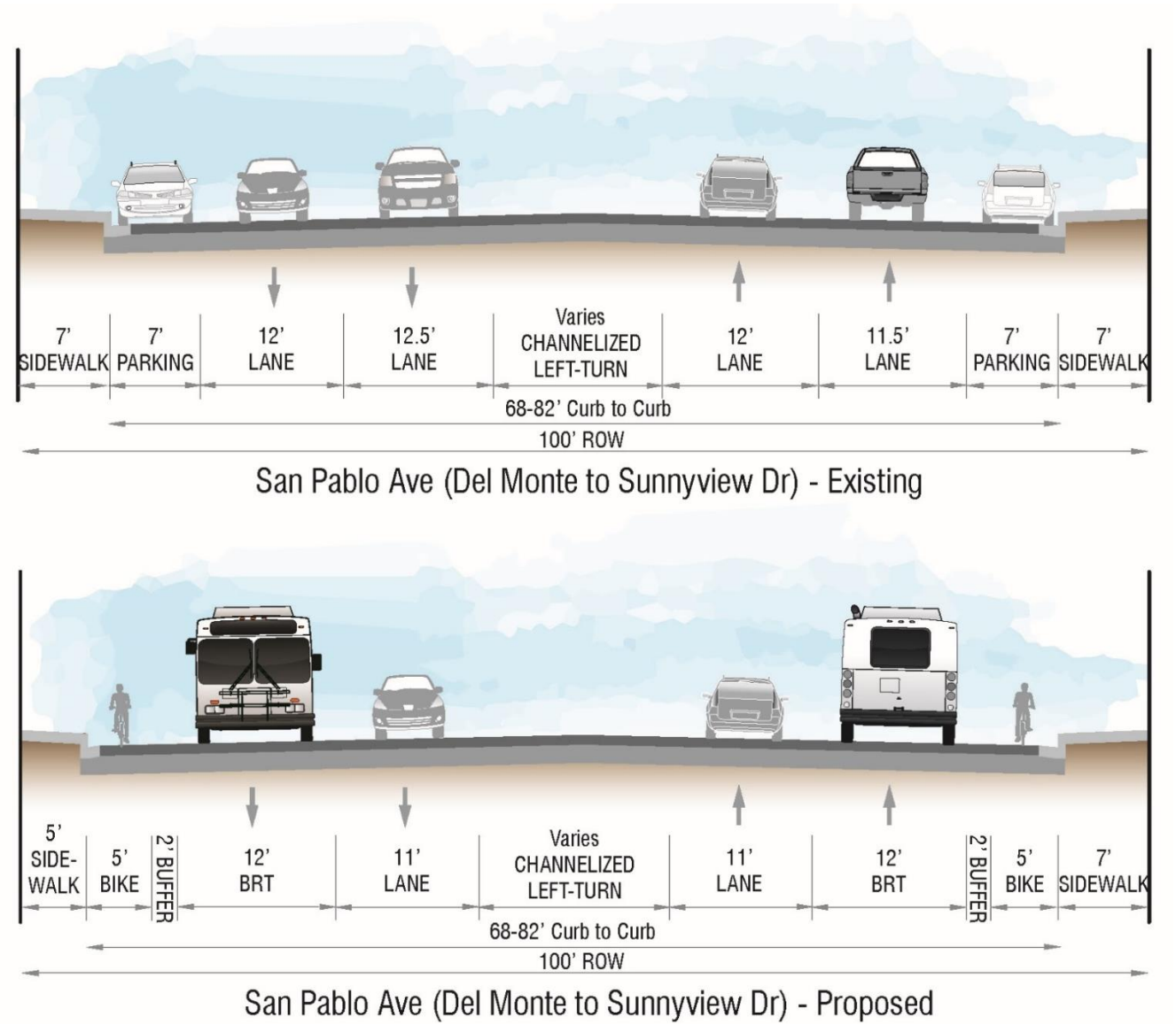

*Source: Kimley-Horn, 2015*

**Figure 3-13: San Pablo Avenue Cross-Section 4 between Richmond Parkway and Del Monte Drive**




*Source: Kimley-Horn, 2015*

**Figure 3-14: San Pablo Avenue Cross-Section 5 between Del Monte Drive and Appian Way**




*Source: Kimley-Horn, 2015*

Between the BART station and 6th Street through downtown Richmond, Macdonald Avenue reduces to a two-lane, low-speed corridor with numerous pedestrian crossings and left-turn lanes. The stretch between 6th Street and Richmond Parkway has three all-way stop controlled intersections. These intersections would need to be signalized to provide bus priority treatments to increase transit travel speed along the corridor. West of Downtown Richmond, Macdonald Avenue fronts housing that is generally low income.

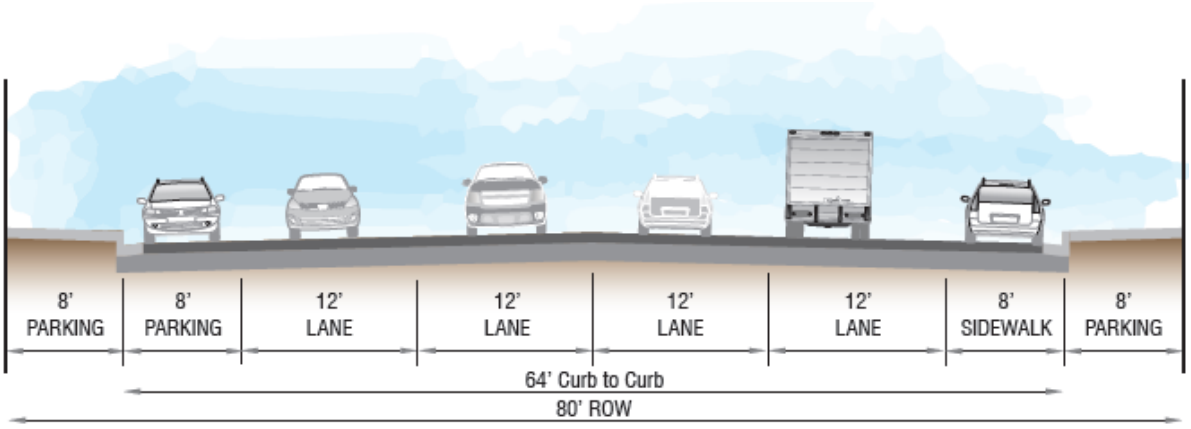
West of 6th Street the roadway widens again to four lanes, with no center turn lane. When the alignment enters Richmond Parkway, traffic volumes increase, but are generally easily accommodated by the four-lane, divided roadway. Richmond Parkway is a higher speed roadway without fronting land uses. The route continues south on Richmond Parkway, which is a lower speed roadway with fronting commercial and lower travel speeds, to its terminus at Cutting Boulevard. The service enters Point Richmond on Cutting Boulevard and transitions to South Garrard Boulevard, West Richmond Avenue, and Railroad Avenue to its western terminus at the Tewksbury Turnaround. **Figure 3-9** also shows the study team's preliminary assessment of where dedicated BRT lanes in a center guideway may be feasible along Macdonald Avenue and where BRT buses would preferably operate in mixed-flow traffic lanes, west of the Richmond BART Station. Representative cross-sections for Macdonald Avenue, east of the Richmond BART Station and including a median station option, are shown in **Figure 3-15**.

## Stations

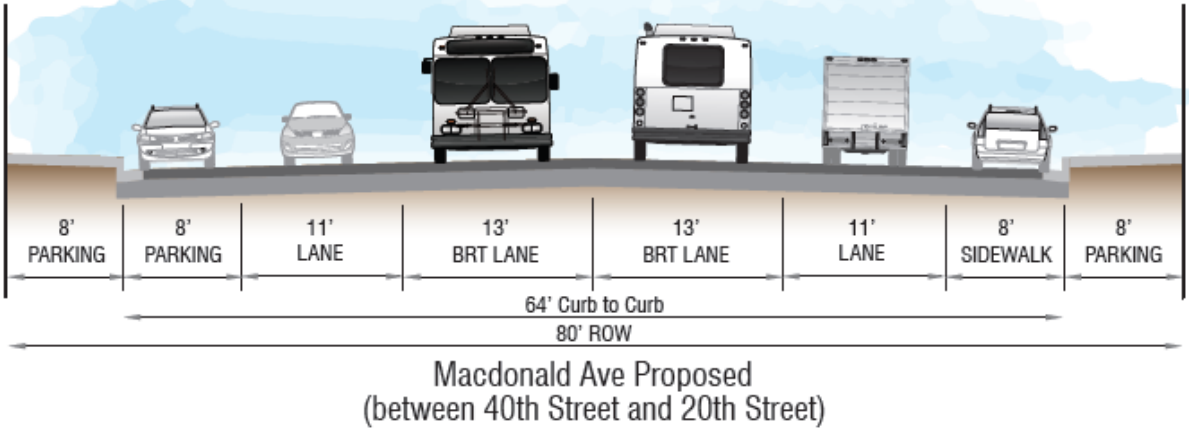
BRT stations on both branches of service would be located to serve major activity centers and key transfer locations between bus lines in West County. Station spacing could follow two strategies. Wide spacing of one-third to one-half mile minimizes transit stops and maintains a high travel speed. This wider station spacing would, however, likely require an overlay of local service with more frequent stops to facilitate access to transit. Narrower station spacing offers a higher level of access to the BRT service and therefore reduces or eliminates the need for a local service overlay. For AC Transit's East Bay BRT project, stations will range from one-quarter to one-third mile apart to allow BRT service only to operate along the designated route.

In median-running segments, stations would also be in the median. They could be on the outside or between the BRT lanes. Removal of parking for a limited length or use of turn lanes would be required to accommodate the stations for the median-running segments. Locating the station between the BRT lanes would require less right-of-way, but would require that buses have driver-side doors to accommodate boarding and alighting on either side of the bus. With side-running BRT, buses would operate in the outside lane against the curb, and stations would be constructed as extensions of the curb. If space does not permit and sidewalk width is adequate, stops would be integrated into the sidewalk. These specific design details would be determined in future studies.

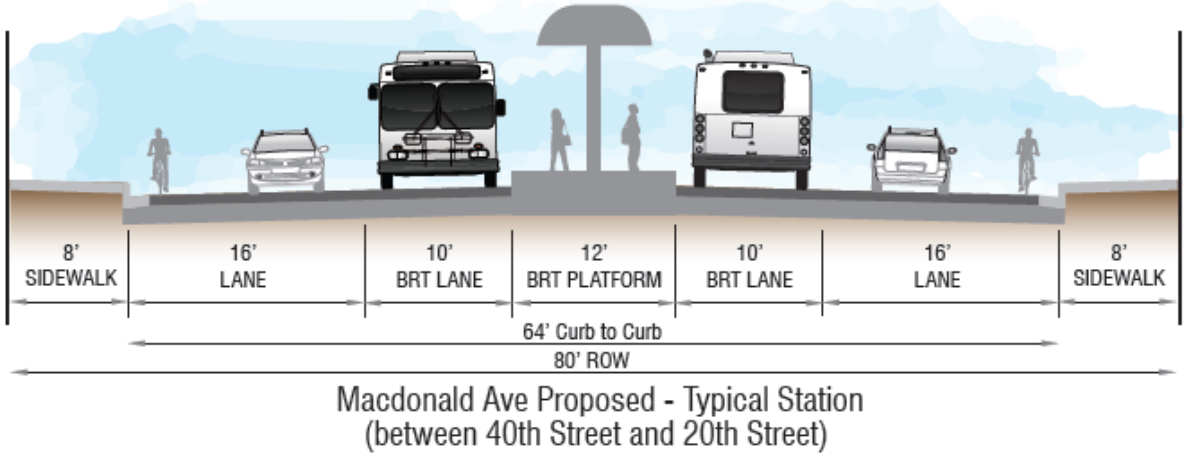
**Figure 3-15: Macdonald Avenue Cross-sections between 40th Street and 20th Street**




Macdonald Ave Existing
(between 40th Street and 20th Street)




Macdonald Ave Proposed
(between 40th Street and 20th Street)




Macdonald Ave Proposed - Typical Station
(between 40th Street and 20th Street)

*Source: Kimley-Horn, 2015*

### *Stations on the North Branch along San Pablo Avenue, including San Pablo Avenue in Contra Costa County*

Key station locations along the San Pablo Avenue corridor within the Study Area would include:

- El Cerrito Plaza BART Station
- El Cerrito del Norte BART Station
- San Pablo Avenue at I-80 undercrossing
- Contra Costa College Transit Center
- Hilltop Mall Transit Center
- Richmond Parkway Transit Center
- Downtown Pinole, and
- Hercules Transit Center.

### *Stations on the West Branch along Macdonald Avenue*

Key station locations along the Macdonald Avenue corridor (after BRT diverges from San Pablo Avenue) would include:

- Richmond Civic Center
- Richmond BART Station
- Downtown Richmond
- Point Richmond, and
- Tewksbury Turnaround.

Other stations in both corridors would be located based on the minimum spacing requirement and available right-of-way. Potential station locations are listed on **Figure 3-7**.

Stations and BRT facilities south of El Cerrito del Norte BART are not described as part of the San Pablo Avenue/Macdonald Avenue BRT Alternative. Improvements necessary to integrate the West County BRT segment with the rest of the San Pablo Avenue alignment to Downtown Oakland would be the responsibility of AC Transit in coordination with WCCTAC and corridor cities in the north and of other agencies, including AC Transit, corridor cities and Alameda County Transportation Commission (Alameda CTC), in the south. As this alternative is refined, the focus would be on a BRT project within the West County Study Area, coordinating with the implementation strategy for the southern segment.

## Potential for Intermodal Connectivity

The San Pablo Avenue/Macdonald Avenue BRT Alternative would provide connections to other bus services at the major transfer centers at Contra Costa College, Hilltop Mall, Richmond Parkway, and Hercules Transit Center on the San Pablo Avenue branch and to Richmond BART

and the Tewksbury Turnaround on the Macdonald Avenue branch. These facilities provide connections to nearly all AC Transit and WestCAT local bus services that operate within Contra Costa County.

Connections to BART, which provides access to major employment centers in Alameda County and San Francisco, would be provided at the Richmond, El Cerrito del Norte, and El Cerrito Plaza BART stations. Connection to Golden Gate Transit service to and from Marin County would be provided at the El Cerrito del Norte and Richmond BART stations, for the Macdonald Avenue corridor only, the Tewksbury Turnaround. The service would provide direct connections to employment centers in Downtown Oakland and connections to inter-regional rail service, Capitol Corridor and Amtrak, at Jack London Square in Downtown Oakland.

## Phasing of Improvements

Depending upon funding availability and ridership demand, the BRT improvements along the San Pablo Avenue segment could be phased, in terms of the level of transit priority treatments or length of corridor investment. BRT can operate in mixed flow for a portion of a corridor and transition to exclusive lanes as demand develops and land use evolves. Alternatively, an initial operating segment could be implemented between downtown Oakland and the Richmond Parkway Transit Center (consistent with the draft recommendations in AC Transit's Major Corridors Study), with an ultimate extension into Hercules when demand increases and justifies high frequency service to the Hercules Transit Center at Willow Avenue. In the near to mid-term, it is anticipated that the highest ridership would occur south of the Richmond Parkway Transit Center, although continued development and land use intensification in Hercules and along the San Pablo Avenue Corridor north of Richmond Parkway will make that segment more viable for the service frequencies typically associated with a BRT-type service.

## Constraints

The proposed San Pablo Avenue/Macdonald Avenue alignment includes travel along a heavily congested San Pablo Avenue corridor, which is served by AC Transit south of Robert H. Miller Drive and WestCAT between Rumrill Boulevard and 7th Street in Rodeo. Because the identified corridor traverses service areas for both agencies, an agreement for funding and providing service along the entire corridor would be required. Major congestion points, including around the BART stations, the I-80 interchange, and the San Pablo Civic Center, result in significant delays and low travel speeds for current transit service. Dedicated transit-only lanes could be pursued, but may be difficult to implement in these segments due to high traffic volumes, numerous turning movements, and heavy on-street parking demand. Commercial uses fronting directly on this corridor will limit opportunities to widen the street curb-to-curb for additional transit amenities.

The Macdonald Avenue corridor includes downtown Richmond. Macdonald Avenue in this area was recently modified to improve walkability, resulting in the reduction of travel lanes to one in each direction and the addition of angled parking with several pedestrian crossings. As this corridor is a single-lane in each direction, buses would be required to operate in mixed flow conditions with low travel speeds. This would increase transit travel time.

Class III bike lanes are designated along segments of the San Pablo/Macdonald Avenue corridor and could be impacted by station and transitway improvements.

Implementation of BRT improvements along the San Pablo and Macdonald Avenue corridors would have an impact on existing traffic flows and the availability of on-street parking. It would also need to be coordinated with the improvements proposed in AC Transit's Major Corridors Study. Additional analysis would need to be undertaken in the project development phase to evaluate the benefits and the impacts and to determine how best to integrate the two projects.

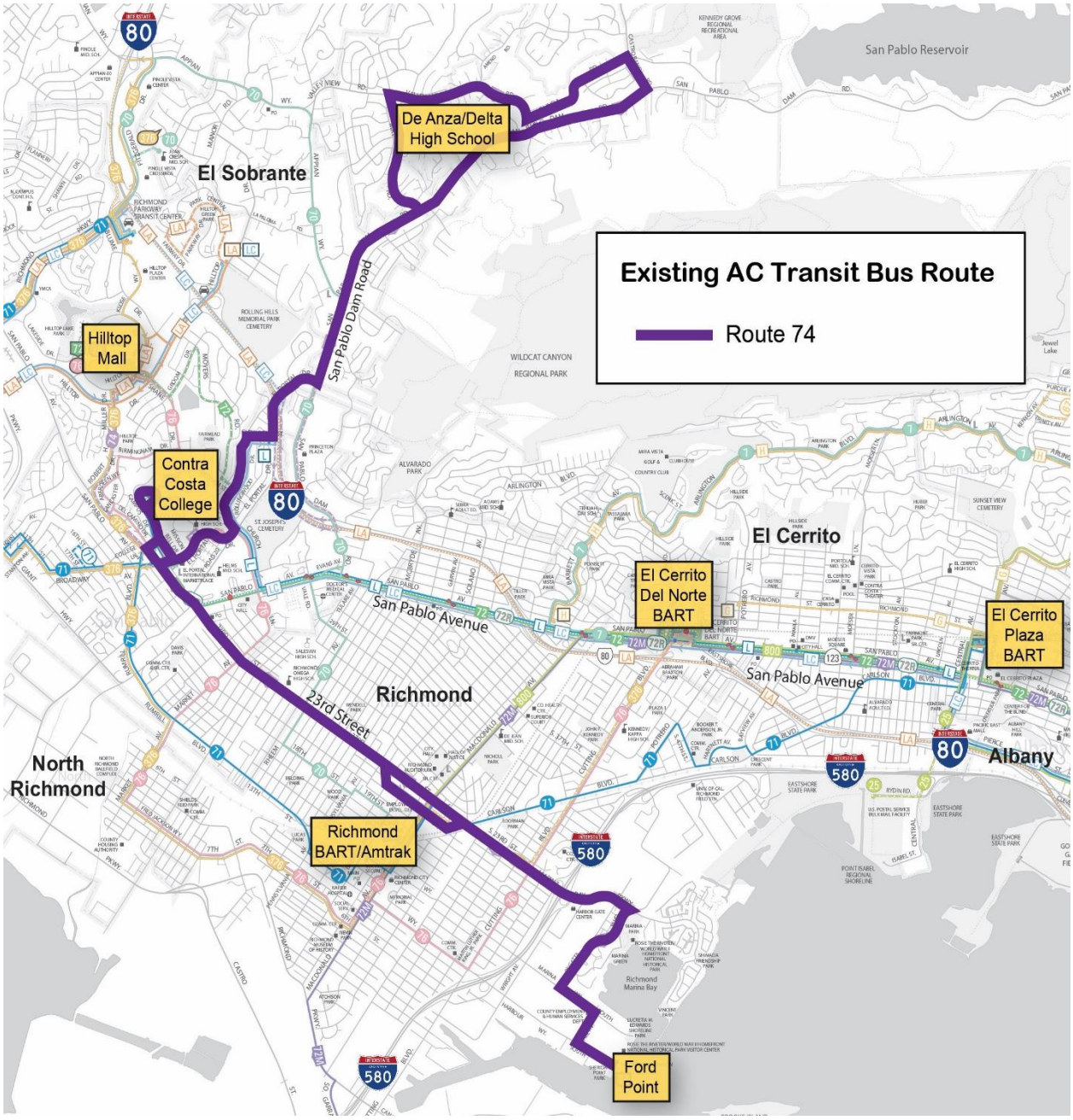
### 3.3.4 Alternative 3—23rd Street BRT

#### Markets Served

The 23rd Street BRT alternative would follow AC Transit Route 74 from the location of the future Richmond Ferry Service at the Ford Plant through the Richmond Marina Bay district via Regatta Boulevard, proceed north along 23rd Street to San Pablo Avenue and would then be extended to Hercules along a San Pablo Avenue route, similar to Alternative 2. The existing Route 74 is shown in **Figure 3-16**.

AC Transit Route 74 currently provides service along 23rd Street between the Richmond waterfront and Contra Costa College. The proposed 23rd Street BRT Alternative would generally follow its alignment and include service enhancements and roadway, transit signal and other capital improvements that would increase transit capacity, bus travel speeds, capacity, and transit desirability along this segment. The service would also be extended north of Contra Costa College to Hercules, tying together the south and north portions of West County and traversing both the AC Transit and the WestCAT service areas. It would provide a high-capacity transit connection for intra-county north-south trips and critical intermodal connections to the Richmond BART and Amtrak/Capitol Corridor stations in Downtown Richmond and to the planned Richmond Ferry Terminal at Ford Point in the Marina Bay/Richmond Harbor districts.

**Figure 3-16: AC Transit Route 74**




*Source: AC Transit, 2015*

The 23rd Street BRT Alternative would, similar to San Pablo Avenue BRT, provide a strong north-south transit spine in a vibrant corridor of varying land uses: regional retail and campus-style commercial/office development in the Hilltop Mall area; the Study Area's major higher education institution at Contra Costa College; neighborhood serving businesses in central Richmond; and dynamically growing residential, commercial and retail uses in the Marina Bay/Richmond Harbor districts in south Richmond. The southern terminus at the Richmond Ferry Terminal, scheduled to open in 2018, is an area with considerable potential for redevelopment. Central Richmond neighborhoods with high transit dependency associated with lower household income would particularly benefit from faster, more reliable transit service to other uses along the corridor.

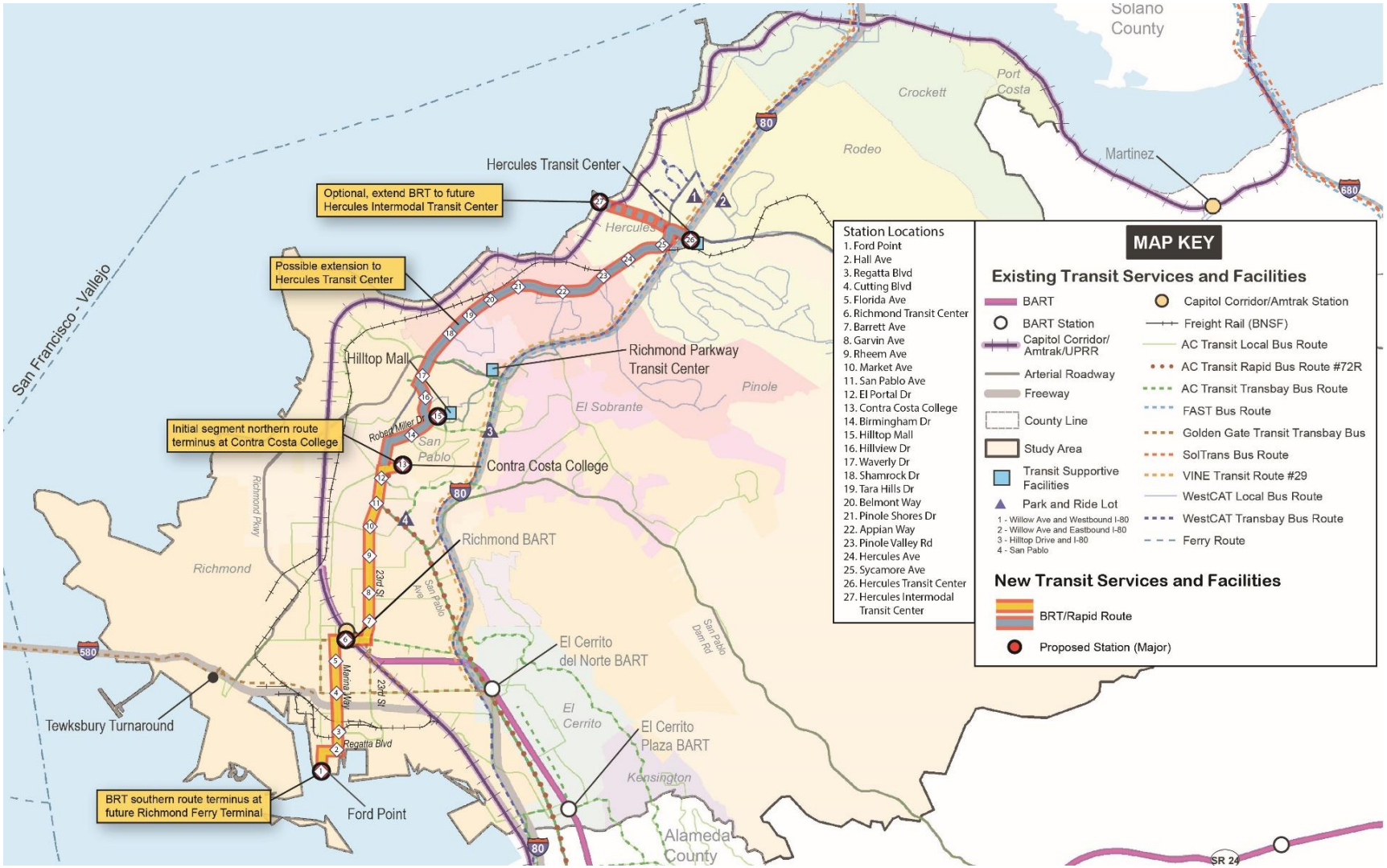
## Alternative Description

The proposed alignment for 23rd Street BRT (Alternative 3) is shown in **Figure 3-17** and would extend from the new Richmond Ferry Terminal at Ford Point to Hercules. Depending upon funding availability and demand, it could be implemented in phases. A logical first phase would be from the Richmond Ferry Terminal to the Contra Costa College Transit Center or Hilltop Mall. A second phase expansion of BRT improvements could continue north, through downtown Pinole and Hercules, terminating at the Hercules Transit Center at Willow Avenue and SR 4. Similar to the San Pablo Avenue branch line for Alternative 2, service could be extended west along John Muir Parkway to the proposed Hercules Intermodal Transit Center located on San Pablo Bay.

The 23rd Street BRT service could include all or some of the following enhancements: median and curbside stations; level boarding, off-board fare collection, traffic signal priority, wider stop spacing, real-time arrival information, enhanced stations, and dedicated travel lanes where feasible. Studies would need to be performed for traffic, right-of-way, parking, and environmental impacts in general to establish the preferred configuration of BRT facilities throughout the corridor.

The proposed alignment would begin in the south at the Richmond Ferry Terminal, which is scheduled to become operational by 2018. From the ferry terminal, the BRT would proceed north along Harbor Way to Hall Avenue, then east along Regatta Boulevard to Marina Bay Parkway. The parkway is a major north-south arterial, through the Richmond Marina and Harbor districts, and after crossing I-580, its northern limit, it becomes 23rd Street. The BRT alignment would follow Marina Bay Parkway and 23rd Street north to Macdonald Avenue, which proceeding west, would provide a direct connection to the Richmond BART station. BRT buses would follow Macdonald Avenue eastbound to the BART station and then return to Macdonald Avenue eastbound to 23rd Street. The alignment would turn north on 23rd Street and continue to San Pablo Avenue.

**Figure 3-17: Alternative 3—23rd Street BRT**




*Source: Kimley-Horn, 2015*

The alignment would turn left from 23rd Street onto San Pablo Avenue and into the Contra Costa College Transit Center via El Portal Drive and Campus Drive. Leaving the Contra Costa College Transit Center, buses would return to San Pablo Avenue and travel north to Robert H. Miller Drive, cross Hilltop Drive, and access the Hilltop Transit Center at Hilltop Mall. Buses would leave the Hilltop Transit Center following Robert H. Miller Drive but turn right onto Hilltop Drive to proceed north and connect again with San Pablo Avenue. This alignment would leave a service gap on San Pablo Avenue between the Robert H. Miller Drive intersection on the south and the Hilltop Drive intersection on the north. However, in the section of San Pablo Avenue between these two intersections there are no direct crossing roadways or connecting pedestrian paths. Adjacent land uses generally face away from San Pablo Avenue and are not accessible from San Pablo Avenue so the demand for transit stops in this stretch of San Pablo Avenue would not be great.

The BRT alignment north of Richmond Parkway along San Pablo Avenue would be the same as proposed for BRT on the San Pablo Avenue branch of the San Pablo/Macdonald Avenue BRT Alternative. It is also the alignment for WestCAT Route C-3, shown in **Figure 3-18**. The BRT service would follow San Pablo Avenue through downtown Pinole and Hercules to Sycamore Avenue for access to the Hercules Transit Center on Willow Avenue. The preferred northern terminus of the 23rd Street BRT Alternative would be the Hercules Transit Center, but an optional connection to the Hercules Intermodal Transit Center along an improved John Muir Parkway would be evaluated if this alternative is chosen for further study.

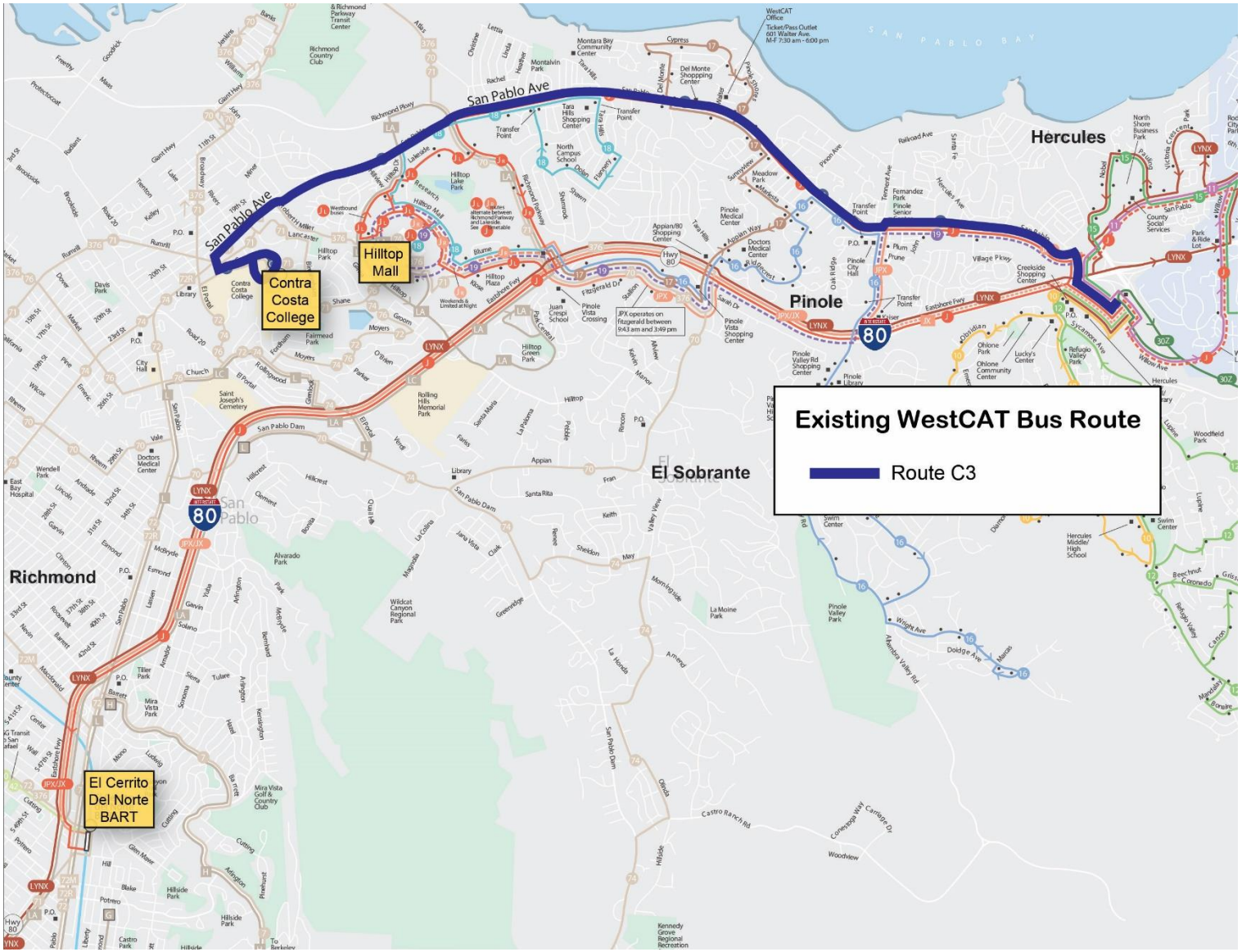
### Vehicles

BRT service is expected to generate higher ridership in the corridor by providing more reliable service with a broader service span and higher service frequencies. Use of larger buses (e.g., articulated vehicles) would be recommended to provide adequate capacity to accommodate new riders.

### Service Characteristics

For the initial definition and screening of transit improvement alternatives, 23rd Street BRT service would be assumed to operate at 10-minute peak-period frequencies between the ferry terminal and Contra Costa College or the Richmond Parkway Transit Center and at a minimum of 15-minute or better frequencies when continuing to Hercules. This would be a substantial

**Figure 3-18: WestCAT Route C-3**




*Source: WestCAT, 2015*

increase compared to existing Route 74 service along 23rd Street, which is every 30 minutes all day. The higher peak frequencies appear justified based on growing travel demand in the corridor due to new development in south Richmond and the vibrant business activity in central Richmond. Midday service frequencies would be every 15 minutes. Weekend service would be offered in the corridor as it is today, but at somewhat lower frequencies than on weekdays to align with expected demand.

Should the alternative be advanced for further study, demand forecasts using the Contra Costa Countywide Model would be performed, and would help refine service and phasing plans.

### Transitway Improvements

Roadway segments proposed for BRT service from the Richmond Ferry Terminal to Contra Costa College vary considerably in their characteristics. **Figure 3-19** depicts the different right-of-way widths along the 23rd Street BRT alignment, as well as the average daily traffic.

Substantial segments of the alignment are four through lanes (two lanes each direction) with turn bays at signalized intersections. In southern Richmond, Marina Way is a two-lane roadway between Cutting Boulevard and just south of Macdonald Avenue. In central Richmond, 23rd Street operates as a one-way couplet with 22nd Street. 23rd Street is three lanes in the northbound direction and 22nd is two lanes in the southbound direction. The BRT corridor includes only 23rd Street, which is the more commercially-oriented street of the couplet. Two-way bus service could be provided along 23rd Street, which would require converting one of the northbound lanes to a southbound bus-only lane along the west curb of the roadway, though this is not essential to the success of this alternative. Under this proposal, buses would not travel along 22nd Street. The ultimate treatment in this section, should it be advanced for further study, would need to be consistent with the City of Richmond plans.

At Brooks Road, 23rd Street again becomes a four-lane, bi-directional arterial, continuing north to Rheem Avenue, where it transitions to two lanes, one each direction, with a center turn lane. This roadway configuration continues to San Pablo Avenue, which is four lanes, two each direction. The corridor to the north, along San Pablo Avenue, Robert H. Miller Drive, Hilltop Drive, San Pablo Avenue and Sycamore Avenue is predominantly four-lane arterials.

At this stage of initial planning, dedicated BRT lanes are proposed for evaluation on the corridor segment from the Richmond BART Station through central Richmond, including 23rd Street, and then again north of Hilltop Mall through northern San Pablo, Pinole, and Hercules. The proposed BRT preliminary configuration is shown in **Figure 3-20**.

Dedicated BRT lanes would improve bus speeds and reliability where traffic conflicts currently often degrade bus operations. The roadway section is sufficiently wide to support BRT, a mixed-flow traffic lane in each direction, exclusive turn lanes, and possibly bike and/or parking lanes. The City of Richmond plans call for a Class III bike route from Ford Point to the Richmond BART Station along Marina Way, along Macdonald Avenue to 23rd Street, and along 23rd Street from Macdonald Avenue to just south of San Pablo Avenue. Representative roadway cross-sections on 23rd Street and on San Pablo Avenue for the segments where dedicated BRT lanes are proposed are shown in **Figure 3-21** and **Figure 3-22**.

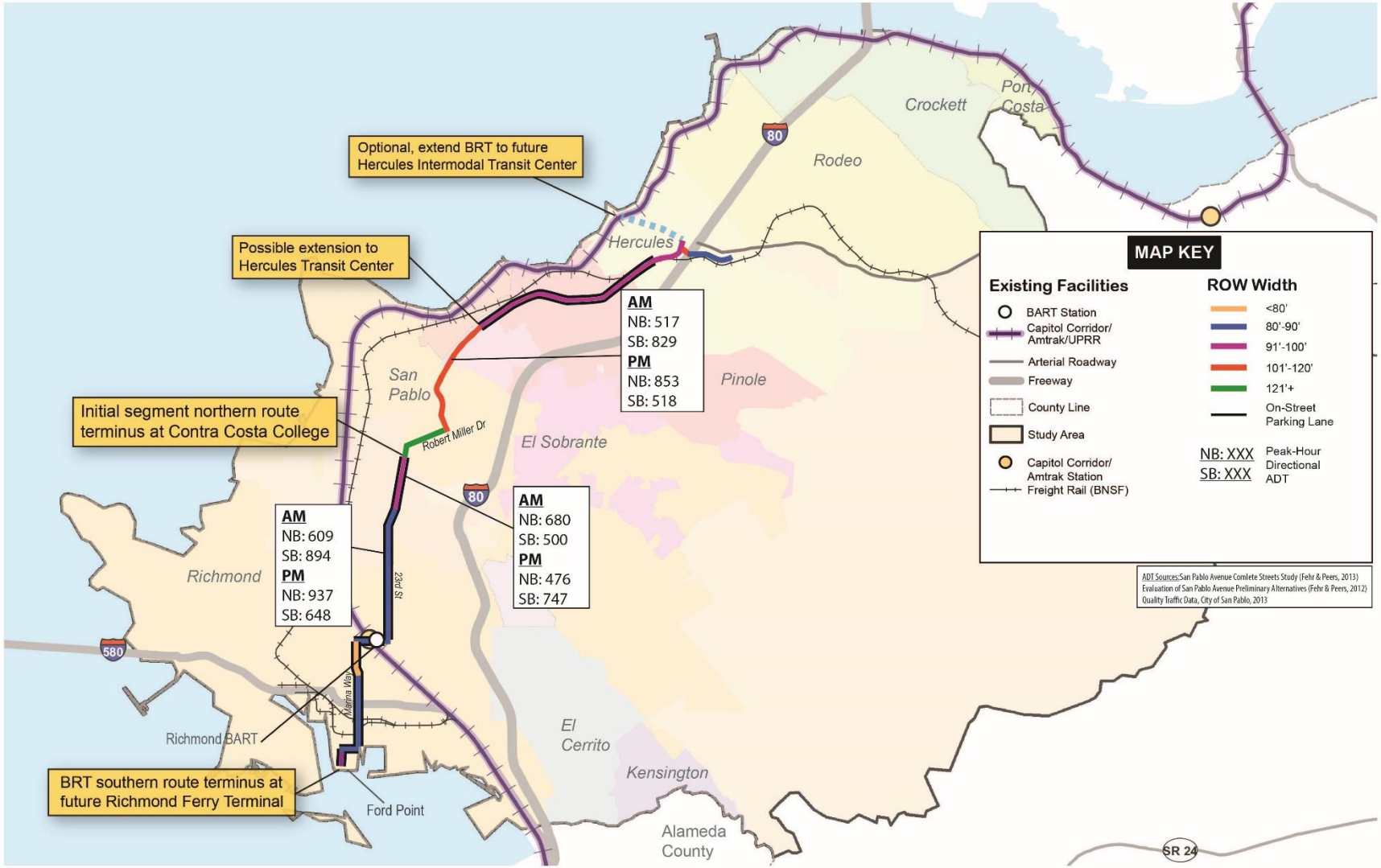
Further detailed traffic and engineering studies would be required to determine the feasibility of dedicated BRT lanes north of Brooks Avenue. From a traffic volumes and bus operations perspective, however, dedicated lanes do not appear warranted in the corridor segments south of Macdonald Avenue and north of Rheem Avenue. The central portion of the 23rd Street corridor is the most congested due to the combination of business and residential generated traffic. However, removing a mixed-flow lane for conversion to a bus-only lane appears feasible based on traffic patterns, volumes, and street capacity.

Traffic diversion to other streets would need to be analyzed when studying the operation of the 23rd Street BRT Alternative, should it be advanced as a preferred transit investment alternative for possible implementation. The West Contra Costa High Capacity Transit Study does not include resources for detailed traffic operations impact analysis. Such analysis is typically performed during engineering design and environmental review of a proposed project. However, because traffic diversion that degrades conditions on parallel roadways and the general character of residential neighborhoods is to be avoided, it is important to understand the potential effects of dedicated BRT lanes on network traffic early in project planning. Therefore traffic operations studies should be performed for a BRT alternative that has the potential to significantly affect existing and future traffic patterns prior to, not after, beginning detailed project design and formal environmental review.

### Stations

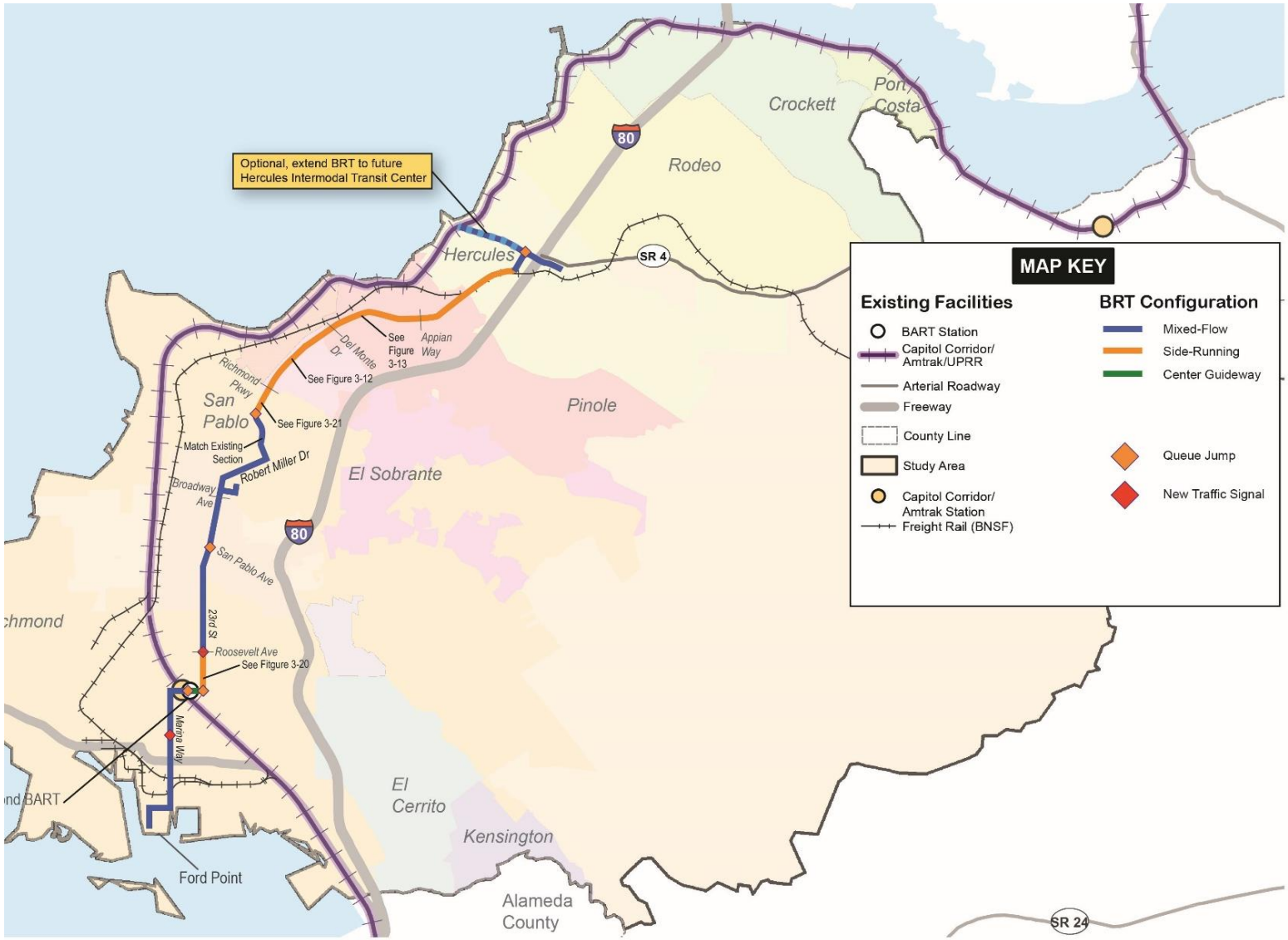
Stations would be located at approximately one-quarter to one-third mile spacing if BRT-only service is proposed in the corridor. One-half mile station spacing, such as on the existing 72R (Rapid), would require an overlay of local service with approximately one-quarter mile spacing of bus stops to maintain transit access. For this study, BRT-only service is currently assumed for the corridor, and station spacing of one-quarter to one-third mile between stops will be also be assumed in the development of capital and operating costs. This is the concept AC Transit has implemented on the East Bay BRT project, which is 9.5 miles in length and includes 34 stations.

**Figure 3-19: 23rd Street Corridor Right-of-Way and Peak Hour Traffic**



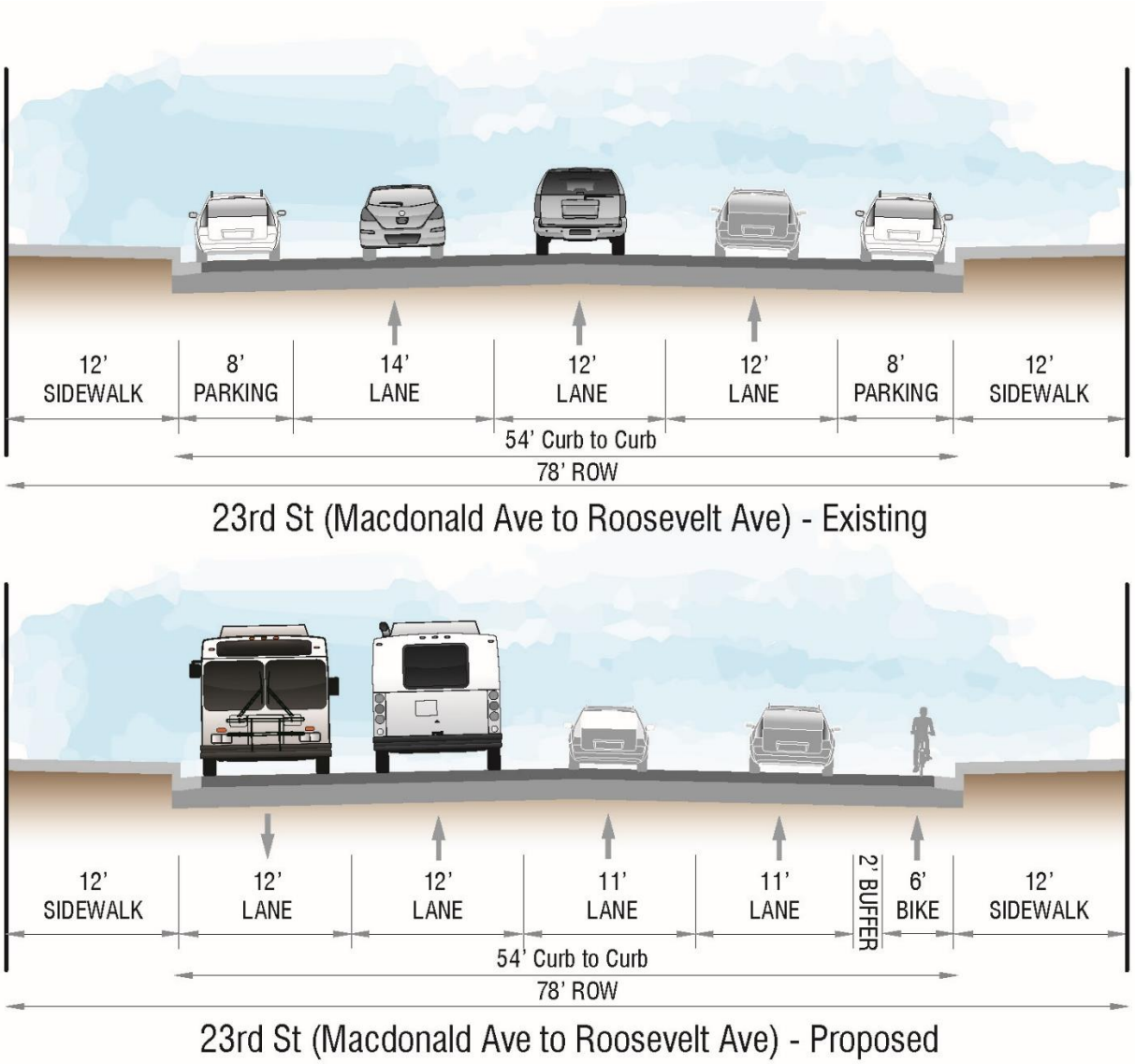

*Source: Kimley-Horn, 2015*

**Figure 3-20: BRT 23rd Avenue Preliminary BRT Configuration**



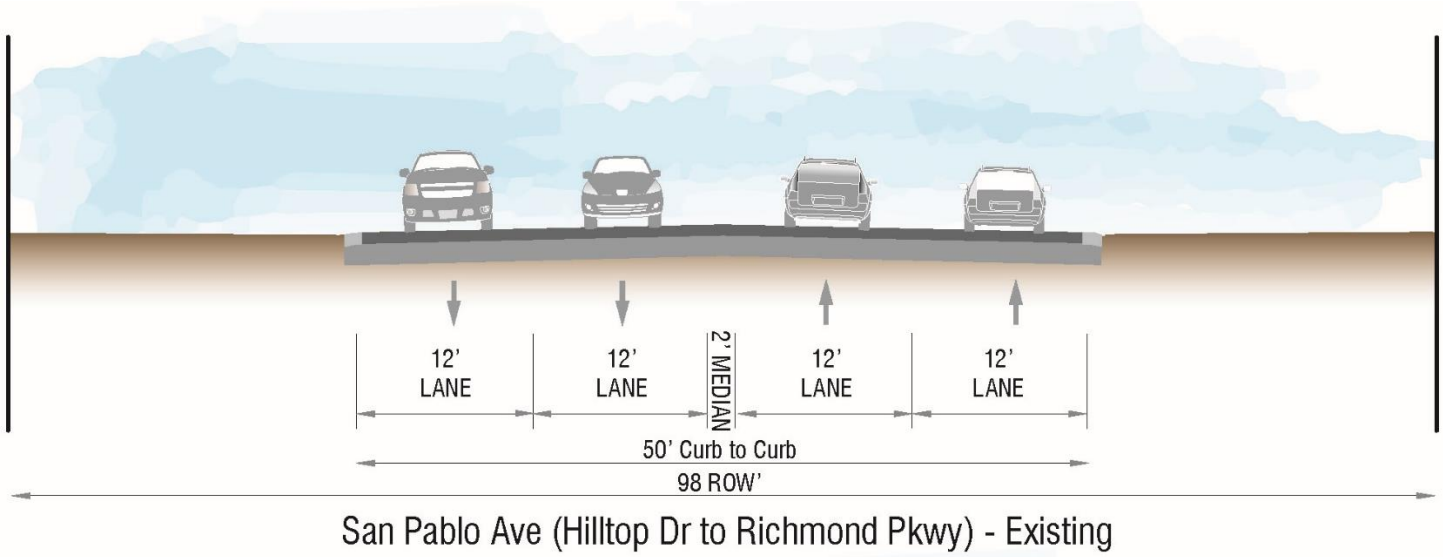

*Source: Kimley-Horn, 2015*

**Figure 3-21: 23rd Street Cross-sections between Macdonald and Roosevelt**




*Source: Kimley-Horn, 2015*

**Figure 3-22: Roadway Cross-section San Pablo Ave between Hilltop and Richmond Parkway**




*Source: Kimley-Horn, 2015*

Key station locations along the 23rd Street corridor to the Contra Costa Transit Center include, proceeding south to north:

- Richmond Ferry Terminal at Ford Point;
- Marina Way at Contra Costa County Probation and Employment offices;
- Marina Way at Martin Luther King Memorial Park;
- Richmond BART (on Macdonald Avenue);
- Alfreda Boulevard at Richmond High School; and
- San Pablo Avenue.

Key station locations for continuation of BRT service to Hercules include:

- Hilltop Mall Transit Center;
- Downtown Pinole; and
- Hercules Transit Center.

Proposed intermediate station locations are depicted on **Figure 3-17**. Station locations would be refined based on available right-of-way and subsequent traffic analysis. All stations would include enhanced passenger amenities and improved pedestrian access, the details to be established during design should the 23rd Street BRT Alternative be recommended for implementation.

Station types will also be determined in future studies. Curbside and median BRT station configurations are options under consideration. Examples are shown in **Figure 3-23**. For the purpose of preparing capital cost estimates and developing concept BRT operating plans for this study, assumptions will be made where each station type is possible. However, the final station types and locations are subject to revision based on future studies.

Where no dedicated traffic lanes are proposed and there is only one travel lane in each direction, evaluation must still be made of the effects on traffic of BRT buses stopping where curb extensions are recommended as a means of providing for level boarding and off-vehicle fare. The potential for incremental increases in delays from buses stopping in the travel lane versus partial lane obstruction at locations where bus bulbs do not exist would need to be evaluated.

**Figure 3-23: Examples of Curbside and Median BRT Stations**


*Source: Kimley-Horn, 2015.*

### Potential for Intermodal Connectivity

Potential intermodal connections along the 23rd Street BRT corridor include the Richmond Ferry Terminal, Richmond BART station, Contra Costa College, Hilltop Mall, and the Hercules Transit Center. The Hercules Intermodal Transit Center would be another connection for a service extension along John Muir Parkway. These locations all provide additional bus connections, with rail connections to the Capitol Corridor/Amtrak service and BART service provided at the Richmond BART Station. This alternative also provides new connections to the proposed Richmond Ferry Terminal.

## Phasing of Improvements

Depending upon funding availability and ridership demand, the BRT improvements along the corridor could be phased, in terms of the level of transit priority treatments or length of corridor investment. BRT can operate in mixed flow for a portion of a corridor and transition to exclusive lanes as demand develops and land use evolves. Alternatively, an initial operating segment could be implemented between the Ford Point Ferry Terminal and the Richmond Parkway Transit Center, with an ultimate extension into Hercules when demand increases and justifies high frequency service to the Hercules Transit Center at Willow Avenue. In the near- to mid-term, it is anticipated that the highest ridership would occur south of the Richmond Parkway Transit Center, although continued development and land use intensification in Hercules and along the San Pablo Avenue Corridor north of Richmond Parkway will make that segment more viable for the service frequencies typically associated with a BRT-type service.

### Constraints

The proposed 23rd Street BRT alignment includes travel along portions of the heavily congested San Pablo Avenue corridor and on 23rd Street through the heart of central Richmond. The corridor is served by AC Transit south of Robert H. Miller Drive and WestCAT between Rumrill Boulevard and 7th Street in Rodeo. Because the identified corridor traverses service areas for both agencies, an agreement for funding and providing service along the entire corridor would be required.

BRT improvements along existing urban arterials face increasing challenges the higher the level of BRT facilities proposed. While increasing the person-trip capacity on a corridor, dedicated bus lanes would reduce arterial capacity for autos and trucks. Their implementation may require the removal of curbside parking along the BRT arterials near stations and signalized intersections and possibly elsewhere. In districts with numerous small businesses fronting the BRT arterial, parking loss would be a major concern. Class III bike lanes are designated along segments along the 23rd Street corridor and could be impacted by station and transitway improvements.

## 3.4 Commuter Rail Alternatives

### 3.4.1 Recommendations from Prior and Other Current Studies

Among the HCT improvements under consideration in West County are two commuter rail alternatives, which would use existing rail tracks within the Study Area and include a potential extension of both alternatives to Oakland by constructing a third main track. The potential for use of the existing freight tracks for expansion of or introduction of new passenger service have been extensively studied over the past several years. These studies looked at the potential for expansion of existing inter-city service on the Union Pacific Railroad (UPRR), introduction of new commuter service on the Burlington Northern Santa Fe (BNSF) alignment, and introduction of DMU technology on either of these corridors.

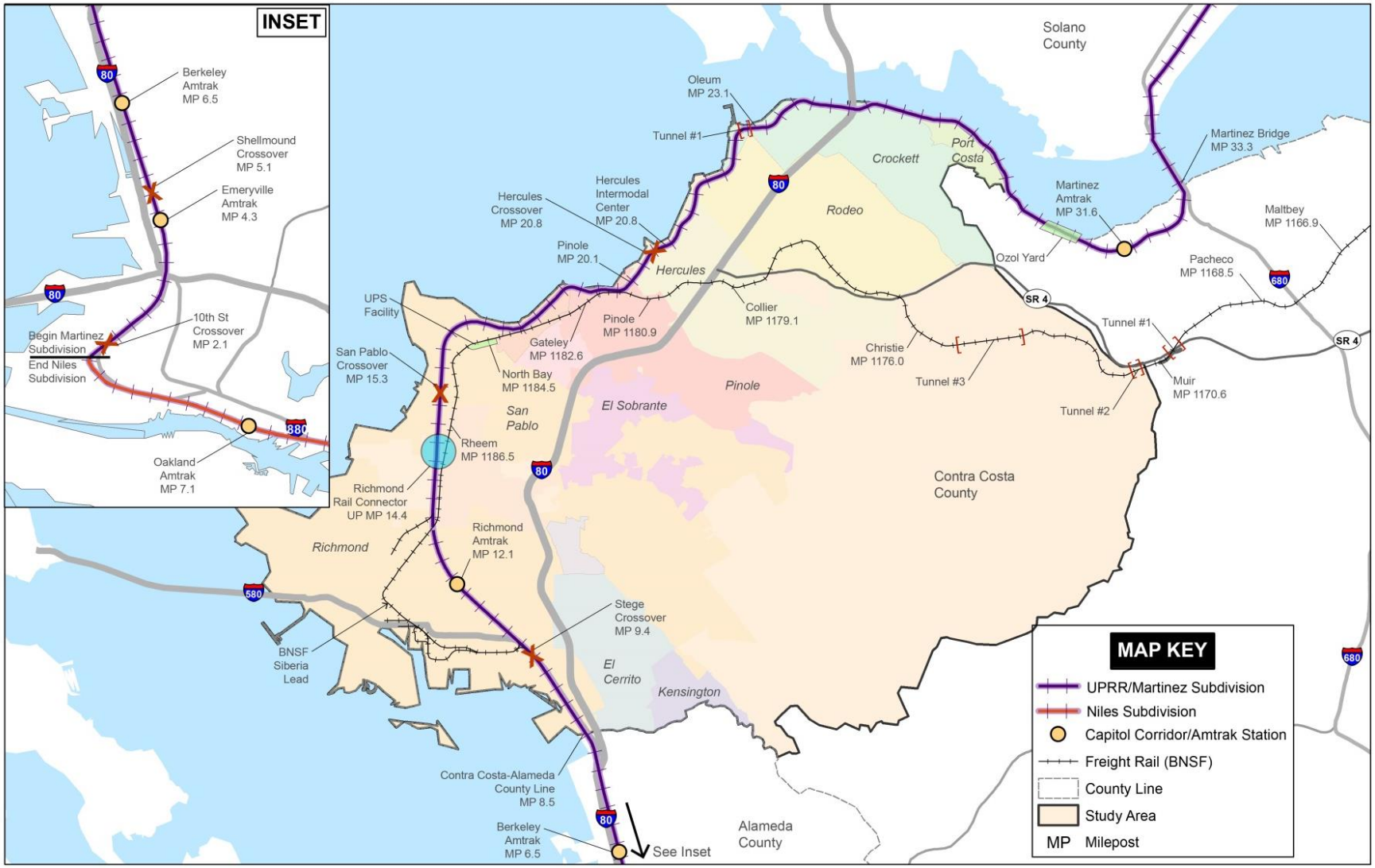
The consultant team working with WCCTAC staff have identified the most promising options for service expansion for each of these corridors for initial evaluation. While the UPRR has considerable constraints associated with expansion of use on this corridor, it is presented for comparative purposes because it provides the strongest link to the proposed Hercules Intermodal Transit Center and may offer short-term potential for transit improvements. The challenges for long-term investments in this corridor, which have been documented in other studies and in the Capitol Corridor Vision Plan, are summarized in this section.

### 3.4.2 Overview of Existing Commuter Rail Service

#### Existing Rail Service

The existing rail structure in the Study Area includes the UPRR Martinez Subdivision, which operates passenger and freight service along a coastal route between Martinez and San Pablo, transitioning to an inland route in Richmond, and the BNSF Stockton Subdivision, which operates a freight-only route between Martinez and Richmond. The existing rail lines are shown in **Figure 3-24**.

**Figure 3-24: Existing UPRR and BNSF Railroad Alignments**




*Source: RL Banks and Kimley-Horn, 2015*

### *Union Pacific Railroad*

The UPRR's Martinez Subdivision extends between milepost (MP) 2.2 in Oakland and MP 106.6 in Roseville. For purposes of this study, the focus of this analysis is on the segment between the Richmond Amtrak Station (MP 12.1) and the Martinez Amtrak Station (MP 31.6) on the Martinez Subdivision, a distance of 19.5 rail miles, with a potential extension to the Oakland Amtrak Station.

The existing rail corridor features a 100-foot wide right-of-way. There are two main line tracks in that right-of-way with a maximum authorized speed of 79 mph (Class 4) between Richmond and the Point Pinole Regional Park access road at MP 15.3. From Point Pinole, train speeds decrease to 40 mph, where they remain to Martinez, due to the curvature of the track that closely follows the shoreline of San Francisco Bay and the Carquinez Strait.

The proposed commuter rail alternatives would build upon the current passenger rail services operated by different entities. The three types of passenger rail services in California include:

- Amtrak long-distance passenger rail service, funded by Amtrak and serving both California and interstate travel markets;

- Inter-city passenger rail service, funded by the state but operated by Amtrak under contract, providing transportation between metropolitan and rural areas of California (Capitol Corridor and San Joaquin service); and

- Commuter rail service, funded by both state and local transportation funds. Commuter rail services are operated by local and regional agencies typically during morning and afternoon peak travel times and provide service within a metropolitan area or between adjacent regions.

Two Amtrak stations, one at Martinez and the other at Richmond, are located on the UPRR Martinez Subdivision. The Martinez station is located outside of the Study Area in Central Contra Costa County.

- **Martinez Station**: This station is located at MP 31.6 outside of the Study Area in Central Contra Costa County, is served by Amtrak's Coast Starlight and California Zephyr long distance trains as the well as state-supported San Joaquin and Capitol Corridor trains. Bus connections are available via Amtrak thruway bus to the North Coast Region of California. The station is also served by regional buses; Tri Delta Transit to/from the Pittsburg BART Station and by WestCAT to/from the Hercules Transit Center. The County Connection also provides local and regional bus services to/from Concord, Pleasant Hill and Walnut Creek.

- **Richmond Station**: This station is located at MP 12.1, is adjacent to the Richmond BART Station. The station is served by Amtrak's California Zephyr, San Joaquin and Capitol Corridor trains, AC Transit, BART, and Golden Gate Transit.

There is also a planned Intermodal Transportation Center in the City of Hercules at MP 21.1. It would be located halfway between the existing Richmond and Martinez Amtrak Stations. The City of Hercules is actively seeking funds to construct this facility. The plan also calls for a WestCAT bus station. Buses would provide feeder service between the surrounding communities of Pinole, Rodeo, El Sobrante, Crockett, Tara Hills and Richmond and the Intermodal Center.[13]

The total daily passenger train count on the Martinez Subdivision is currently 42 passenger trains per day. **Table 3-3** summarizes the weekday passenger train travel along the Martinez Subdivision.

**Table 3-3: UPRR Martinez Subdivision Weekday Passenger Trains**

| Train Type | Daily Frequency (one-way trips) |
|---|---|
| ***Amtrak Long Distance Passenger Service*** | |
| Coast Starlight (Los Angeles to Seattle) | 2 |
| California Zephyr (Oakland—Chicago) | 2 |
| ***State-Supported, Inter-city Passenger Rail Service*** | |
| San Joaquin (Oakland—Bakersfield) | 8 |
| Capitol Corridor (Oakland—Sacramento) | 30 |
| ***Total Inter-city Passenger Trips*** | ***42**** |

*Source: RL Banks, 2015.*
** "Capitol Corridor Inter-city Passenger Rail Service Business Plan Update FY 2015-16 to FY 2016-17," April 2015.*

### Amtrak Long-Distance Passenger Rail Service

Two daily, Amtrak long-distance trains, the Coast Starlight and the California Zephyr, operate in the Study Area. The Coast Starlight daily round trip is the second-most popular long-distance train in the Amtrak system. During 2014, the Coast Starlight carried 459,450 passengers along this route. The route provides daily round-trip service between Los Angeles and Seattle via Oakland, Sacramento and Portland. The California Zephyr provides daily round-trip service between the Bay Area and Chicago via Emeryville, Sacramento, Reno and Denver, often carrying heavy passenger loads between the Bay Area and Reno. During 2014, the California Zephyr carried approximately 366,560 passengers along this route.[14]

[13] "Intermodal Transit Center", City of Hercules website
[14] Source : Amtrak

**Inter-city Passenger Rail Service**

Two inter-city passenger rail services operate in the Study Area: the San Joaquin route and the Capitol Corridor route. These state-funded trains, which operate solely within California, are designed to supplement the "national system" service funded entirely by Amtrak.

- **San Joaquin Route.** This route extends 316 rail miles between Oakland and Bakersfield. Effective July 1, 2015, the San Joaquin Joint Powers Agency (SJJPA) became responsible for the management of the San Joaquin trains and is in the process of negotiating a new contract with Amtrak to operate four daily round trips between the San Francisco Bay Area through the San Joaquin Valley and Bakersfield with bus connections to/from Southern California. The SJJPA is also planning to operate a fifth daily round trip beginning in April 2016, once an agreement is in place with the host railroads. Once the two additional (one round trip) San Joaquin trains begin operating, there will be no more train slots available to operate passenger trains on the Martinez Subdivision, absent further negotiation.

  Amtrak operates the San Joaquin Route under provisions of its contracts with host railroads- BNSF and UPRR. BNSF owns the majority of the right-of-way along this route (Port Chicago-Bakersfield), while UPRR owns 39 miles at the northern end of the route between Oakland and Port Chicago (containing the track within the Study Area), and 49 miles between Stockton and Sacramento. Over 1.1 million passengers traveled on San Joaquin trains in fiscal year (FY) 2012, making it the fifth-highest inter-city ridership in the country.

- **Capitol Corridor Route.** This route extends 169 rail miles between San Jose and Auburn. UPRR owns the entire route except for three miles between Santa Clara and San Jose, which is owned by the Peninsula Corridor Joint Powers Board. Operation of the Capitol Corridor service is based on multi-party agreements between CCJPA, Amtrak, and UPRR.

  The Capitol Corridor Joint Powers Authority (CCJPA) contracts with Amtrak to operate 15 daily round trips. The CCJPA is responsible for overseeing the Capitol Corridor service through its operating contract with Amtrak, while the state funds the service. The CCJPA also has agreements with UPRR that allow for the operation of the existing 15 Capitol Corridor trains based on the necessary capacity improvements funded by the CCJPA to accommodate those trains without degradation of the freight rail service on the Capitol Corridor. In addition, in areas where passenger trains can operate at higher speeds, the CCJPA pays an additional fee to maintain the track at Class IV (80 miles per hour [mph]) instead of Class III (60 mph).

CCJPA also funds a dedicated track maintenance crew and the provision of incentive payments to the host railroad to reduce the number of slow orders and improve the trains' on-time performance. [15] CCJPA reported a total ridership on Capitol Corridor of 1.7 million in FY year 2014. Ridership in FY 2014 was up 1.1 percent from the prior year, continuing to make the Capitol Corridor Amtrak's third-busiest corridor. The Richmond station contributed 53,877 annual boardings and 57,014 annual alightings (530 average daily passengers). On-time performance on the Capitol Corridor is 95 percent. The Capitol Corridor service route and stations are depicted on **Figure 3-24**.

### *Burlington Northern Santa Fe (BNSF)*

The BNSF Railway's Stockton Subdivision extends between Calwa (Fresno) at MP 994.9 and Richmond at MP 1189.0. For purposes of this study, the focus of this analysis is on the segment between Pacheco (Martinez) at MP 1168.5 and Richmond, connecting via the UPRR Martinez Subdivision to the Oakland Jack London Square Amtrak Station (MP 7.1 on the UP Niles Subdivision), a distance of approximately twenty miles.

In Contra Costa County, the BNSF connects with UPRR at Port Chicago (MP 1164.0) with the San Joaquin Amtrak trains and at the Richmond BART/Amtrak Station. The Richmond Rail Connector line branches off the BNSF Stockton Subdivision at MP 1186.4 near the Richmond Parkway and connects with the UPRR Martinez Subdivision at MP 14.4 near Parr Boulevard. The new Richmond Rail Connector was constructed to prevent Port of Oakland trains from causing motor vehicle traffic delays in the City of Richmond. Presently there are freight trains operating on this segment of track, but no passenger service.

## Why Expanded Commuter Rail Service

Expansion of commuter rail service on the UPRR or BNSF rail lines has the potential for new service operating on existing rail rights-of-way, without the need for creation of new rail corridors with associated costs and environmental impacts. The rail corridor and station infrastructure are already in existence and could potentially be upgraded with additional track to provide more cost-effective service than new rail. The existing infrastructure also provides connections to other transit operators including AC Transit, BART, County Connection, Golden Gate Transit, WestCAT, and Tri Delta transit, if service is extended to Martinez.

As the rail corridors also serve the counties to the north, south, and east to Central Contra Costa County, there is the potential for commuter rail service to intercept more of the through

[15] Slow orders are issued by a railroad when track conditions fall below accepted criteria that allow trains to travel at a designated speed limit within that area.

trips on I-80 that contribute to congestion in this corridor than a service that terminates within West County.

The biggest potential conflict with the expansion of commuter rail is the ability to accommodate both freight and passenger rail service in the same corridor. The types of improvements that would be required to implement new commuter rail type of service in either of these corridors are discussed below and have the potential to be quite costly. New service would also require new agreements with the freight operators and owners of the railroad to introduce new service.

### 3.4.3 Alternative 4—UPRR Corridor Commuter Rail

#### Markets Served

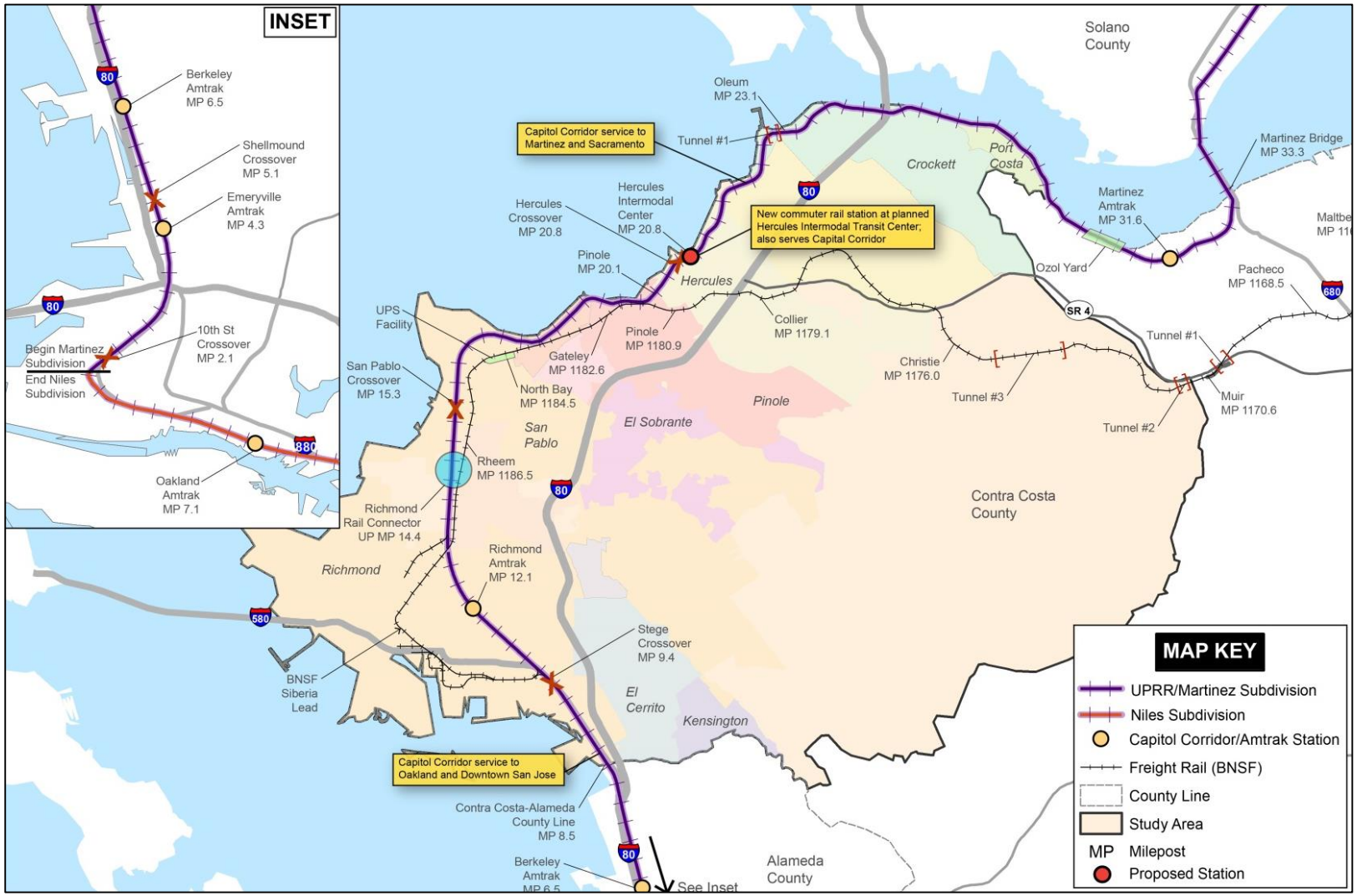
As stated above, new or expanded commuter rail service implemented on either the UPRR or the BNSF corridors would have the potential to capture the large potential transit market coming from Solano and Yolo counties that are traveling to destinations in Oakland and to connect to the BART system for those trips destined for San Francisco. While current service connects these markets, the fares are priced high to reflect an inter-city rate structure rather than a regional commute fare structure and the frequencies are less than those on a high-capacity regional service.

The commuter rail would serve the Richmond and the Hercules area and provide a connection to Martinez. At the Richmond BART/Amtrak Station, the transit connections to the remainder of West County and to Marin County are available. Transit connections in Hercules would include WestCAT and a potential ferry connection. Because the number of stops is more limited, broad coverage would require transfers to other forms of transit and a fare penalty. If service is extended to Oakland, the potential for serving broader markets would exist.

#### Alternative Description

Alternative 4 would add new commuter rail operations on the UPRR track between Martinez and Richmond with a potential extension to Oakland. The alternative calls for the addition of four commuter trains in the morning peak and four trains in the afternoon peak operating on 30-minute headways, for a total of eight trains per day. The commuter rail service would be scheduled to operate within the gaps of the existing Capitol Corridor service. Since the railroad is currently at their negotiated capacity, the construction of a third main track between the Richmond BART/Amtrak Station (MP 12.1) and the Martinez Amtrak Station (MP 31.6) would be necessary to ensure reliable commuter rail operations. The proposed alignment for Alternative 4 is shown in **Figure 3-25**.

**Figure 3-25: Alternative 4 - UPRR Corridor Commuter Rail**




*Source: RL Banks and Kimley-Horn, 2015*

This alternative is considered because the existing rail alignment seems an obvious choice for expanded service; however, there are serious potential constraints that exist with this option.

Once the two additional San Joaquin trains begin operating in April 2016, there will be no more train slots available to operate passenger trains on the Martinez Subdivision, absent negotiation. For commuter service to begin along this corridor, a sponsor would have to negotiate a new agreement with UPRR. In preliminary discussions with UPRR, the railroad stated that it is not interested in working with any other entity except the CCJPA. This means that any new commuter rail service would most likely need to be operated by CCJPA.

Secondly, any additional passenger trains would require the public sector to build expensive additional mainline tracks between Martinez and Richmond. The current alignment travels along the shore of San Francisco Bay, an environmentally sensitive area that faces the possibility of being inundated due to rising sea levels caused by global warming. This condition may require that the UPRR raise the grade of the alignment between Point Pinole and Martinez to prevent sea level inundation. In the long term, UPRR may seek an alternate route for their service, as Capitol Corridor is considering, to address this issue. If in the future, SJJPA decided to move the San Joaquin trains from their current routing to a more direct Bay Area route via the Altamont Pass, this would free up train slots for commuter trains to replace the San Joaquin trains on UPRR trackage. Once again a new agreement would have to be negotiated with UPRR to operate additional commuter rail service beyond the currently agreed upon 42 passenger trains per day.

### *Potential Oakland Extension*

The UPRR Martinez Subdivision is a double track railroad on right-of-way wide enough to expand the infrastructure between Oakland and Richmond to four main tracks, except between Grand Avenue in Oakland and 65th Street in Emeryville, where acquisition of 20 to 30 feet of right-of-way would be required. There is adequate room in other locations, however, within the existing right-of-way to construct an additional single-track rail line to support the introduction of commuter rail service, provided adequate cross-over tracks also are built to facilitate the meeting and passing of trains.

The operation of Capitol Corridor train service and freight train at-grade operations through Jack London Square are considered problematic due to multiple, potential conflicts with pedestrians and motorists at the street surface level. The planning and establishment of new commuter rail service in this corridor would need to consider the long-term strategies identified in the Capitol Corridor Vision Plan regarding grade separation throughout the subject area.

## Service Characteristics

The proposed new commuter rail operations between Martinez and Richmond, with the potential for extension to Oakland, would add four additional commuter trains in the morning peak and four trains in the afternoon peak, or a total of eight trains per day. The commuter rail service would be scheduled to operate within the gaps in the service provided by CCJPA inter-city trains. This would provide 30-minute headways in the Study Area during the peak period and would require four train sets.

The maximum grade on the UPRR Martinez Subdivision between Richmond and Martinez is one-quarter of one percent, which would not cause any issues related to commuter train operations in terms of motive power and speed. However, the railroad alignment follows the shoreline of San Francisco Bay between Point Pinole and Martinez, requiring a 40 mph speed limit between these two points to negotiate the curvature of the bay.

The line is also subject to sea level rise and flooding during heavy storms. In the short term, UPRR could raise the grade of the track but ultimately may be required to construct a new alignment further to the east to continue operating on this line.

## Trackway Improvements

The existing infrastructure on the Martinez Subdivision between Oakland and Richmond is essentially a double track mainline that at one time featured four main tracks and is classified as a high density rail corridor.[16] UPRR currently uses a Centralized Traffic Control (CTC) signal system to manage the movement of trains safely and efficiently in this corridor. The Martinez Subdivision hosts a weekday average of 42 regular passenger trains and approximately sixteen UPRR and six BNSF freight movements. [17, 18]

According to the Association of American Railroads (AAR), a double track railroad has a theoretical capacity of between 75 and 100 trains. With an existing mix of 62 passenger and freight trains using the Richmond-Martinez rail corridor each day, the theoretical capacity is reduced, to about a 50 to 75 train practical capacity to account for the mixing of passenger and freight activity. It is assumed that UPRR would consider that the Martinez Subdivision is close to its maximum practical capacity and would require new tracks to accommodate additional train service.

[16] Corridors that are forecast to experience major growth in freight and/or passenger rail service. The construction of a third main track will be required to accommodate the projected growth. Earth Tech, DMJM Harris, *Regional Rail Plan*, prepared for the Metropolitan Transportation Commission, September 2007.

[17] Based on discussions with the UPRR.

[18] Cambridge Systematics, Inc., *MTC Regional Goods Movement Plan, Task 2C Infrastructure, Services and Demographics/Freight Flows*, prepared for the Metropolitan Transportation Commission, April 2015.

A third main track could be added to provide more capacity to support new commuter rail service. It would require the construction of 13.0 miles of third main track between the Oakland Jack London Square Amtrak Station (MP 7.1) and the Richmond BART/Amtrak Station (MP 12.1)

The addition of new track between Oakland and Richmond would be a significant challenge. The Capitol Corridor Vision Plan indicates that the heavily urbanized section between Oakland and Richmond is among the most heavily congested rail corridors in California with points of limited rights-of-way. The service overlap between the Port of Oakland freight movements and the increasing demand for passenger service are a particularly acute problem in this section of the UPRR alignment. The existing right-of-way in Oakland/Emeryville between Grand Avenue and 65th Street is only 100 feet in width and would likely require an additional 20 to 30 feet of right-of-way to add additional track. Grade separation of tracks in the Jack London Square area and West Oakland is also envisioned to accommodate increased passenger and freight rail activity. This section also has the potential for sea level inundation.[19]

The addition of track in the Richmond to Martinez section has two primary challenges: the winding existing alignment that limits speed of the existing passenger and freight trains and the potential for sea level rise. While the introduction of Positive Train Control has the potential to facilitate faster train speeds, the curvature of the track will continue to control the top speeds through this section and the opportunities for realignment of the track in the shoreline corridor are limited.

If this alternative is pursued further, modeling this segment to calculate the actual line capacity and determine where sidings could be constructed would be needed to optimize the commuter train service.

### *Crossover Tracks*

Should the obstacles of adding a third track be overcome, the introduction of track crossovers are recommended to maximize the throughput of trains on the UPRR alignment by allowing trains to pass each other. Construction of five new crossovers to match the existing crossovers on the current tracks at Hercules (MP 20.8), San Pablo (MP 15.3), Stege (MP 9.4) in Richmond, Shellmound (MP 5.1) in Emeryville, and Tracks One and Two at Tenth Street (MP 2.1) in Oakland may be required to institute new commuter rail service.

[19] Capitol Corridor 2014 Vision Plan Update, Final Report, November 19, 2014, prepared by Nelson\Nygaard for CCJPA.

### At-Grade Crossings

The introduction of commuter rail service would require the placement of concrete panels and rails across some roadways to accommodate the new third track. Lights and gates would need to be moved to different locations to accommodate the new track at the following locations:

- Pinole at Tennent Avenue (MP 19.9);
- Richmond at four locations: Cutting Boulevard, Market Avenue, Brookside Drive and Parr Boulevard;
- Emeryville at 65th Street;
- Oakland at two locations: Martin Luther King, Jr. Way and Market Street.

### Signals

New train signals would be required at the following locations to control the transitions at crossovers and stations:

- San Pablo Crossover (MP 15.3) at both ends of the new track;
- Richmond Amtrak Station on Track 3 (MP 12.1), new approach signals;
- Stege Crossover (MP 9.2) at both ends of the new track;
- Emeryville at 65th Street;
- Shellmound Crossover (MP 5.1) at both ends of the new track; and
- Tenth Street Crossover (MP 2.2) at both ends of the new track.

### Bridges

Railroad bridges would need to be widened at the following locations:

- Richmond - The railroad bridges at three locations in Richmond would need to be widened: 23rd Street, Macdonald Avenue and Barrett Avenue.
- Oakland - The railroad bridge at Seventh Street would need to be widened.

### Drainage

Drainage facilities would need to be extended at the following locations:

- Pinole - Widen Garrity Creek Bridge (MP 18.5) and widen Pinole Creek Bridge (MP 20.1).
- Richmond - Extend double box culvert at Wildcat Creek (MP 13.7); widen San Pablo Creek Bridge (MP 14.1) and widen Drainage Canal Bridge (MP 15.0).

### Other Facilities

Essential elements of operating a commuter rail service include facilities to clean, maintain and store equipment. Operation of commuter rail service to/from Oakland, may afford the opportunity to use the existing Amtrak Maintenance facility in Oakland.

## Vehicles

### *Locomotives*

Locomotive emission standards were first adopted in December 1997 by the Environmental Protection Agency (EPA). The standards relate to hydrocarbon, oxides of nitrogen, particulate matter and carbon monoxide emissions and were progressively tiered over time to reduce the diesel emissions. Tier 0 standards apply to locomotives manufactured between 1973 and 2001; Tier 1 standards apply to locomotives manufactured between 2002 and 2004; Tier 2 standards apply to locomotives manufactured between 2005 and 2011; and Tier 3 standards apply to locomotives manufactured between 2012 and 2014. All locomotives manufactured in 2015 or later must meet the Tier 4 locomotive emissions standards.

Conventional Tier 4 (with respect to emissions) diesel electric locomotives would be appropriate vehicles to service this corridor. Manufacturers producing this equipment include: Electro-Motive Division, General Electric, Brookville Corporation and Siemens Rail Systems.

### *Bi-Level Coaches*

Bi-level coaches are most desirable to support commuter rail operations because they are more energy efficient and have a lower operating cost per passenger. Bi-level cars can carry twice as many passengers as a single level rail car without requiring additional locomotive horsepower to pull them. Bi- levels feature a lowered floor as well as an extended roof to accommodate two levels of seats.

Bi-level cab cars are placed at the end of a trainset and feature a cab area built into a walled-off end of a coach, allowing the engineer to operate the train remotely from the rear of the train. Many commuter trainsets are used in a push-pull configuration to allow trains to quickly change direction. When in push mode, the forward facing rail car must have a cab car configuration to allow the locomotive engineer the ability to see ahead from the rear of the train.

Bi-level commuter coaches and a bi-level cab car would be the appropriate rolling stock, which would allow the train to be operated in either direction without having to turn the locomotive around, so as to maximize efficiency and minimize track occupation.

### *DMUs*

Passenger rail cars would need to meet current Federal Railroad Administration (FRA) standards for crashworthiness to operate on freight rail tracks. FRA is developing standards for “lightweight” passenger equipment, capable of operating in mixed traffic with freight trains operating under Positive Train Control (PTC) which is being mandated by the FRA to be installed

by the end of 2015.[20] Capitol Corridor is in the process of installing Positive Train Control. As noted earlier in this document, the recent development of a crashworthy DMU for operation on the SMART rail line in Sonoma and Marin County also expands the potential for using DMUs on the Capitol Corridor line. The benefits of these DMU vehicles are that they are flexible with respect to grades, and they have superior acceleration/deceleration and reduced energy consumption and greenhouse gas (GHG) effects.

## Stations

The Martinez Amtrak Station is located at MP 31.6. The existing station features three station tracks and two station platforms. The station platforms are 0.3 mile long (MP 31.1 to MP 31.4). It is anticipated that the new commuter rail service would have access to the existing station and platform.

Under the proposed Alternative 4 UPRR alignment, one additional commuter rail station site located on the UPRR Line would be proposed at the Hercules Intermodal Transit Center MP (21.1). This is a planned station site that would be located at Bayfront Boulevard in Downtown Hercules and include an 800-foot station platform. The City of Hercules is actively seeking funding to construct this new facility.

The Richmond Amtrak Station is located at MP 12.1. The existing station has two tracks separated by a center platform. A second platform would need to be constructed on the east side of the mainline to accommodate the third main track.

The planning and establishment of new commuter rail service in the corridor between Richmond and Oakland would require evaluation of the following station improvements.

- **Berkeley Amtrak Station** - (MP 6.5) The existing station features one station platform on the east side of the railroad. The length of the existing platform would need to be reduced to allow installation of the third main track on the east side of the railroad. The reduced station platform length would be wide enough to accommodate the new track and still function as a platform.

- **Emeryville Amtrak Station** - (MP 4.3) The existing station features two tracks separated by a center platform. The station tracks are 0.5-mile long (MP 4.2 to MP 3.7). It is anticipated that new commuter rail service would have access to the existing station platform.

[20] This equipment is expected to be significantly lower in weight and therefore have improved acceleration/deceleration capabilities (and lower energy consumption) compared to today's passenger equipment which is designed to sustain a crash ("crashworthiness') under current train control technologies.

- **Oakland Amtrak Station (Jack London Square)** - (MP Niles 7.1) The existing station features two tracks separated by a center platform. The station tracks are 0.4-mile long (MP 7.25 to MP 6.85). It is anticipated that the new commuter rail service would have access to the existing station platform. A new set of layover tracks would be required to accommodate the commuter rail equipment near the Amtrak Maintenance Facility.

## Potential for Intermodal Connectivity

The potential for intermodal connectivity would exist at each of the existing stations. The commuter rail would serve the Richmond and potentially the Hercules area. At the Richmond/Amtrak Station, bus transit connections to the remainder of West County and to Marin County are available. Transfers would be available to BART, AC Transit, and Golden Gate Transit.

Transit connections in Hercules would include WestCAT and a potential ferry connection. Because the number of stops is more limited, broad coverage would require transfers to other forms of transit and a fare penalty. If service is extended to Martinez and to Oakland, the potential for serving broader markets would exist.

## Phasing of Improvements

Implementing Alternative 4 in the UPRR alignment in the near term improvements could be very difficult due to current CCJPA and UPRR requirements. However, there are short-term solutions that could improve the service to West Contra Costa County. Existing inter-city train service between Martinez, Richmond, Berkeley, Emeryville and Oakland which is priced at inter-city rates could be subsidized by West County to reduce rates to more reasonable levels, thereby providing a more readily available commuter service in the near-term. Also if the San Joaquin service is shifted away from this corridor, it could open opportunities to introduce new commuter service in this corridor.

In the near- to medium-term, if the City of Hercules, working in cooperation with WCCTAC and CCTA, were able to meet the service requirements stipulated by the CCJPA to add a stop at Hercules, then the potential to stop Capitol Corridor inter-city trains at the Hercules Intermodal Center could be realized.

The State of California is in the process of developing a vision-based update to its State Rail Plan, which is considering substantial increases in passenger service levels to meet the State's air quality and greenhouse gas reduction targets. In the long-term, assuming the possibility of expanding the joint capacities of the existing UPRR and BNSF lines through West County and using more robust capacity management tools such as scheduled operation of all trains and

shared dispatching, commuter rail service could become a feasible alternative on the UPRR alignment.

### Constraints

There are significant challenges that would need to be overcome before commuter trains could operate on the UPRR Martinez Subdivision. The first challenge would be to negotiate a contractual agreement between the operator and UPRR, as the rail owner. UPRR has expressed reluctance to enter into a new operating agreement with another agency within the Capitol Corridor, requiring any new service to be operated by CCJPA, the inter-city rail agency. The CCJPA is reluctant to add any additional station stops to their schedule because of the degradation in the service and the reduction in capacity that would result.

The second challenge is the threat of sea level rise from global warming. The Martinez Subdivision rail corridor includes two main line tracks that follow the curvature of San Francisco Bay from Point Pinole to Martinez. As sea level rises, a large portion of the Martinez Subdivision would be impacted, including the section between Richmond and Oakland, affecting the rail infrastructure. Long-term investments identified in the CCJPA's Capitol Corridor Vision Plan involve service expansion through speeding up transit times by straightening curves, and protecting the system from sea level rise as an option or partially relocating service to alternative corridor.

The third challenge would be the construction of an additional third main track along the existing rail corridor. Much of the existing corridor follows the shoreline of San Francisco Bay which is an environmentally sensitive area requiring wetlands and other mitigation measures before any new construction could take place.

## 3.4.4 Alternative 5—UPRR-BNSF Corridor Commuter Rail

### Markets Served

Similar to Alternative 4, this alternative would provide rail service between Hercules and Richmond with the potential for extension to Martinez in the north and Berkeley, Emeryville, and Oakland in the south. While current Capitol Corridor service connects these markets, a commuter rail service that is focused on enhancing connections from West and Central Contra Costa County to Alameda County would have the potential to provide more frequent, high-capacity service at a cheaper fare structure.

At the Richmond Amtrak/BART Station, bus transit connections to the remainder of West County and to Marin County are available as is connection to the BART system. Transit

connections in Hercules would include WestCAT. Unlike Alternative 4, this alternative would not provide a connection to the proposed Hercules Intermodal Transit Center.

This alternative would also enhance connections between the Hercules and Pinole area and Central Contra Costa County. This is a travel market that shows moderate transit suitability and a high travel demand to the southern part of West County.

Because the number of stops is limited, broad coverage would require transfers to other forms of transit and a fare penalty. If service is extended to Oakland, the potential for serving broader markets would exist.

## Alternative Description

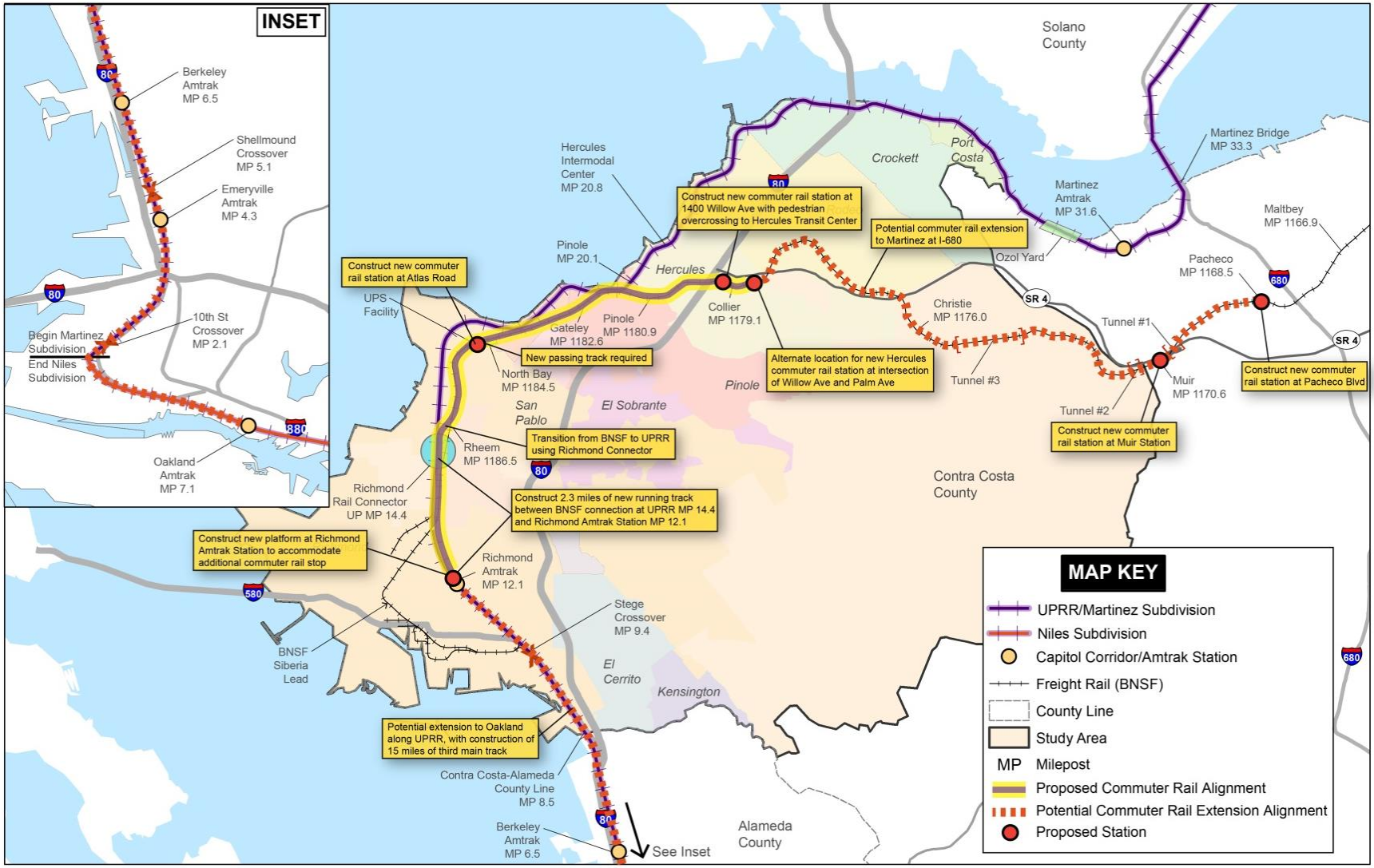
Alternative 5 includes the introduction of commuter rail service on a corridor following the alignment of segments of the UPRR and BNSF railroad rights-of-way in West County and Central Contra Costa County. This alternative proposes the operation of eight peak period commuter rail trains connecting Oakland in the west with the county seat of Martinez in the east, operating on the BNSF Railway's Stockton Subdivision between Martinez and Richmond. The trains would operate on 30-minute headways with four round trips in the morning peak period and four round trips in the evening peak period. The potential for extending service into Oakland as a long-term measure is also proposed.

This proposed alternative would require improvements to stations, track, grade crossings, bridges and signals to accommodate the new commuter rail service. With station stops in Hercules, and direct access to BART at Richmond, and potentially downtown Oakland, commuter rail could offer residents new transit options along an existing rail alignment. The proposed Alternative 5 UPRR-BNSF Alignment is shown in **Figure 3-26**.

### *Potential Oakland Extension*

The extension of service along the UPRR Martinez Subdivision between Richmond and Oakland would have the same issues outlined in Alternative 5 under the Alternative Description. In addition to the constraints of adding a third track through the Emeryville area and the potential for inundation from sea level rise, the joint operation of passenger and freight service in the vicinity of the Port of Oakland and Jack London Square are significant.

**Figure 3-26: Alternative 5—UPRR-BNSF Corridor Commuter Rail**




*Source: RL Banks and Kimley-Horn, 2015*

## Service Characteristics

The proposed new commuter rail operations would add four commuter trains in the morning peak and four trains in the afternoon peak, or a total of eight trains per day. This would provide 30-minute headways during the peak commute periods serving travel within West County and connecting to points in Central Contra Costa County and in northern Alameda Counties. The maximum grade on the BNSF Stockton Subdivision between Pacheco and Richmond is one percent, which will not affect commuter train operations adversely. The railroad uses automatic block signals (ABS and track warrant controls to safely manage the movement of trains in this corridor).[21]

According to AAR, a single track railroad should enjoy a theoretical rail capacity of 18 to 25 trains per day. BNSF operates an average of thirteen freight trains per day on the Stockton Subdivision.[22] The curvature of the alignment results in speed restriction to 35-45 mph between Richmond and Martinez, thereby reducing practical capacity. Applying the capacity guidelines previously cited from the 2007 AAR Report would indicate that the practical capacity probably lies in the eighteen to twenty-five trains range.[23] With the addition of a dedicated running track between the siding at Gateley and the siding at North Bay in north Richmond, there should be enough capacity to operate twenty-two trains per day on this line. A more detailed modeling analysis would need to be conducted to calculate the actual line capacity on this segment.

Despite the speed restrictions, the railroad should have the ability to accommodate some commuter rail trains, provided public funds for infrastructure improvements are made to offset the reduction in capacity that the commuter rail service will cause. Also, as noted previously, more coordinated scheduling of freight traffic in conjunction with improved train control could free up future schedule “slots.”

The introduction of Positive Train Control also has the potential to speed up train operations, should the physical limitations of the track alignment be addressed.

## Trackway Improvements

The BNSF Stockton Subdivision is a single track freight railroad with sidings located approximately every four miles in the Study Area. There is adequate room within the existing right-of-way to construct the necessary rail improvements to facilitate commuter rail, although

[21] Automatic Block Signals (ABS) is a railroad communications system that consists of a series of signals that divide a railroad into sections or blocks. The system controls the movement of trains between the blocks using automatic signals.

[22] BNSF Railway

[23] Per the standard described for “Multiple Train Types.”

there are locations including tunnels, rock cutting, bridges and trestles, where significant engineered improvements would be necessary to fully utilize the owned right-of-way.

On the BNSF Subdivision, there are congestion issues that would need to be resolved regarding the United Parcel Service (UPS) North Bay transload facility located in north Richmond. The rest of the track should be able to accommodate the new commuter rail service. The North Bay facility is a container transload facility owned by UPS that uses the BNSF to move its containers to and from the San Francisco Bay Area by rail. The UPS contract with BNSF requires certain performance measures to be met. To meet these strict requirements, UPS trains take priority over all other train movements along this segment of the Stockton Subdivision. To ensure commuter trains would not experience delays associated with the switching of this facility, it would be necessary to construct a dedicated, 1.9 mile long running track between North Bay Siding at MP 1184.5 and Gateley Siding at MP 1182.6. A new bridge would also be required at Tara Hills Road and Garrity Creek (MP 1183.5). This would allow local switching jobs to operate to and from the North Bay facility without tying up the mainline and blocking commuter rail trains.

If this alternative is pursued further, modeling this segment to calculate the actual line capacity and determine where additional enhancements would be needed to optimize the commuter train service.

The following is a summary of the improvements that have been identified on both the BNSF Stockton Subdivision and UPRR Martinez Subdivision to operate commuter rail service between Martinez and Oakland.

### *Crossovers*

Crossovers provide flexibility of train movements. Construction of three new crossovers to match the existing crossovers may be required by UPRR at Stege (MP 9.4) in Richmond, Shellmound (MP 5.1) in Emeryville, and Tracks One and Two at Tenth Street (MP 2.1) in Oakland.

### *At-grade crossings*

In all cases, the lights and gates would need to be moved to a different location to accommodate the new track. At-grade crossings would require the placement of concrete panels and rails across roadways at the following locations:

- Richmond at four locations: Cutting Boulevard, Market Avenue, Brookside Drive and Parr Boulevard;
- Emeryville at 65th Street; and
- Oakland - at two locations: Martin Luther King, Jr. Way and Market Street.

### Signals

New train signals would be required on the BNSF Stockton Subdivision at the following locations to control the crossover and station transitions:

- Pacheco Commuter Rail Station (MP 1168.5) at both ends of the new station;
- Muir Commuter Rail Station (MP 1170.6)at both ends of the new station;
- Either the Hercules Transit Center Commuter Rail Station at (MP 1179.9) or at the Hercules Commuter Rail Station (MP 1179.3) at both ends of the station depending on the station location selected; and
- Atlas Road Commuter Rail Station at (MP 1184.8) at both ends of the station.

New signals would be required on the UPRR line at the following locations:

- Richmond Amtrak Station on Track 3 (M.P. 12.1) new approach signals.
- Stege Crossover (M.P 9.2) at both ends of the new track;
- Shellmound Crossover (MP 5.1) at both ends of the new track; and
- Tenth Street Crossover (MP 2.2) at both ends of the new track.

### Bridges

Railroad bridge widening or new bridges would be required at the following locations:

- Oakland - the railroad bridge at Seventh Street would need to be widened;
- Richmond - the railroad bridges at three locations in Richmond would need to be widened: 23rd Street, Macdonald Avenue and Barrett Avenue; and
- Tara Hills Road and Garrity Creek (MP 1183.5) would require the construction of a new bridge.

### Drainage

Drainage facilities would need to be extended at the following location:

- Richmond - The San Pablo Creek Bridge (M.P. 14.1) must be widened and the double box culvert at Wildcat Creek (M.P. 13.7) must be extended.

### Other Facilities

Essential elements of operating a commuter rail service include facilities to clean, maintain and store equipment. By operating a commuter rail service to/from Oakland, there may be an opportunity to utilize the existing Amtrak Maintenance Facility, which would reduce the operating cost of having to build and maintain a separate maintenance facility dedicated to the commuter rail equipment.

## Vehicles

The vehicle technology discussed in Alternative 4 would apply here as well. If conventional inter-city passenger train technology is selected then locomotives meeting EPA Tier 4 emissions standards would be required as implementation would be post 2015. These conventional locomotives are recommended to be paired with bi-level conventional coaches to take advantage of their better energy efficiency, higher capacity, and lower operating costs per passenger.

The recent manufacture of FRA crashworthy DMU vehicles for the SMART corridor in Sonoma and Marin County, also expands the potential for the use of DMU vehicles on this corridor. These cars have greater flexibility with respect to grades, superior acceleration/deceleration, and reduced energy consumption and greenhouse gas effects.

## Stations

There are five potential commuter rail station sites located on the BNSF Line. They are:

1. **Pacheco Station** (MP 1168.5) - This proposed station site would be located on a vacant parcel of land along Pacheco Boulevard, just west of the Interstate 680 access ramps. Pacheco Boulevard provides access to downtown Martinez along a signalized, four-lane road. Dedicated shuttles buses would need to be provided to connect with the downtown business district. This site would require the construction of an 800-foot station platform, a station with amenities and a parking lot.

2. **Muir Station** (MP 1170.6) - This proposed station site would be located along Muir Station Road on a vacant parcel of land near the Grace Episcopal Church. It has direct access to SR 4 and downtown Martinez via Alhambra Way. It would require the construction of an 800-foot station platform and an overhead pedestrian walkway across Muir Station Road to allow commuters safe access between the parking lot and the station. Dedicated shuttle buses would need to be provided to connect with the downtown business district.

3. **Hercules Station** (MP 1179.3) - This proposed station site would be an alternative to the Hercules Transit Center listed below (i.e. only one or the other alternative station would be constructed) and would be located near the intersection of Palm Avenue and Willow Avenue, across the street from the Valley Bible Church. The site has direct access to SR 4 via Willow and Sycamore Avenues. There is vacant land along both sides of the railroad, which would allow the station to be constructed on either side of the railroad. There is an existing siding on the east side of the railroad at Collier MP 1179.7. This siding could

be used to develop a station platform rather than having a platform on the mainline. An 800-foot station platform would need to be constructed as well as a parking lot.

4. **Hercules Transit Center** (MP 1179.9) - This proposed station site would be located at 1400 Willow Avenue on a vacant parcel of land across the street from the Hercules Transit Center. The Hercules Transit Center features an existing parking lot and is served by WestCAT and Lynx buses that connect with BART at El Cerrito Del Norte. A pedestrian overcrossing would need to be constructed to ensure safe passage between the commuter rail station 800-foot platform and the Transit Center. In addition, a parking structure at the existing Transit Center would need to be constructed to accommodate the additional parking required by commuter rail passengers.

5. **Atlas Road Station** (MP 1184.8) - This proposed station site would be located on the west side of the BNSF mainline on a vacant parcel of land near the intersection of Atlas Road and Giant Road in Richmond. The proposed site also would be one mile west of the intersection of San Pablo Avenue and Richmond Parkway, two major thoroughfares. An 800-foot station platform would need to be constructed as well as a parking lot, station and amenities. It would serve a mix of residential and commercial uses in the vicinity.

The stations in Alternative 5 on the UPRR Subdivision are the same as in Alternative 4. Descriptions of the Richmond, Berkeley, Emeryville, West Oakland, and Oakland Amtrak, stations are described in Alternative 4 above.

## Potential Intermodal Connectivity

Planning of new station sites should include looking at connectivity to local transit services and accommodating bicyclists, pedestrians and disabled riders. With the exception of the proposed station at the Hercules Transit Center, the new stations proposed north of the Richmond Amtrak/BART Station, all of the stations would need to consider the potential for connectivity with existing AC Transit and WestCAT bus service.

The proposed Atlas Station site currently has AC Transit service in the immediate vicinity. The existing Hercules Transit Center is served by 11 WestCAT routes, but pedestrian access is fairly limited. WestCAT provides service in the vicinity of the alternative Hercules Station site, though it would be advantageous to integrate transit services with the existing Hercules Transit Center, considering the existing focus of WestCAT service at this location. The potential Pacheco Station is potentially accessible by one existing County Connection transit route, but this particular station location may be more suited to auto access.

At the existing Richmond BART/Amtrak Station, riders will be able to connect with BART. The existing Berkeley, Emeryville, and Jack London Square Amtrak stations provide AC Transit bus connections as well as opportunities to access the train by bicycle and on foot, but they do not connect to the regional train network. A more in-depth study would need to be undertaken to determine the best intermodal options at each new station location.

## Phasing of Improvements

While this alternative is not likely feasible in the short-term, it has the good potential for mid-term or long-term investment if the ridership is robust and it proves to be cost-effective. In the short-term, the option for subsidizing fares on the existing Capitol Corridor may be the most feasible way to quickly expand high-capacity transit service in West County.

The potential to operate a commuter rail service on the BNSF Alignment, in the mid-term, may be greater than for Alternative 4 due to the current lower level of freight traffic. This alignment also affords the potential for faster train speeds and more accessible station locations. The biggest issue would be funding and building the necessary improvements on this alignment to protect freight capacity, while continuing to operate on the UPRR. In the mid- term, the introduction of more frequent trains and new stations may be possible provided an agreement can be worked out with BNSF Railway.

The long-term looks bright regarding this alternative because this alignment is also being considered for use by CCJPA in its long-term planning to operate faster inter-city trains and the need to move away from the San Francisco Bay shoreline.[24] Due to the BNSF alignment's higher elevation and distance away from the coast and station locations that are more easily accessed, investing in this alignment appears to be a better choice for long- term passenger rail service in Contra Costa County.

## Constraints

While the constraints associated with this alternative may be less than noted for Alternative 4, there would still be challenges associated with establishing new passenger rail service on an existing freight rail line and to introduce new service in the portion of the line that the UPRR controls.

- This service would require negotiating a contractual agreement between the operator, UPRR, and the BNSF. The introduction of new trains on the UPRR portion from just north

[24] The Capitol Corridor would follow a different alignment once it passes the Hercules Transit Center is it would transition north to pass through Martinez to cross over on the existing or a new Benecia Rail Bridge.

of Richmond south into Oakland, one of the most congested rail corridors in the state, would have the same challenges as outlined in Alternative 4.

- The second challenge is the threat of sea level rise from global warming. While the transition to the BNSF inland alignment in Richmond reduces the impact of sea level rise, the problem still exists for the section of track between Richmond and Oakland.

- The third challenge would be the construction of an additional third main track along the existing rail corridor between Richmond and Oakland.

## 3.5 BART Alternatives

### 3.5.1 Recommendations from Prior and Current Studies

Several BART extension alternatives have been assessed in previous studies.

- The 1992 BART West Contra Costa Extension Alignment Study identified four possible BART alignments that would extend BART service from the Richmond-El Cerrito area to Crockett.

- The 1996 MTC I-80 Corridor Study examined ten possible improvement projects for the I-80 corridor that included two BART extensions- one to Vallejo and one to Hercules.

- The 2007 MTC Regional Plan identified a BART extension from the Richmond BART station to Hercules that followed the shoreline and paralleled the UPRR/Capitol Corridor route.

- The 2014 BART Vision Plan identified two potential BART improvements using DMU technology. One option reviewed DMU service along the UPRR/Capitol Corridor route and the other DMU alternative extended from the Richmond BART station to the Hercules area, using a combination of new right-of-way and right-of-way along I-80.

The issues identified for the Capitol Corridor would be the same for BART if an alignment along the shoreline was chosen. The existing rail alignment, due to its proximity to the shoreline, is subject to inundation in the future in association with sea level rise. Based on growing concern about climate change and the potential environmental impacts associated with this change, a major new investment in a shoreline corridor seem more risky today than they did in the past. While the grades for the UPRR as well as the BNSF rail corridors are compatible with a BART extension, the alignments of both these railroads have a number of tight curves that slow the operations of the rail service. This would have to be taken into account if these corridors were to be used for BART technology.

Diesel Multiple Units (DMU) service along the shoreline of the San Francisco Bay from Oakland to Richmond has been identified as a possible BART alternative technology and these options were included in the 2014 BART Vision Plan. However, the greatest constraint for BART investment in this corridor would be its proximity to the shoreline, making it vulnerable to future rises in sea level. If existing UPRR and/or BNSF right-of-way was used, crashworthy vehicles would also need to be deployed or the railroads would likely require construction of intrusion barriers or acquisition of additional right-of-way to create further separation from the freight rail operations. Market availability of crashworthy DMU's for the SMART service has made this less of a constraint.

Given the existing rail alignments, potential issues associated with inundation from sea level rise, grades, and the limited number of potential transportation corridors in West County as noted in previous studies, the I-80 corridor emerged as the most logical corridor for consideration of extension of BART service using existing BART technology.

### 3.5.2 Overview of Existing BART Services

#### Existing BART Services

BART provides heavy-rail, rapid transit service in West Contra Costa County with three stations in the Study Area – Richmond, El Cerrito del Norte, and El Cerrito Plaza – which provide connections to San Francisco, Alameda, Contra Costa, and San Mateo counties. Two lines run through the West Contra Costa County area: Fremont-Richmond and Richmond-Daly City/Millbrae. Average weekday ridership for the three stations is approximately 18,000. The most heavily utilized station is the El Cerrito del Norte Station as it also serves as a major transfer point from local bus service to BART.

On a typical weekday in 2014, the downtown Berkeley Station was the most heavily used single point of exit for riders entering at Richmond, El Cerrito del Norte, and El Cerrito Plaza Stations and represented approximately 13 percent of exits for West Contra Costa County area riders. The four stations in San Francisco downtown area (Embarcadero, Montgomery, Powell, and Civic Center) account for 38 percent of the exits from trips originating from West County.[25] The remaining San Francisco stations (16th Street, 24th Street, Glen Park, and Balboa Park) accounted for approximately 7 percent of exits.[26] The downtown Oakland stations (12th and 19th Street Stations) represent approximately 12 percent of the exits and the stations adjacent to downtown Oakland (MacArthur, Lake Merritt, and Fruitvale) accounted for 9 percent of

[25] As a comparison, 66 percent of all BART trips system wide start or end at one of the four Market Street stations in San Francisco.

[26] BART, 2014 Ridership, www.bart.gov/about/reports/ridership

exits. By extending BART service, access to the greatest number of regional markets would be provided.

BART provides service at 15-minute frequencies on the weekday and at 20-minute frequencies on weekends. Service spans 20 hours on weekdays and 16 to 18 hours on weekends.

### Why Expanded BART Services

Currently the BART service carries a substantial number of patrons, primarily with destinations in San Francisco, Berkeley, and Oakland, but also affording the opportunity to reach multiple destinations throughout the Bay Area. The area in West County that is currently best served by BART - Richmond and El Cerrito - is the area that registers the highest for transit suitability and also has the highest trip densities, providing the potential for generating the greatest high transit ridership. The El Cerrito del Norte Station also serves as a major transfer point for passengers coming by bus from the north along I-80.

As BART has the greatest regional coverage of all potential high-capacity transit in the Study Area, it is logical to consider the potential for capturing new ridership by extending service to the north. The transit market assessment shows that densities and transit suitability in the mid-part of West County around Hercules and Pinole are emerging in the future and may have the potential to generate a level of ridership that justifies the extension of BART. Such an extension would intercept drivers closer to their trip origin and potentially reduce the length of their trip on I-80. This will need to ultimately be evaluated for ridership potential and cost-effectiveness, if it is determined that BART is one of the final alternatives evaluated.

## 3.5.3 Alternative 6—BART Extension from Richmond Station to Hercules

### Markets Served

The most transit suitable markets identified in the Study Area are Richmond, El Cerrito, and San Pablo. These areas not only have the highest population and employment density within West County, but they also have the highest trip generation rates (both origins and destinations) within the Study Area. The Hercules and Pinole areas, however are continuing to emerge as areas with a high number of trip origins from the Study Area, and have the potential for trip generation growth in the future.

In addition to a high level of trip interchanges occurring within these five cities, there is also a high propensity of travel to San Francisco, Berkeley, and Oakland destinations. These trip patterns have the potential to be served by an extension of the existing BART system. Not only

would it serve these major destinations, but it would also provide access to many additional destinations throughout the Bay Area.

## Alternative Description

This alternative would proceed from the Richmond BART maintenance yard, northerly of the Richmond BART station to access the I-80 Corridor. Initially it would run parallel to the UPRR tracks from 13th Street then run on aerial structure along Rumrill Boulevard in San Pablo. Crossing over San Pablo Avenue, it would access Hilltop Mall via a deep bored tunnel. The alignment would then parallel the eastbound lanes of I-80 in a side-running configuration with a combination of columns and retaining walls to the Appian Way intersection. From this point it would continue to parallel the eastbound lanes of I-80 to reach the Hercules Transit Center on Willow Avenue, southeasterly of the I-80—SR4 interchange. **Figure 3-27** shows the proposed Alternative 6. A conceptual layout, with profile grades, is included in Appendix A.

## Service Characteristics

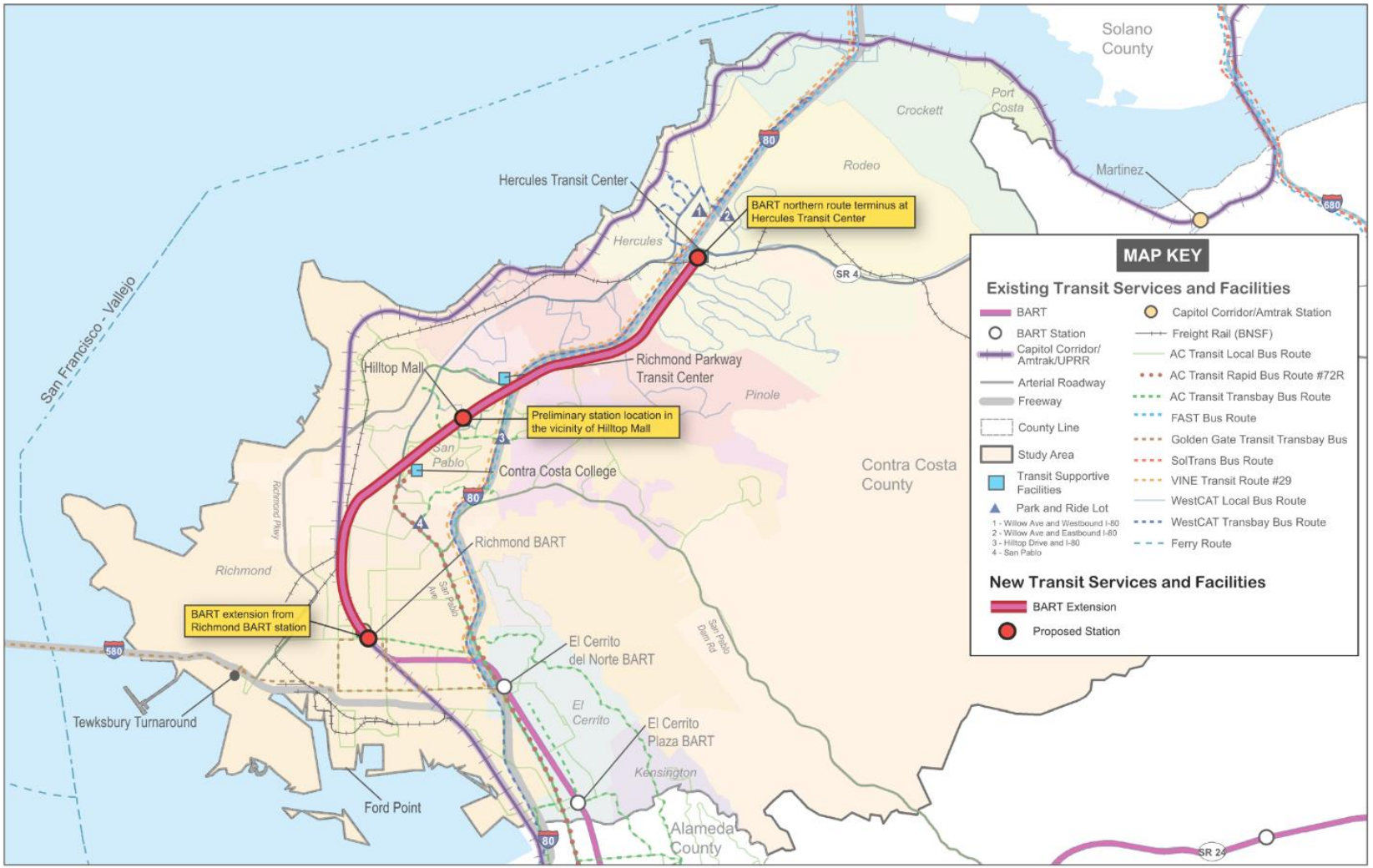
The train would be assumed to operate at the same frequencies as the existing BART lines serving the Richmond station, 15 minutes on weekdays and 20 minutes on weekends, with the same service span as the existing BART train. If this alternative is advanced for further study, ridership estimates would need to be conducted to confirm that there is adequate ridership to support this level of service.

New trains operating on this line to and from San Francisco would, however, add more passengers to two constrained BART locations that are already operating beyond capacity: the Transbay Tube and the Oakland Wye. In order to not degrade service on the existing Richmond line, a service extension could require the purchase of additional railcars, as well as the construction or enhancement of BART rail yard and shops. Like other potential extensions of BART, there would be a need to coordinate investments in the BART core system with new extensions to the system to ensure reliable operation of the entire system.

## Corridor Improvements

The right-of-way for 13th Street adjacent to the BART maintenance yard has two lanes in each direction plus parking on both sides of the street. Constructing an aerial structure in 13thstreet appears feasible and support columns could be placed within the existing street right-of-way.

**Figure 3-27: Alternative 6—BART Extension from Richmond Station to Hercules**




*Source: WSP | Parsons Brinckerhoff and Kimley-Horn, 2015*

Proceeding north, 13th Street turns into Rumrill Boulevard where the street turns into a boulevard with a landscaped median, left turn pockets and on-street parking. This portion of the proposed alignment traverses residential and neighborhood commercial areas. The housing along 13th Street/Rumrill Boulevard serves lower-income families and there could be environmental justice issues should new rail facilities be built in this area. Vacant properties along 13th Street, however, could be an opportunity for redevelopment or urban infill.

The alignment would continue on Rumrill Boulevard, turning easterly to its interception with San Pablo Avenue near Contra Costa College. The alignment would continue on Rumrill Boulevard to its intersection with San Pablo Avenue near Contra Costa College. At this location the alignment would transition to a tunnel configuration due to the major change in elevation to access the Hilltop Mall mesa. The tunnel would go under the mall and an underground station in the vicinity of the mall would be constructed. From the mall, the alignment would go under the westbound and eastbound lanes of I-80 and continue to parallel the freeway, on the east side, using a combination of elevated structure or trench depending on the grades of I-80.

Constructing the BART extension in or adjacent to the I-80 corridor would require a design that addresses the existing steep highway grades to meet BART design criteria. BART Facilities Standards (January 2015) permit vertical grades up to a maximum of 3 percent (4 percent may be possible on an exception basis). Meeting the profile standard could be achieved by using a side-running alignment with trenching through the higher elevation areas that have steeper grades and by adding retained fill or using structures to flatten grades for the lower elevations.[27]

### Vehicles

Using existing BART technology provides the opportunity for this extension to be fully integrated with other BART lines. Train frequencies for peak travel and off-peak periods could mirror the existing service on the Richmond BART line and change in the future as ridership warranted or system expansion occurred.

Maintenance of BART trains for the Richmond—Hercules extension could be conducted at the existing Richmond BART yard, but this would require additional yard track capacity. Another option would be to construct yard tracks and maintenance capability in the vicinity of Hercules. This could result in duplicative maintenance services, additional personnel and an increase in operating costs. Also, BART standards indicate that for operational purposes a turnback or storage track would be required at or near the route terminus in the vicinity of Hercules.

[27] A similar treatment was used along the BART Millbrae/SFO line between Glen Park and Colma.

## Stations

Preliminary station locations identified for this alternative include an underground, intermediate station in the vicinity of Hilltop Mall, southerly of the Richmond Parkway and I-80 to provide access to the Hilltop Mall area. At the northern terminus of this route a station has been tentatively identified for the Hercules Transit Center located at Willow Avenue near the SR 4 and I-80 intersection. This facility is currently operated by BART. There is a potential for variation on these stations locations, for example instead of a Hilltop Mall station, alternative station sites might be considered at Contra Costa College or Richmond Parkway Transit Center.

Parking spaces available for transit use vary considerably with each proposed station location. For example at Hilltop Mall, parking is widely available during week days when transit usage is at peak levels. Should the mall be redeveloped, the parking availability may be more limited unless the parking supply is expanded to accommodate both the new development and the BART station. Currently, vacant spaces are numerous and existing parking lots may offer the opportunity for shared use between mall tenants and transit users both now and in the future. At the Hercules Transit Center parking is currently near capacity with few vacant spaces during weekdays. However, the large site seems suitable for a parking structure. While a new parking structure would increase the total number of spaces to support a BART service extension and access to the station, costs would have to be a consideration as each car stall could cost $60,000 per space.

## Potential for Intermodal Connectivity

Hilltop Mall currently serves as a major transit transfer point. Intermodal connections, accommodating the connection of BART and bus services, could be incorporated into the design of the Hilltop Mall station or alternatively from the Richmond Parkway Transit Center via bus or shuttle service to/from the Hilltop Mall. Also a BRT/express bus connection, such as Alternative 1, to the Richmond Parkway Transit Center via the I-80 Corridor would be possible. Future connections to the Capitol Corridor or commuter rail along the San Francisco Bay could be achieved by providing BRT or express bus service from the Hilltop Mall station to the proposed rail station in Hercules on the UPRR rail line or to the BNSF line if that is used for passenger service in the future.

## Phasing of Improvements

Establishing a stronger market for transit by expanding express bus service along the I-80 corridor would be an interim solution for building up transit ridership in the corridor. Also as an interim, phased measure, a single station extension could be considered. Extension of BART service to the Hilltop Mall area would provide intermodal connections and increased ridership

for this line. Longer term, the service could be extended to Hercules using a phased approach as demand warrants.

### Constraints

The greatest constraints associated with a BART extension in this corridor relate to the grades that are encountered on and approaching the I-80 corridor and the ability for the BART system as a whole to absorb additional ridership, particularly in the heavily constrained transbay corridor and for trains serving the downtown and West Oakland stations.

The cost of BART service is an additional constraint. BART is the most expensive option of all high-capacity transit services considered in this study. Furthermore, the proposed BART alignment includes tunneling and aerial structures, both of which add considerable cost to the already-high cost of a BART extension.

Construction of the rail extension, requires building most of the alignment on structure or in a tunnel, resulting in a more costly solution than building the extension on flatter grades. **Figure A-1** in Appendix A shows the estimated distance of structures and tunnels in the BART alignments.

## 3.5.4 Alternative 7—BART or DMU Extension from the El Cerrito del Norte Station to Hercules

### Markets Served

This alternative connects the new markets in Hercules and Pinole with the already popular travel destinations of San Francisco, Berkeley, and Oakland destinations. The BART extension to the northern part of West County would open up new trip generators for these destinations. This alternative would provide one-seat service on BART (i.e., would not require a transfer to or from a WestCAT bus) to many additional destinations throughout the Bay Area.

Like Alternative 6, this alternative would also provide service to the areas in West County that have the greatest potential to support transit: Richmond, El Cerrito, San Pablo, Pinole, and Hercules. Trips to and from the Richmond BART Station would likely have a lower level of service as service would need to be split between the Richmond and the Hercules lines and could introduce general concerns related to Title VI and environmental justice.

### Alternative Description

This alternative would run on an aerial structure from the El Cerrito del Norte BART Station to I-80 using San Pablo Avenue or a combination of local streets and then turning easterly to run parallel to the eastbound lanes of I-80. The proposed alignment would continue to run parallel

along the eastbound lanes of I-80 until it reached the Hercules Transit Center on Willow Avenue, southeasterly of the I-80 and SR 4 interchange. **Figure 3-28** shows the proposed Alternative 7. A conceptual layout, with profile grades, is included in Appendix A.

Two sub-alternatives are proposed using different technology. Alternative 7.1 would incorporate traditional BART technology and Alternative 7.2 would incorporate DMU technology. The proposed alignment, station locations and design requirements would be the same for both Alternative 7.1 and Alternative 7.2. Alternative 7.2 would operate the DMU on standard gauge tracks, not the wider Indian gauge used for the BART system. If DMU service were to be implemented, in addition to the new operating track, separate tracks would be required to access maintenance facilities and storage/layover tracks.

Maintenance of BART trains for the El Cerrito del Norte–Hercules service could be handled at the existing Richmond BART yard, but may require additional yard track capacity. The introduction of DMU cars, would require a separate or expanded maintenance facility. For the BART technology under Alternative 7.1, the need for additional capacity would need to be confirmed. For the DMU trains under Alternative 7.2, new track would definitely be required to accommodate the different gauge of the DMU trains. Another option would be to construct a layover/maintenance facility in the vicinity of Hercules, but this may result in duplicative maintenance services, additional personnel and an increase in operating costs.

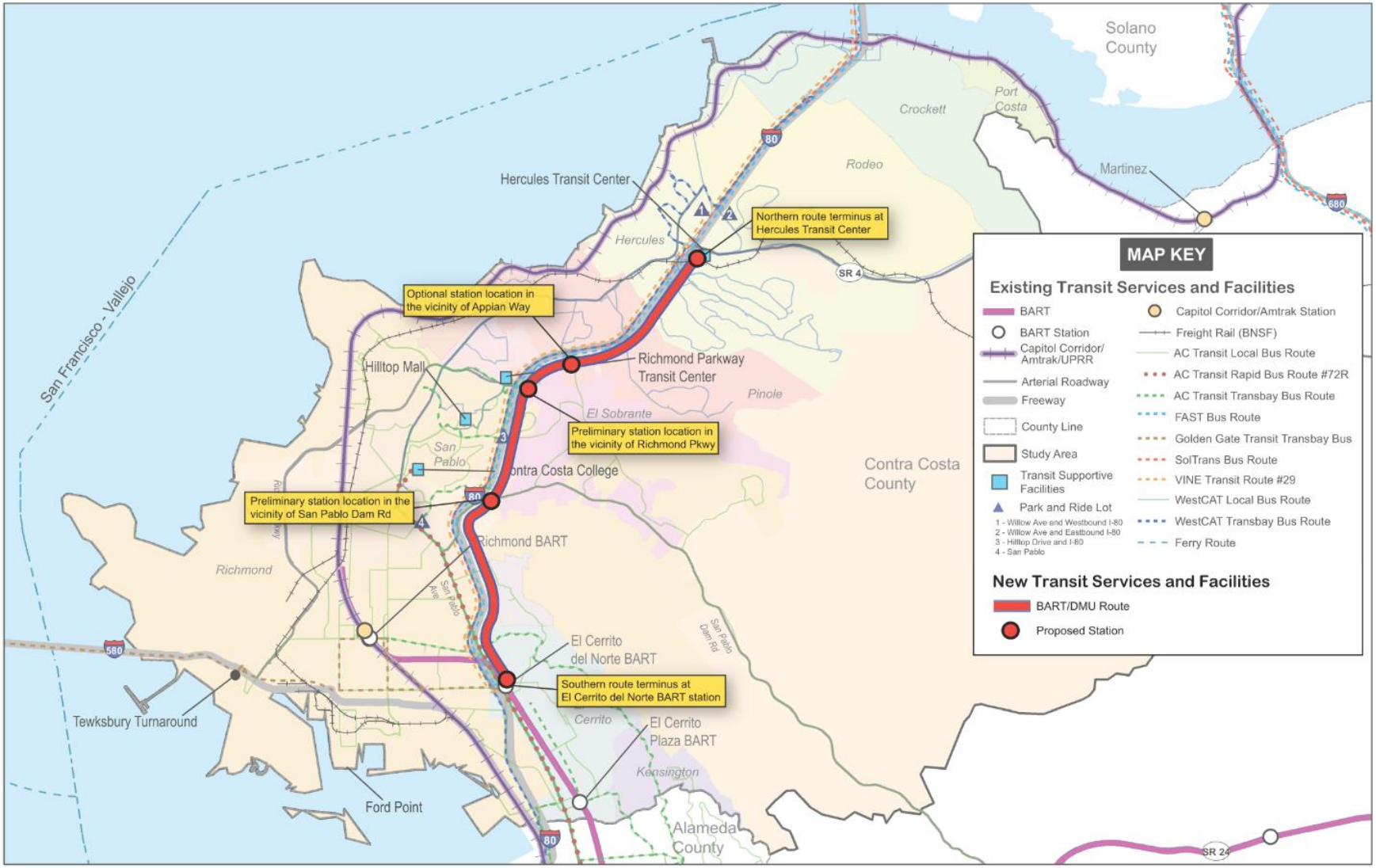
Use of DMU technology for Alternative 7.2 would include the following additional variations from Alternative 7.1 using traditional BART technology. Alternative 7.2 would:

- Require a cross-platform transfer to access the Richmond-Fremont BART line for passengers continuing their southerly trip beyond the El Cerrito del Norte Station.
- Operate the Hercules line as a local branch line or shuttle, functioning as a secondary line, as transfers would be required to continue to Hercules.

### Service Characteristics

This alternative has operational challenges for both East Bay and transbay service. For both alternatives, new passengers would be added to the Fremont-Richmond and the Richmond-Daly City/Millbrae lines. For the line serving San Francisco, additional passengers would be added to the already constrained Transbay Tube and Oakland Wye.

**Figure 3-28: Alternative 7—BART Extension from El Cerrito del Norte Station to Hercules**




*Source: WSP | Parsons Brinckerhoff and Kimley-Horn, 2015*

For Alternative 7.2, the DMU alternative, the El Cerrito del Norte station would need to be reconfigured to permit cross-platform transfers to serve the existing BART lines, since the DMU trains would not go to San Francisco/Daly City or south to Fremont. A transfer between BART and DMU service would be required for those traveling beyond the El Cerrito del Norte station. Similar to the e-BART service being implemented in eastern Contra Costa County, close timing of transfers between DMUs and BART trains could provide a reliable connection between the two systems.

This alternative would also require the Hercules - El Cerrito line to operate as a local branch line or a shuttle, functioning as a secondary line without through service. For Alternative 7.2, it would be logical to continue the main service to Richmond, with the DMU service serving as the shuttle north to Hercules.

## Corridor Improvements

Street right-of-way for the proposed alignment would be adequate at the initial segment of the extension north of the El Cerrito del Norte station. Parallel streets including Key Boulevard have a narrow right-of-way with space limitations. However, BART parking lots at the station may provide an opportunity to transition from the station over to San Pablo Avenue to access the I-80 Corridor.

Utilizing the I-80 Corridor provides an opportunity to reduce acquisition of private right-of-way and construct BART/DMU facilities within an existing transportation corridor. However, the existing vertical grades for I-80, while suitable for highway vehicles, are too steep in some locations for BART/DMU rail operations. BART Facilities Standards (January 2015) permit vertical grades up to a maximum of 3 percent (4 percent may be possible on an exception basis). Reducing the I-80 grades to meet BART requirements could be achieved by trenching or tunneling through the higher elevation areas that have steeper grades and by adding retained fill or using structures to flatten grades for the lower elevations. Maximum grades specified for the BART system are considered compatible with DMU technology as well.

Although both BART (7.1) and DMU (7.2) technologies incorporate a 3 percent maximum grade, advanced electric multiple units (EMU ) technology may allow the use of a steeper profile which could substantially reduce the cost of aerial structures and retaining walls. The Seattle Sounder Link LRT and the new Koln-Frankfurt high speed line in Germany have sustained grades of 4 percent using higher powered EMU Inter-city Express trains. However, electrifying the lines would be an additional cost consideration.

Alternative 7.2, DMU service on this line, similar to what is proposed in East Contra Costa County, could be implemented at lower cost compared to BART technology, as a powered third

rail, electrical substations and related components would not be needed. However, DMU equipment is not fully compatible with BART trains due to the difference in track gauge and absence of electrified propulsion. Thus, a transfer between BART and DMU service would be required for those traveling beyond the El Cerrito del Norte station.

The geologic map for the Richmond-San Pablo[28] area identifies a landslide rubble formation that has the potential for slope instability near the I-80 Corridor. This is located at the San Pablo Dam Road interchange with I-80. At this location it is likely that tracks would be in a tunnel or covered trench thus mitigating the risk. The BART/DMU extension from the El Cerrito del Norte BART station would cross the Hayward Fault Zone in the vicinity of San Pablo Dam Road and I-80. Designs of aerial structures and tunnels would need to consider this seismic condition.

### Vehicles

Using existing BART technology for Alternative 7.1 provides the opportunity for this extension to be fully integrated with other BART lines, use ticketing machines and other aspects of the current operation. Train frequencies for peak travel and off-peak periods could mirror the existing service on the Richmond BART line and change in the future as ridership warranted or system expansion occurred.

For Alternative 7.2, the use of DMU technology would require the adoption of new technology for BART. The use of the lighter and lower capacity DMU vehicles that can operate on 4 percent grades—would provide some greater flexibility for this option. Because it uses different vehicle technology, however, special considerations would be needed for this alternative to become operational.

The El Cerrito del Norte Station would need to be reconfigured to permit cross-platform transfers to the Fremont and Daly City lines serving this station, since the DMU trains would terminate at El Cerrito del Norte.

Maintenance of both additional BART vehicles for Alternative 7.1 and DMU vehicles for Alternative 7.2 would require additional yard track capacity, thereby increasing the non-revenue train miles. Another option would be to construct a layover/maintenance facility in the vicinity of Hercules, but this may result in duplicative maintenance services, additional personnel and an increase in operating costs.

[28] US Geological Survey, Geological Map of the Richmond Quadrangle, Contra Costa County, 2005.

## Stations

Potential station locations for Alternative 7.1 and 7.2 have been identified for the following locations: the vicinity of San Pablo Dam Road and I-80; vicinity of Richmond Parkway and I-80; at or near Appian Way and I-80; and the northern terminus proposed for this route would be at the Hercules Transit Center, located near the I-80 and SR 4 interchange.

Parking spaces available for transit use vary considerably with each proposed station location. For example, at the Hercules Transit Center, parking is very constrained during week days when transit usage is at peak levels. Few vacant spaces are available; however, the large site could provide the space for a parking structure, which would increase the total number of spaces to support an extension of BART or DMU service. At the Richmond Parkway park-and-ride lot some vacant spaces appear to be currently available, but expansion of parking may be needed depending on ridership demand and number of future users arriving by auto. For proposed stations at Appian Way and San Pablo Dam Road, parking would need to be built as part of each station's development.

## Potential for Intermodal Connectivity

Extending BART service north to Hercules would add new markets to take advantage of the connections with Capitol Corridor trains and Amtrak's San Joaquin and the California Zephyr available at the Richmond BART Station (this alternative would require a transfer to make the connection). Alternatively, a future connection to commuter rail service would be possible at the Hercules Transit Center on a potential BNSF alignment (Alternative 5). Future connections with BRT or express bus services along the I-80 corridor could be possible at the Hercules Transit Center, Richmond Parkway Transit Center, at Appian Way and I-80, and at the San Pablo Dam station site.

## Phasing of Improvements

As an interim, phased measure, a single station extension could be considered. Extension of BART service to the potential station sites at San Pablo Dam Road or Richmond Parkway Transit Center would provide intermodal connections and increased ridership for this line. Longer term, the service could be extended to Hercules using a phased approach as demand warrants.

A one-station extension for DMU service is also possible, but would be more challenging given the expense associated with the acquisition of new vehicles and the need for special maintenance facilities.

## Constraints

Several operational challenges for this alternative have been identified, for both East Bay and transbay service. Both Alternative 7.1 and 7.2 would face the challenge of high-cost structure and tunnels to accommodate service in the I-80 corridor. While BART and DMU can be built on structure or in a tunnel, this is more costly than building the extension at flatter grades.

For both alternatives, new passengers added to the San Francisco line would contribute to further crowding on the already capacity constrained San Francisco Transbay Tube and for trips destined to downtown and West Oakland as well. As with other extensions proposed for the BART system, investment would be required in the core system to ensure that service on the network is not degraded.

Alternative 7.1 has the potential to isolate the Richmond BART station as either it or the extension to Hercules/Pinole would need to be operated as shuttle service or as a secondary line. This alternative would need to consider how service destined to Richmond and service destined to Hercules via El Cerrito del Norte would be split, thereby potentially reducing service levels to Richmond. The reduction of service to the BART Richmond Station is likely a Title VI and environmental justice issue. This problem is minimized under Alternative 7.2, as the Richmond line would remain the main BART line, with the DMU service operating as a shuttle to Hercules/Pinole.

For Alternative 7.2, the DMU alternative, the El Cerrito del Norte Station would need to be reconfigured to permit cross-platform transfers to accommodate through movement on the BART system. If DMU service were to be implemented, new facilities would be required that are separate from existing facilities, including new operating track, new maintenance facility (or expanded existing maintenance), separate tracks access maintenance facilities, and storage/layover tracks.

# 4 SUMMARY

The most promising high-capacity alternatives defined in this Technical Memorandum include a mix of modal route extension options, including express bus and bus rapid transit; rail, including commuter rail and BART; and ferry. The alternatives were developed with respect to the goals and objectives adopted by WCCTAC and taking into account previous and ongoing studies, new information collected as part of this study, including the market analysis, and refinement of previous high performing options. The alternatives serve the documented travel markets, represent proven modes of transit travel and offer high capacity options for West County residents and employees.

Some alternatives have multiple termini and up to two modal options. Multiple termini, or destinations, will be evaluated for ridership potential and then refined to reflect a primary terminus or primary and secondary termini. Dual modal considerations are under consideration for: BRT corridors that lend themselves to upgrade to light rail transit as transit demand increases with more intensive development along the corridors; commuter rail corridors that could use DMU technology as an alternative to conventional heavy rail; and DMU as an alternative to extending BART from the El Cerrito del Norte Station. Like LRT, BART is a more cost-effective mode when transit demand increases and frequent, very high-capacity train service is required to accommodate demand (generally in areas of high population and/or employment density).

A preliminary assessment of the potential intermodal connections provided by these alternatives as compared to the existing conditions is provided in **Table 4-1**.

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**Table 4-1: High Capacity Transit Multi-Modal Connections**

| | | Oakland Jack London Square/ Amtrak Station | 12th & 19th Street BART stations | El Cerrito del Norte BART station | Richmond BART/ Amtrak stations | Atlas Way Commuter Rail | Tewksbury Turnaround | Park-and-Ride Richmond Pkwy/Canal Blvd | Park-and-Ride 23rd St/Marina Bay Parkway | Richmond Ford Point Ferry Terminal | Express Bus Stop San Pablo Avenue and Barrett Avenue | Contra Costa College Transit Center | Hilltop Mall Transit Center | Richmond Pkwy Transit Center | Hercules Transit Center | Hercules Intermodal Transit Center | Martinez Commuter Rail |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bus Service** | | | | | | | | | | | | | | | | | |
| ***Existing*** | | | | | | | | | | | | | | | | | |
| | AC Transit Line 72R | ■ | ■ | ■ | | | | | | | | ■ | | | | | |
| | AC Transit Line 72M | ■ | ■ | ■ | ■ | | ■ | | | | | | | | | | |
| | AC Transit Line 74 | | | | ■ | | | | | ■ | | ■ | ■ | | | | |
| | WestCAT Line J | | | ■ | | | | | | | | | ■ | ■ | ■ | | |
| | WestCAT Line C-3 | | | ■ | | | | | | | | ■ | ■ | | | | |
| | Golden Gate Transit Line 40 (Marin County/Richmond-San Rafael Bridge) | | | ■ | | | ■ | | | | | | | | | | |
| | Golden Gate Transit Line 42 (Marin County/Richmond-San Rafael Bridge) | | | ■ | ■ | | ■ | | | | | | | | | | |
| | SolTrans (Solanto County/Carquinez Bridge) | | | ■ | | | | | | | | | | | | | |
| | Vine Transit (Napa County/Carquinez Bridge) | | | ■ | | | | | | | | | | | | | |
| ***Proposed Alternatives*** | | | | | | | | | | | | | | | | | |
| | Alternative 1 - Express Bus service (I-80) | | ■ | | | | | ■ | ■ | | ■ | | | ■ | ■ | | |
| | Alternative 2 - San Pablo Avenue/Macdonald Avenue BRT | ■ | ■ | | ■ | | ■ | | | | | ■ | ■ | ■ | ■ | | |
| | Alternative 3 - 23rd Street BRT | | | | ■ | | | | | ■ | | ■ | ■ | | ■ | ▭ | |
| **Rail Service** | | | | | | | | | | | | | | | | | |
| **Existing** | | | | | | | | | | | | | | | | | |
| | Capitol Corridor | | | | | | | | | | | | | | | | |
| ***Proposed Alternatives*** | | | | | | | | | | | | | | | | | |
| | Alternative 4 - UPRR Corridor Commuter Rail | ■ | | | ■ | | | | | | | | | | | ■ | ■ |
| | Alternative 5 - UPRR -BNSF Corridor Commuter Rail | ■ | | | ■ | ■ | | | | | | | | | ■ | | ■ |
| **BART Service** | | | | | | | | | | | | | | | | | |
| ***Existing*** | | | | | | | | | | | | | | | | | |
| | San Francisco-Richmond Line | | ■ | ■ | ■ | | | | | | | | | | | | |
| | Richmond-Fremont Line | | ■ | ■ | ■ | | | | | | | | | | | | |
| ***Proposed Alternatives*** | | | | | | | | | | | | | | | | | |
| | Alternative 6 - BART Extension from Richmond Station to Hercules | | ■ | ■ | ■ | | | | | | | ■ | ■ | | ■ | | |
| | Alternative 7.1 - BART Extension from El Cerrito del Norte Station to Hercules | | ■ | ■ | ■ | | | | | | | | | ■ | ■ | | |
| | Alternative 7.2 - DMU Extension from El Cerrito del Norte Station to Hercules | | ■ | ■ | ■ | | | | | | | | | ■ | ■ | | |

| Legend | |
|---|---|
| ■ | = Serves transit facilities at this location |
| | |
| ▭ | = Optional extension will serve transit facilities at this location |

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# 5 NEXT STEPS

The high-capacity alternatives identified in this technical memorandum will be reviewed with respect to the Evaluation Criteria described in Technical Memorandum #9. The two-step screening process will apply the evaluation criteria, which reflect the project goals and objectives, to each alternative at each step. At the conclusion of the first tier, qualitative evaluation, four alternatives will be advanced for further definition including: additional detail on the physical features of the mode, including termini and stations; capital and operating costs; environmental impacts; and ridership in the context of current and future (2040) land use and socio-economic conditions.

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# Appendix A

# BART Profiles

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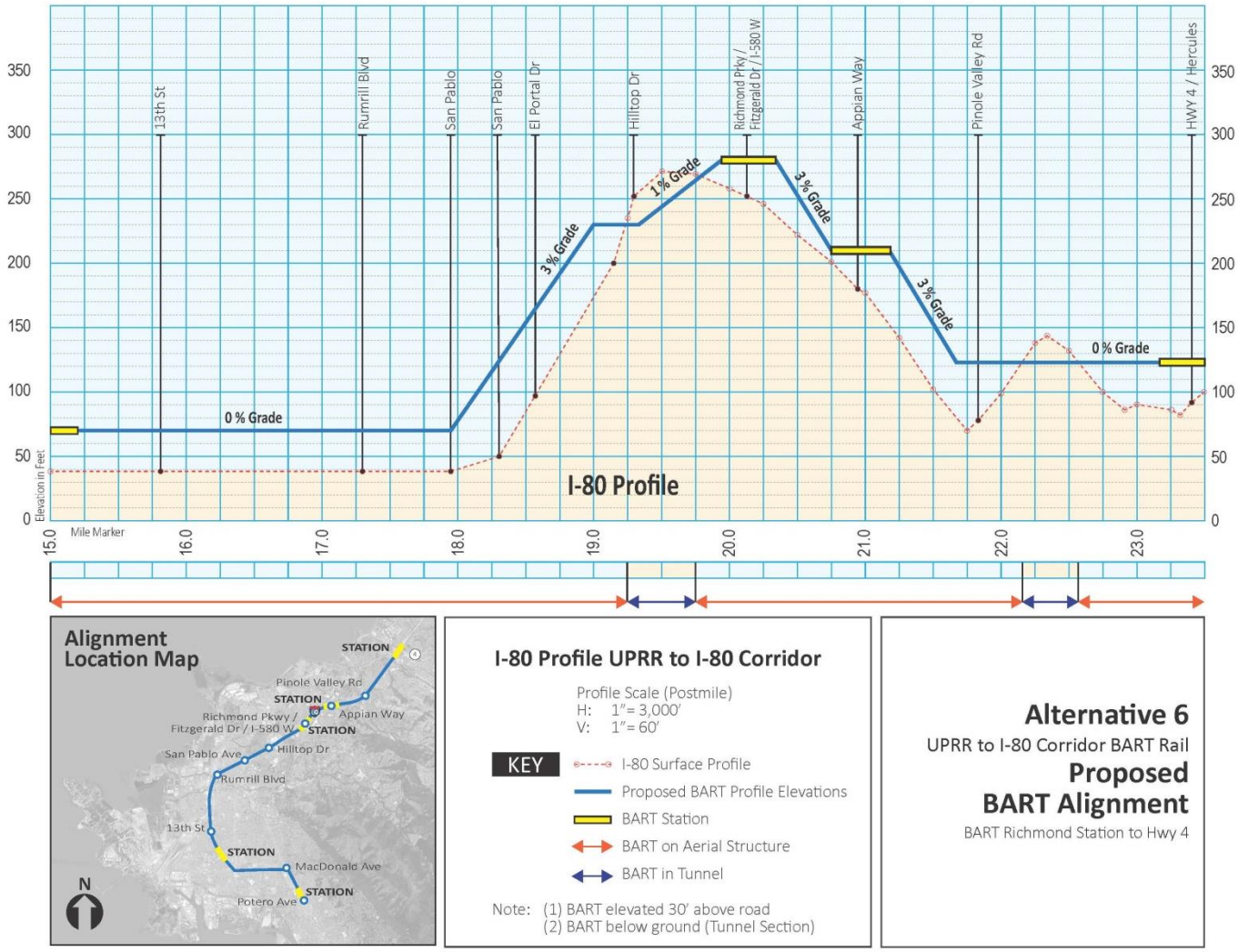
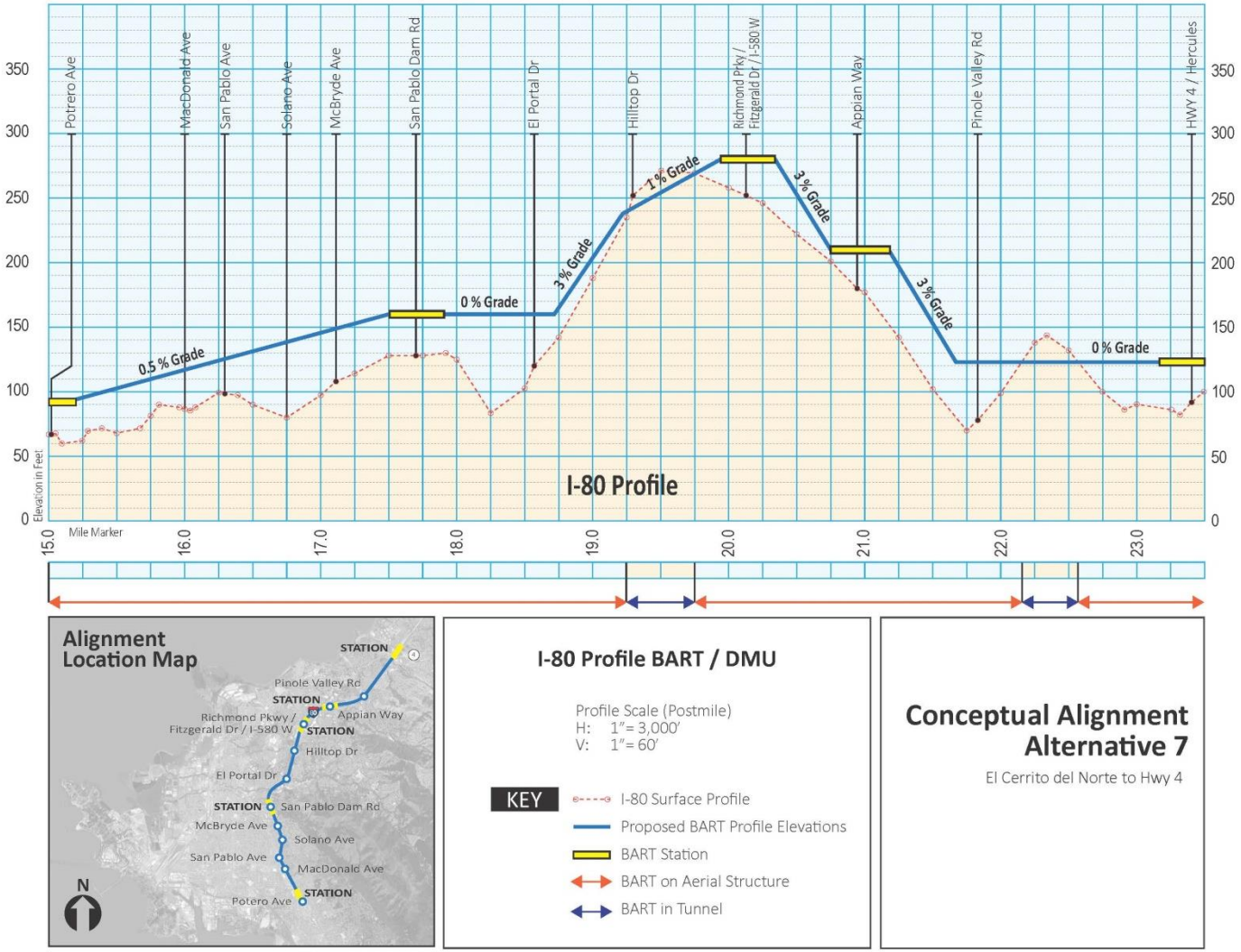
**Figure A-1: Alternative 6 —BART Extension from Richmond Station to Hercules Profile**




*Source: WSP | Parsons Brinckerhoff, 2015*

**Figure A-2: Alternative 7 —BART Extension from El Cerrito del Norte Station to Hercules Profile**




*Source: WSP | Parsons Brinckerhoff, 2015*