METROPOLITAN TRANSPORTATION COMMISSION

Southern Alameda County Rail Integrated Analysis

Appendix E: Ridership, Revenue and Train Capacity Analysis

July 20, 2023

In partnership with:

San Joaquin Regional Rail Commission

Alameda County Transportation Commission

CalSTA

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METROPOLITAN TRANSPORTATION COMMISSION

Memo

Date:	Thursday, July 20, 2023
Project:	Southern Alameda County Integrated Rail Analysis (SoCo Rail Study)
To:	Kara Vuicich, MTC Project Manager Dan Leavitt, SJRRC
From:	AECOM
Subject:	**Ridership, Revenue, and Train Capacity Analysis Technical Memorandum**

Introduction

The Southern Alameda County Integrated Rail Analysis (SoCo Rail Study) builds on the foundation of the 2018 California State Rail Plan (CSRP), which established a 2040 statewide vision for an integrated statewide passenger rail and express bus network that would be implemented in near-term, medium-term, and long-term phases. As part of this vision, the 2018 CSRP identified numerous rail hub stations around the State. One hub identified is an "East Bay" hub located in southern Alameda County, which sits at the nexus of the megaregional rail services from Sacramento and Central Valley and the Bay Area rail and bus services.

During Phase 1 of the SoCo Rail Study, Metropolitan Transportation Commission (MTC) and its partners identified the existing Union City Intermodal Station, which includes the San Francisco Bay Area Rapid Transit (BART) Station, as the best location for the rail-to-rail East Bay Hub as identified in the 2018 CSRP. In partnership with BART and AC Transit, the City of Union City adopted the Intermodal Station District Plan in 2002 to create a pedestrian- and transit-oriented community surrounding the Union City BART Station with future rail and transit connections.

Based on the location of the rail-to-rail hub connection, as per the 2018 CSRP, and in coordination with the City of Union City, the proposed project is referred to as the "Union City Intermodal Station Phase 3 Project". Phase 2 of the SoCo Rail Study advanced the planning for the Union City Intermodal Station Phase 3 Project, identifying the necessary infrastructure improvements to deliver three Altamont Corridor Express (ACE) intercity rail round trips, operated by the San Joaquin Regional Rail Commission (SJRRC) to and from the Union City Intermodal Station.

Purpose of This Memorandum

This technical memorandum summarizes the methodology used to develop ridership forecasts for the Southern Alameda County Integrated Rail Analysis ("SoCo Rail Study") to support a proposed extension of Altamont Corridor Express (ACE) service to the Union City Intermodal Station, where ACE will connect with the BART system, Transbay buses to the Peninsula, and other local transit services. In addition to this extension, the ridership forecasting effort also includes the expanded Valley Rail Program providing connectivity to the high-speed rail (HSR) Early Operating Segment (EOS) between Merced and Bakersfield, as well as the North Valley Rail project to extend rail service north of Sacramento into Yuba and Butte Counties. This memorandum describes the process of developing the ridership forecasts, including key assumptions and inputs such as demographic data and conceptual operating plans, and summarizes the ridership results.

The memorandum is divided into the following main sections:

- General Methodology
- Base-Year Ridership and Validation
- Demographic Assumptions
- Scenarios and Forecasts
- Train Capacity Analysis

General Methodology

The ridership forecasts were developed by combining and synthesizing results from two independent models: (1) the ACE Passenger Rail Forecasting Model ("ACE Model"), and (2) the Alameda County Transportation Commission (ACTC) travel demand forecasting model ("ACTC Model"). This joint-model approach allows the ridership forecasting effort to take advantage of each individual model's strengths.

The ACE Model is focused specifically on ACE (and passenger rail, in general), and encompasses a larger, megaregional and interregional geography for the expanded ACE and Amtrak San Joaquins systems that is well beyond the geographic extent of any of the individual urban travel demand models used by the Metropolitan Transportation Commission (MTC), the San Joaquin Council of Governments (SJCOG), or other applicable metropolitan planning organizations (MPOs). On the other hand, the ACTC Model provides finer modeling detail at the Union City end of the system, including network assignment procedures to allow for better reporting of transfers within the Bay Area.

The two individual models (ACE Model and ACTC Model) and the joint-modeling approach are described in more detail in the following subsections.

ACE Model

AECOM developed and has used the ACE Model to forecast ridership for recent and ongoing plans and projects to implement service improvements to and extensions of the ACE and Amtrak San Joaquins service as part of the Valley Rail Program (including ACE extensions to Sacramento and Merced). The ACE Model has also been used to support ridership forecasting efforts for the Valley Link project.

The ACE Model considers both intercity and commuter passengers and is based on a ridership forecasting model for Amtrak called the National Intercity Model, also developed by AECOM. The ACE Model was calibrated to match existing ACE and San Joaquins ridership and updated to account for future short- and long-term investments in the passenger rail network in Northern California, including select connections with BART. Additionally, it has been updated to include Valley Link service.

The ACE Model is an incremental model designed to produce ridership forecasts for mainline passenger rail services. The model pivots off of observed ridership and service by station pair to capture the ridership impacts of making incremental changes to service. Forecasts are based on demographic growth around stations and service characteristics (such as train frequency, travel times, and the time of day that trains operate). In cases where there is no existing service, a new station is assigned a “proxy” station that has similar characteristics (e.g., station area population and employment levels) to the new station, and the base ridership is adjusted to account for differences in market size and service. Each train is modeled separately, which allows for time-of-day factoring for both departure and arrival times. Connections are explicitly modeled and factored down to reflect the lower appeal of a required transfer. The model produces ridership forecasts that are unconstrained with regards to train capacity and parking capacity.

The three primary inputs to the ACE Model—base-year ridership, demographics, and service plan—are discussed in more detail in later sections of this memorandum.

MODEL LIMITATIONS

Due to the ACE Model being specifically focused on quantifying the ridership impacts of incremental changes to passenger rail service, it does not include features frequently found in other types of models, such as urban travel demand forecasting models used by MPOs. Thus, the model does not incorporate features such as trip purpose or rider characteristics, which are frequently found in urban travel demand forecasting models. Similarly, the model does not account for the effects of additional roadway congestion (e.g., automobile travel times) or local transit connections, nor does it forecast changes in travel by other modes (e.g., road or air for longer-distance travel, or road, local transit, biking, and walking for shorter-distance travel).

Such effects and features require additional input data and may be more valuable or meaningful in larger, more complex models used to simulate and forecast a wider range of metrics at a finer level of detail. Urban travel demand models used by MPOs are designed to produce forecasts across hundreds or thousands of transportation analysis zones (TAZs) within an entire metropolitan area. Such models therefore need to include a high level of detail on the street grid and roadway network, transit system and service characteristics, and other parameters of the overall regional transportation network. These models may also be designed to simulate behavior across *multiple* travel modes, in which case it may be important to capture personal or trip-specific characteristics (e.g., trip purpose, household income, etc.) that affect mode choice, as well as the effects of mode-specific constraints on those choices (e.g., effects of roadway congestion on transit ridership). Including personal or trip-specific characteristics typically requires extensive data collection on travel behavior and ultimately may still require assumptions about travel (e.g., value of travel time savings), which may be difficult given the uncertainty surrounding post-pandemic trends for commute and other travel.

In the case of this ridership forecasting effort for the extension of ACE to the Union City Intermodal Station, however, the desired outputs are singularly focused: station-level ridership for one mode (passenger rail), for a much coarser network (i.e. less than 50 stations within the overall Valley Rail system as compared to hundreds of stations and bus stops in a typical urban travel model), and for an incremental change (expansion of an existing system). Thus, use of a more complex model would not necessarily produce results that are substantially different from, or more accurate than, a more focused model like the ACE Model.

- ***Local Transit Connections***

While the ACE Model is focused primarily on mainline passenger rail (commuter and intercity), it also includes other services that exist because they provide a connection to mainline passenger rail. Thus, while the model does not explicitly include local transit connections at stations (e.g., BART, local bus or light rail, etc.), it does include the HSR connection in Merced, as well as select Thruway bus connections that are specifically designed to extend the reach of the mainline passenger rail network to areas that do not have direct train service. These connections are explicitly modeled as part of the overall service plan (represented by timepoints in a combined systemwide timetable), with additional application of a “transfer penalty” factor to account for the inconvenience and lower appeal of required transfers.

While the model does not include local transit connections, the effect of these connections on overall ridership is implicitly considered in the model calibration effort. In much of the Central Valley, for example, local transit services are limited and are not expected to increase in frequency or coverage to meaningfully affect the forecasted ridership. In addition, the use of a joint-model approach combining the ACE Model with the ACTC Model (as described in further detail later) partially compensates for some of the limitations in the ACE Model by allowing for better assignment and better transfer reporting within the Bay Area, where local transit and other multi-modal station access (e.g., biking, walking, etc.) are more prevalent.

- ***Roadway Congestion***

While roadway congestion is not modeled explicitly in the ACE Model, its effects are captured implicitly when the Model is calibrated to base-year rail ridership, which is affected by base-year automobile travel times and roadway congestion levels. Therefore, the Model implicitly assumes that future-year roadway congestion will be similar to existing conditions. As described in more detail later in this section, use of a joint-model approach combining the ACE Model with the ACTC Model also allows for the effects of roadway congestion to be accounted for explicitly within the Bay Area and also San Joaquin County, where high levels of congestion on highways are a key factor in ridership.

- ***Trip Purpose and Rider Characteristics***

Trip purpose and rider characteristics are not modeled explicitly in the ACE Model. Instead, these details are captured implicitly when the ACE Model is calibrated to base-year rail ridership and through the use of “proxy” stations, which help the ACE Model understand the characteristics of new stations by relating new stations to comparable existing stations. By pivoting off the calibrated base-year model, for example, the future-year forecasts therefore assume that the distribution of trip purposes and rider characteristics remain unchanged or similar to base-year conditions. In addition, the use of proxy stations partially accounts for key market differences (e.g., commuter travel vs. intercity travel) based on trip distance and expected fares.

MODEL OUTPUTS

In addition to the primary output (ridership), the ACE Model also produces several secondary outputs that are derived directly from the ridership, including revenue and avoided vehicle miles traveled (VMT).

- ***Revenue***

Fares do not affect ridership numbers directly in the ACE Model, and revenue is calculated based on the ridership forecasts. Unmodeled attributes such as fares are therefore indirectly included in the incremental model through the calibrated baseline ridership, in that it is assumed that the proposed fares will be the same or similar to the existing fares. In cases where there is no existing ridership, such as for extensions, new stations are assigned a proxy station that has similar characteristics (including market size, service levels, and fares) to the new station.

The revenue is calculated as the forecasted ridership for each station pair multiplied by the existing average fare for each station pair. For new station pairs, fares are interpolated based on existing fares.

- ***Avoided Vehicle Miles Traveled***

As automobile travel is not included in the ACE Model, avoided VMT is estimated by taking passenger miles traveled (PMT)—i.e., train miles by station pair multiplied by ridership—and adjusting PMT downward using a factor that represents average vehicle occupancy (AVO) for personal vehicle travel and other effects described below.

In terms of AVO assumptions for intercity transportation, an AVO of 1.2 has been used by the California High-Speed Rail Authority (CHSRA) and the Early Train Operator (ETO) for estimating VMT reductions and associated greenhouse gas (GHG) reductions for the HSR EOS.[1] AVO rates for commuter-focused projects (such as commuter rail and freeway improvements), on the other hand, are generally lower than for intercity rail projects, reflecting a higher propensity for single-occupant vehicles (SOVs) for commute travel due to shorter trip distances, employment requirements (e.g., unusual shift times, work vehicle requirements), and other considerations. The San Joaquin Council of Governments (SJCOG), for example, has applied AVO rates as low as 1.10 and 1.15 for the Valley Link rail project and for various freeway improvement projects along Interstate 580 (including the segment through the Altamont Pass), Interstate 205, State Route 99, and State Route 120 within San Joaquin County.[2] ACTC

[1] *California High-Speed Rail Early Train Operator Side-by-Side Study Quantitative Report* (February 8, 2020), available at https://hsr.ca.gov/wp-content/uploads/docs/about/business_plans/2020_Business_Plan_Side_by_Side_Study_Quantitative_Report.pdf.

[2] *Congested Corridors Plan* (March 2020), available at https://www.sjcog.org/DocumentCenter/View/5121/SJCOG-Congested-Corridor-Plan-Report-final?bidId=.

estimated similar but slightly higher AVO rates, ranging from 1.16 to 1.22, for Interstate 580 within the Tri-Valley based on 2018 data.[3]

Given the potential variability in AVO across geographies and trip types/purposes, the ACE Model simplifies the VMT estimation process by assuming a conservative factor of 1.375 for AVO. This value was originally an AVO estimate derived from data collected in a Caltrans survey of drivers using westbound I-580 over the Altamont Pass, conducted on a Thursday in September 2005. The value was derived from responses to a question relating to group size, which was then extrapolated to average daily traffic.

More recent sources, however, have assumed or estimated substantially lower values for AVO, including the ACTC estimates (ranging from 1.16 to 1.22) developed in 2018. This trend may be a reflection of differences in geography or location (Altamont Pass vs. Tri-Valley) and margins of error in the 2005 survey methodology, as well as the general decrease in carpooling over the last several decades. Beyond the general decline in carpooling, the ACTC also specifically noted that AVO rates along I-580 decreased with implementation of express lanes within the Tri-Valley portion of the corridor.[4]

Despite these differences, the ACE Model has conservatively retained use of the much higher AVO estimate of 1.375 derived from the 2005 Caltrans survey data, which results in a lower estimate of avoided VMT when compared to alternative AVO values that are lower. It also aligns better with higher expected AVO rates for intercity travel (compared to commute travel), recognizing that the proposed Union City rail service and much of the larger future service plan for the combined ACE and San Joaquins system are specifically designed to capture intercity travel (as discussed in more detail in the “Scenarios and Forecasts” section of this memorandum). Use of 1.375 instead of lower values also allows the AVO estimate to account both for the AVO rate and for other effects on PMT that would not reduce VMT, such as induced demand, changes in train or station choice among existing riders, and mode shifts from non-automobile modes.

Induced demand, for example, represents new trips induced specifically by the project and would not represent a VMT reduction benefit of the project. This also holds for existing riders who switch trains (i.e., take a train at a different time) or shift from another non-automobile mode (e.g., local transit or intercity bus) as a result of the project. In all of these cases, the project would not generate a VMT reduction benefit. In the case of riders who shift stations, there may be some (typically minor) VMT reduction benefit, such as from an existing ACE passenger who shifts to Union City and walks to their workplace instead of using the Fremont station and taking a taxi or transportation network company (TNC) vehicle (e.g., Uber, Lyft).

When holding PMT constant, use of an AVO of 1.375 instead of 1.20 (as suggested based on the general upper bound of AVO rates from the various sources cited above) results in an avoided VMT estimate that is approximately 13 percent lower, which reasonably accounts for

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[3] *I-580 Express Lanes After Study: Report to the California State Legislature* (October 25, 2018), available at https://www.alamedactc.org/wp-content/uploads/2018/11/580_Express_Lanes_After_Study_FINAL-1.pdf.

[4] *Ibid.*

induced demand and the other effects described above. Compared to a lower baseline AVO of 1.15 for commute travel, the difference increases to 16 percent.

It should also be noted that the actual (i.e., net) benefit of the project with respect to VMT reductions should be calculated by taking the *incremental* change in the avoided VMT (i.e., from No Build to Build). The No Build and Build scenarios for the project are described in more detail in the “Scenarios and Forecasts” section of this memorandum.

ACTC Model

The ACTC Model is the countywide transportation planning model for use within Alameda County, and is maintained and updated by ACTC in consultation with MTC, Alameda County, and local jurisdictions within the County. Like the other countywide models in use within the nine-county San Francisco Bay Area, the ACTC Model is consistent with the regional travel demand forecasting models maintained by MTC, as well as the land use and socio-economic database maintained by the Association of Bay Area Governments (ABAG).

The ACTC Model is a typical four-step model and includes an iterative feedback loop to ensure that travel choices are predicted based on congested travel conditions. After traffic is assigned to the road network, congested travel times are calculated based on traffic congestion, and these congested times are brought back to the mode choice step which considers the attractiveness of auto versus transit for each trip. The loop is repeated to ensure stable results.

In support of the BART to Livermore Extension Draft Environmental Impact Report (“BLVX DEIR”), a modified version of the ACTC Model was developed, with refinements to improve model validation for travel between the Tri-Valley and San Joaquin County and the rest of the San Francisco Bay Area. This version of the ACTC Model was then used to forecast traffic volumes and transit ridership in the Tri-Valley area for the BLVX DEIR. The model demographics were updated to include the demographics from Plan Bay Area 2040 and SJCOG’s 2018 Regional Transportation Plan (RTP), as discussed in more detail in the “Demographic Assumptions” section.

The ACTC Model includes a network representation of local transit services within Alameda County, as well as key regional transit services that connect Alameda County with the larger Bay Area. Transit services represented in the ACTC Model include BART, Amtrak, Caltrain, Muni Metro, Santa Clara Valley Transportation Authority (“VTA”), Sonoma–Marin Area Rail Transit (SMART), AC Transit, Union City Transit, the San Joaquin Regional Transit District (“RTD”) (bus service to / from BART’s Dublin / Pleasanton Station), and ferry services. In particular, the ACTC Model represents BART service and the interaction between BART and other services well. The ACTC Model therefore serves as a good tool to understand the interaction between urban transit services.

The ACTC Model covers Alameda County, the other eight counties of the nine-county Bay Area, and San Joaquin County. However, the network is not very detailed in San Joaquin County and the zones are coarser. Planned ACE extensions and other transit services beyond San Joaquin County are not represented in the ACTC Model.

Joint ACTC–ACE Model

As mentioned above, the ACTC Model is a good tool to understand the interaction between BART and other transit services within the Bay Area, as well as the influence of traffic congestion within San Joaquin County. In contrast, the ACE Model does a good job representing ACE service and mainline passenger rail, especially beyond San Joaquin County. Therefore, for the SoCo Rail Study, AECOM developed a joint model based on the ACE Model and the "BLVX" version of the ACTC Model. Outputs from the ACE Model were combined with the ACTC Model to take advantage of the ACTC Model's network assignment procedures, enabling better reporting of transfers and other ridership statistics.

The first step in this process was to run the ACE Model to forecast ridership outside the geographic area of the ACTC Model. For this step, station-to-station trip tables were produced for the ACE network and the new Union City train services.

Next, the base year ACTC Model was run. The proposed ACE service (described in more detail in the "Scenarios and Forecasts" section of this memorandum) was inputted into the model as an additional ACE line with the service truncated to the portions of the proposed routes within the Bay Area counties (Alameda County and Santa Clara County) and San Joaquin County, as the ACTC Model's coverage does not extend beyond San Joaquin County. Like other transit services in the ACTC Model, the ACE extension to Union City was coded with the proposed stops, running times, and headways, in the standard model input format. Unlike the detailed train-level timetable in the ACE Model, the ACTC Model utilizes a headway representation of transit service.

The resulting station boardings were then compared to boardings from the ACE Model. The proposed ACE extension to Union City provides a connection to the Union City Intermodal Station, which opens up convenient access to BART for markets along the ACE network. As mentioned previously, however, the ACTC Model does not adequately represent demand beyond San Joaquin County. Therefore, station-to-station forecasts from the ACE Model were added to the ACTC Model. Station-to-station trips from the ACE Model were allocated to specific origins and destinations, approximated using a contiguous series of TAZs covering the geographic extent of the modeling effort in the ACTC Model. The results were then checked to avoid double-counting trips forecasted in the ACTC Model, creating a combined set of transit trip tables to assign to the ACTC Model networks for generating estimates of boardings and alightings at the Union City station.

As described above, the integration of the ACE Model and the ACTC Model helps to understand and provide better distribution of ACE trips into the Alameda County area using the detailed transit network and transit assignment procedures in the ACTC Model. This joint-model approach also allows some effects, such as roadway congestion, to be partly accounted for explicitly within the Bay Area portion of the ACE system. Congestion between Union City and the Tri-Valley and San Joaquin County, for example, is inherently captured by the ACTC Model when estimating ridership at Union City.

Combining the ACTC Model with the ACE Model also recognizes that the ACTC Model does not capture detailed effects outside of the nine-county Bay Area and San Joaquin County. In fact, most urban travel demand models are designed specifically for use at the city, county, or metropolitan / urbanized area level, and are not designed to produce forecasts or simulate effects at the megaregional scale of the combined ACE and San Joaquins system.

Base-Year Ridership and Validation

As described previously, the ACE Model is primarily driven by base-year ridership, demographics, and service characteristics. This section describes the process of developing and validating the base-year ridership for the ACE Model.

As the ACTC Model is maintained separately by ACTC, no validation is necessary for the ACTC Model. There were no changes to the ACTC Model's structure, constants, factors, or other elements as part of this SoCo Rail Study forecasting effort, other than to update the demographic inputs to reflect the latest available data at the time the model was being set-up. The process of updating demographic assumptions for both the ACE Model and the ACTC Model are discussed in subsequent sections later in this memorandum.

National Intercity Model

The ACE Model was originally based on the National Intercity Model developed by AECOM to support proposed changes and service improvements in both long- and short-distance rail corridors throughout the United States, including state-supported corridors. This model has been used for a variety of purposes, including by Amtrak and its state partners to plan and budget for intercity passenger rail services:

- Business planning
  - Amtrak: Annual budget development
  - California Department of Transportation (Caltrans): Yearly Corridor Business Plans
  - Caltrans: California State Rail Plan (10-year horizon)
- Service planning
  - Evaluation of service options on existing routes:
    - Travel times
    - Stopping patterns
    - Frequency
  - Evaluation of service options on new routes
    - New corridors / markets
    - Extensions of existing corridors

ACE Model Genesis and Calibration

The ACE Model was developed to support the ridership forecasting efforts for ACE, including the existing commuter rail service and future commuter and intercity rail expansions within the Central Valley, the Altamont Corridor, and elsewhere. Drawing from the Model's original roots in the National Intercity Model, the ACE Model has been upgraded and expanded to include the

San Joaquins intercity rail service, which shares much of its service area in the Central Valley with the existing ACE service and future planned ACE expansions.

One of the most significant early applications of the ACE Model was for the ACE*forward* program, composed of an expansive series of service changes for ACE that included travel time reduction, additional round trips, extensions into new corridors, new stations on the existing ACE route, new weekend service, potential HSR connections in Merced, and potential BART connections in the Tri-Valley or at Union City.

As part of the development process for ACE*forward*, the ACE Model was calibrated to ACE ridership in Fiscal Year (FY) 2013, using observed daily ridership reports logged by the contract operator (Herzog Transit Services) for four days in 2013 (July 9, August 13, September 17, and November 19). Table 1 summarizes average station ons and offs and segment volumes for the selected dates in 2013.

Table 1: Average Daily Ridership by Station and Segment (2013)

Station	Westbound (AM)			Eastbound (PM)			Daily
	Ons	Offs	Segment Volume (departing)	Ons	Offs	Segment Volume (arriving)	Segment Volume
Stockton	283	—	283	—	266	266	549
Lathrop–Manteca	551	0	834	0	538	804	1,638
Tracy	612	3	1,443	2	574	1,376	2,819
Vasco Road	172	76	1,539	47	157	1,486	3,025
Livermore	194	77	1,656	52	177	1,611	3,267
Pleasanton	424	300	1,780	317	425	1,719	3,499
Fremont	122	235	1,667	278	173	1,614	3,281
Great America	0	1,254	413	1,209	0	405	818
Santa Clara	0	80	333	84	0	321	654
San Jose	—	333	—	321	—	—	—
Total	**2,358**	**2,358**	**2,358**	**2,310**	**2,310**	**2,310**	**4,668**

Note: Average daily ridership across a sample of four selected dates in 2013: July 9, August 13, September 17, and November 19. The term “daily” connotates “daily reports” that were run on the dates identified as opposed to “daily service”. At the time, ACE only operated on weekdays and therefore was not a daily service, but rather a weekday service. ACE briefly ran a pilot Saturday service and occasional event-day service for Levi’s Stadium, but otherwise has been a weekday-only service throughout its history.

To derive trip tables by train and station pair, an iterative factoring process was applied to the observed boardings (ons) and alightings (offs) for each train in both the inbound (westbound) and outbound (eastbound) directions (from Table 1). This iterative process factors the observed data, proportionally, to obtain the trips for each station pair by matching the total ons and offs for each station respectively. The forecasted ridership and passenger miles from the ACE Model were then adjusted to match the actual FY2013 values of 1,019,700 and 45,159,600, respectively.

Table 2 summarizes the estimated average daily ridership by station pair based on the observed data from the four selected dates in 2013.

Table 2: Estimated Average Daily Ridership by Station Pair (2013)

Origin ↓	← Destination →										
	SKT	LTM	TRC	VAS	LIV	PLS	FMT	GAC	SCC	SJC	**Total**
SKT	—	0	1	15	13	46	28	135	9	36	**283**
LTM	0	—	2	27	24	87	55	269	16	71	**551**
TRC	0	2	—	34	31	100	58	293	19	77	**614**
VAS	10	18	19	—	9	30	17	87	5	24	**219**
LIV	9	19	19	5	—	37	22	102	6	27	**246**
PLS	50	100	107	28	32	—	55	276	19	74	**741**
FMT	32	67	71	20	23	65	—	92	6	24	**400**
GAC	122	249	267	77	92	270	132	—	0	0	**1,209**
SCC	9	17	19	6	7	18	8	0	—	0	**84**
SJC	34	66	72	21	23	72	33	0	0	—	**321**
Total	**266**	**538**	**577**	**233**	**254**	**725**	**408**	**1,254**	**80**	**333**	**4,668**

Note: Average daily ridership across a sample of four selected dates in 2013: July 9, August 13, September 17, and November 19.

Since that version of the ACE Model, incremental improvements and changes to the model have been incorporated throughout the past several years to support various ridership forecasting efforts for ACE and Amtrak San Joaquins services. For this SoCo Rail Study, an extensive restructuring and base-year update (to 2019) was completed in 2023, but the underlying ACE Model has not changed. To re-calibrate the ACE Model to a 2019 base year, trips by station pair from the 2013 base-year model were escalated according to growth factors calculated using actual ridership performance in 2013 and 2019, with additional adjustments applied to match actual ridership performance at each station in 2019.[5]

For reference, Table 3 summarizes observed ridership and passenger miles against corresponding base-year forecasts from the current version (2019 base year) and most recent previous version (2018 base year) of the ACE Model. As shown in Table 3, the current base-year ridership forecast for 2019 is approximately two percent lower for ACE and six percent lower for the San Joaquins than the corresponding actual 2019 ridership and is therefore within a reasonable expected range. This conclusion also holds for 2018, where the model's ridership forecasts are approximately four percent lower for ACE and two percent lower for the San Joaquins compared to the actual ridership. Since its development for the ACE*forward* program, the ACE Model has been used to support ridership forecasting for a wide variety of projects for

[5] The rationale for selecting a 2019 base year and the process of adjusting the model's future-year forecasts to account for the long-term ridership effects of the COVID-19 pandemic are discussed in more detail later in this section under "Post-Pandemic Travel Trends".

ACE and the San Joaquins, and its results have been thoroughly reviewed as part of each of these efforts, providing further confidence in the model's overall accuracy and reasonableness.

Table 3: Observed vs. Modeled Ridership – System-Level Comparison

ACE				
Calendar Year	Observed		Modeled	
	Annual Ridership	Annual Passenger Miles	Annual Ridership	Annual Passenger Miles
2013	940,774	42,140,286	—	—
2014	1,075,648	48,424,520	—	—
2015	1,209,755	52,241,764	—	—
2016	1,290,085	55,471,664	—	—
2017	1,299,717	55,703,220	—	—
2018	1,398,954	61,400,684	1,451,800	65,195,800
2019	1,506,183	65,810,476	1,469,600	65,196,900
2020	1,061,990	46,419,957	—	—
2021	160,007	8,891,727	—	—

San Joaquins		
Calendar Year	Observed	Modeled
	Annual Ridership*	Annual Ridership
2013	1,195,898	—
2014	1,202,624	—
2015	1,181,639	—
2016	1,135,424	—
2017	1,125,626	—
2018	1,090,200	1,070,000
2019	1,076,454	1,008,100
2020	794,634	—
2021	392,538	—
2022	656,469	—

* Actual ridership for the San Joaquins represents the corresponding State fiscal year (July–June) that includes the six months preceding the calendar year and the first half of the calendar year. For example, the actual ridership for FY 2012–13 (i.e., July 2012–June 2013) is reported here under the calendar year for 2013.

Table 4 compares observed and modeled ridership for ACE at the station level. As shown in Table 4, the current version of the ACE Model was calibrated to reproduce 2019 ACE station-level ridership, generally falling within four percent (and usually within two percent) of observed ridership, except at two stations (Fremont and Great America).

Table 4: Observed vs. Modeled Ridership – Station-Level Comparison (ACE)

Station	Annual Ridership (2019)		Difference	Percent Difference
	Observed	Modeled		
Downtown Stockton (Cabral)	171,138	171,100	-38	0.0%
Lathrop–Manteca	246,556	246,600	44	0.0%
Tracy	572,318	572,200	-118	0.0%
Vasco Road	208,487	214,700	6,213	3.0%
Livermore	306,576	311,900	5,324	1.7%
Pleasanton	321,066	333,400	12,334	3.8%
Fremont	182,853	149,900	-32,953	-18.0%
Great America	556,716	510,200	-46,516	-8.4%
Santa Clara	243,266	246,700	3,434	1.4%
San Jose	179,322	182,400	3,078	1.7%

Analysis of ACE's Existing Ridership Markets

ACE's existing route links three distinct regions within the Northern California Megaregion—the Central Valley (specifically, the northern San Joaquin Valley), the Tri-Valley, and the South Bay—with each separated by significant geographical barriers (the Altamont Pass and Niles Canyon). To better understand ACE's existing ridership patterns at the regional level, the ridership by station pair in Table 2 can be grouped into these respective regions, or "superzones". The results of this analysis are summarized in Table 5.

Table 5: Estimated Average Daily Ridership by Superzone Pair (2013)

Origin ↓	← Destination →			
	Central Valley	Tri-Valley	South Bay	Total
Central Valley	5	377	1,066	**1,448**
Tri-Valley	351	141	714	**1,206**
South Bay	1,025	694	295	**2,014**
Total	**1,381**	**1,212**	**2,075**	**4,668**

As shown in Table 5, most of the trips are between the Central Valley and the South Bay or between the Tri-Valley and the South Bay, which account for approximately 45 percent and 30 percent, respectively, of the total ridership. However, there is also substantial movement between the Central Valley and the Tri-Valley, which accounts for approximately 16 percent of the total ridership. Intra-zone trip-making within the Tri-Valley (three percent) and within the South Bay (six percent) largely make up the remainder of the ridership.

The San Joaquin Regional Rail Commission (SJRRC) completed an ACE passenger survey in 2014, which gathered more detailed information about ACE passengers, including place of residence and place of employment. Table 6 summarizes county of residence for ACE passengers, after extrapolating the survey data to the estimated average daily boardings (weekdays only) during the first half of 2014 (5,000) and the estimated total annual ridership for 2014 (1.24 million). Figure 1 and Figure 2 illustrate the data gathered in the 2014 survey on trip origins (i.e., place of residence) and destinations (i.e., place of employment).

Table 6: ACE Ridership by County of Residence (2014)

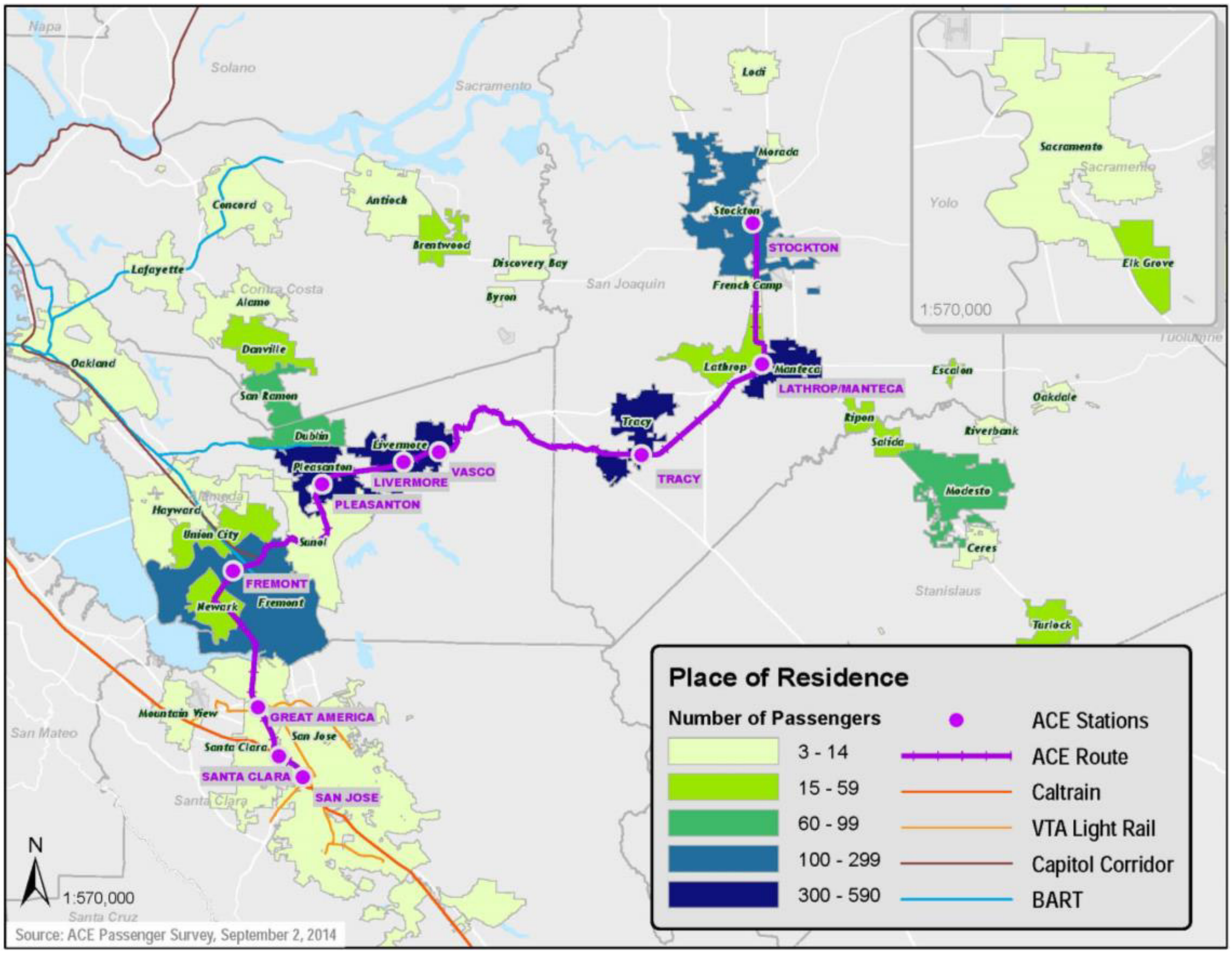
County of Residence	Passengers		Share of Total
	Daily	Annual	
San Joaquin	2,500 (*)	620,000	50%
Stanislaus	340	84,320	7%
Alameda	2,120 (**)	525,760	42%
Santa Clara	40	9,920	1%
Total	**5,000**	**1,240,000**	**100%**

* Includes 17 passengers from Sacramento, Calaveras, and El Dorado Counties.

** Includes 185 passengers from Contra Costa County.

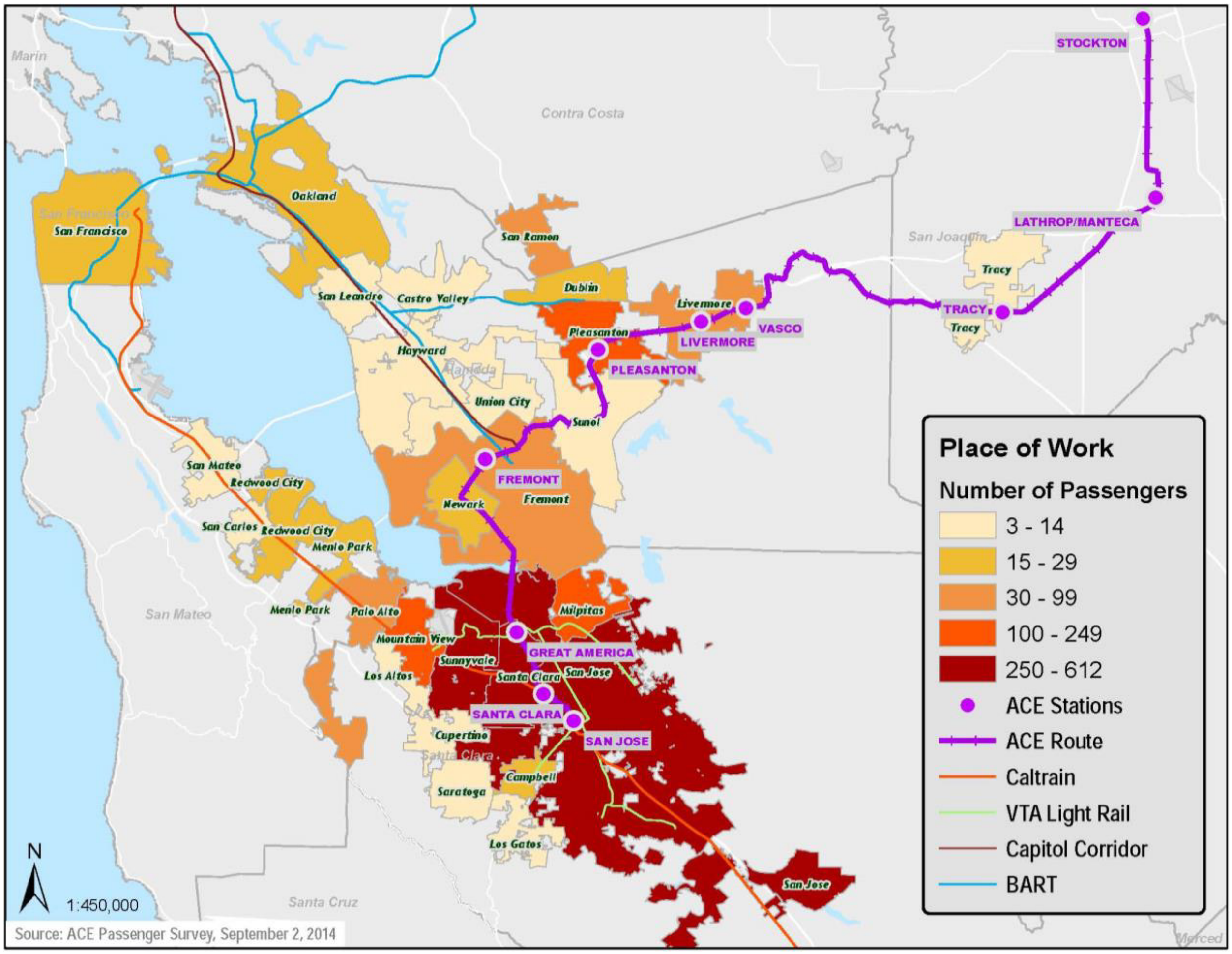
Source: SJRRC 2014 ACE passenger survey

Figure 1: SJRRC 2014 ACE Passenger Survey – Place of Residence



Note: Places of residence reported by westbound (AM) riders; round trip travel would be twice as many passengers.

Figure 2: SJRRC 2014 ACE Passenger Survey – Place of Employment



Note: Places of employment reported by westbound (AM) riders; round trip travel would be twice as many passengers.

As shown in Table 6 and Figure 1, the overwhelming majority of ACE passengers reside in the northern San Joaquin Valley (Stockton, Manteca, and Tracy), the Tri-Valley area (Pleasanton and Livermore), and Fremont. A small, but not insignificant, share of riders also reported places of residence in Stanislaus County, extending as far south as Modesto and Turlock.

As illustrated in Figure 2, the majority of ACE passengers are employed in the South Bay, concentrated in Santa Clara, Sunnyvale, and San Jose and adjacent cities (e.g., Mountain View, Palo Alto, Milpitas). Other areas of high employment concentration include Fremont and the Tri-Valley area. Smaller percentages of ACE passengers also reported working as far away as Oakland, San Francisco, and the Peninsula (e.g., Redwood City).

Post-Pandemic Travel Trends

Ridership forecasting efforts for the SoCo Rail Study began during the tail end of pandemic-related restrictions and California's COVID-19 State of Emergency, when ridership was still in flux due to work-from-home policies, business closures, and other effects. Given the unprecedented nature of the pandemic and the uncertainty regarding post-pandemic ridership trends—including the lack of a clear, defined trajectory that could be established from ridership data during the pandemic—the ACE Model was calibrated using base ridership numbers for 2019, the last complete year of “unaffected” data prior to the pandemic. Additional adjustment factors were then incorporated into the model’s future-year forecasts to account for the long-term ridership effects of the pandemic and the associated uncertainty, with the expectation that ridership in 2030 would at least partially, but not necessarily fully, recover to pre-pandemic levels.

As described in further detail in later sections of this technical memorandum, however, the demographic growth forecasts used in the ACE Model are based on Caltrans data that at least partially account for some of the effects of the pandemic (e.g., slower population and employment growth). Because of the nature of the joint ACTC–ACE Model, however, use of this Caltrans data alone does not fully account for post-pandemic ridership trends. To better align the model forecasts with expected ridership trajectories, AECOM developed and applied two factors based on existing ridership for intercity rail service and commuter rail service, separately, to account for the long-term impact of COVID-19 and associated changes (e.g., increase in work-from-home activity) on ridership.

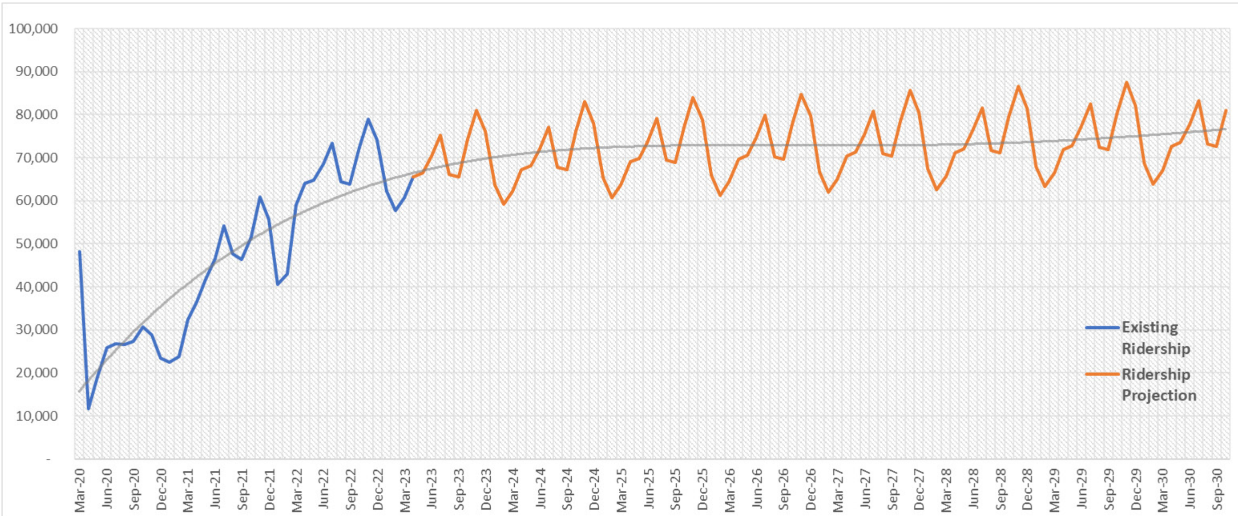
Complete monthly ridership data for ACE is available from the Federal Transit Administration’s National Transit Database (NTD); ridership data for the period from January 2019 to February 2023 were compiled from the NTD for the purposes of this forecasting effort. For the San Joaquins, monthly ridership data are available from Amtrak’s monthly performance reports; ridership data for the period from October 2018 to March 2023 were compiled from the Amtrak performance reports for the purposes of this forecasting effort.

By observing actual ridership performance in both the pre-pandemic and pandemic-recovery phases, AECOM calculated trendlines for both ACE and San Joaquins ridership (see Figure 3 and Figure 4). Based on these trendlines, AECOM developed separate factors for long-term post-pandemic ridership recovery for intercity service and commuter service. These long-term ridership recovery factors reflect the percentage of annual ridership recovery in 2030 compared to pre-pandemic (2019) levels.

As shown in Figure 3, actual San Joaquins ridership recovered rapidly in the first year after the pandemic hit in March 2020, followed by a relatively slower and steadier recovery starting in 2022. By the end of FY20, total ridership had already recovered to 56 percent of the FY19 level, while FY22 ridership recovered to 66 percent of the FY19 level. It should also be noted that San Joaquins ridership follows seasonal patterns, as seen in Figure 3, with peak times during summer break (June–July) and during the fall / winter holiday season (October–December).

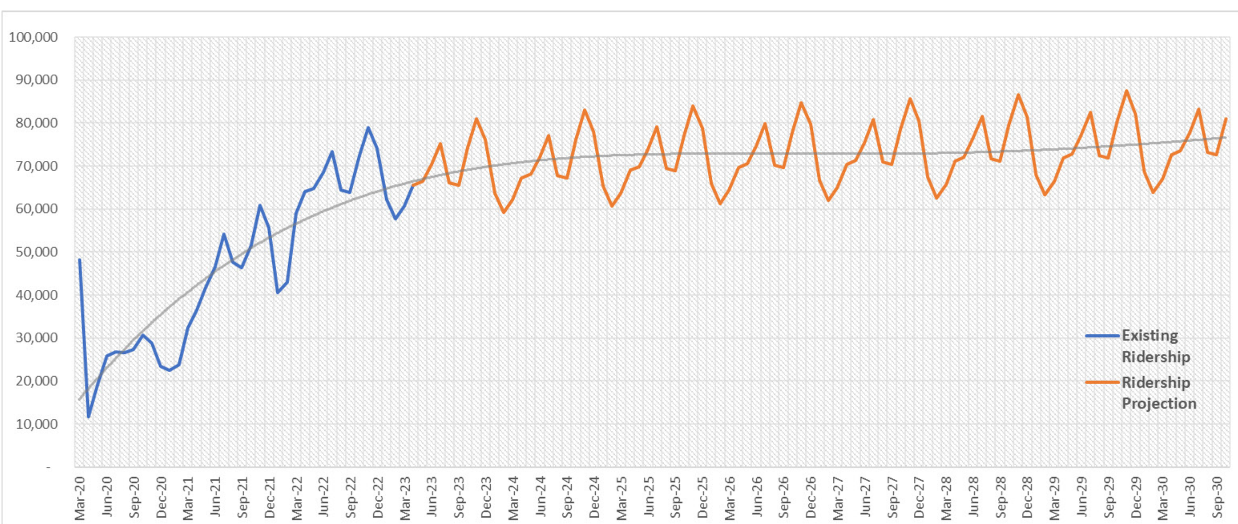
Based on these observations, it is assumed that ridership would continue to follow these seasonal patterns, but that background ridership growth would largely plateau from 2025 through 2030, with only about 1 percent growth annually. Annual San Joaquins ridership in 2030 is therefore projected to be 84 percent of the pre-pandemic level.

Figure 3: San Joaquins Monthly Ridership – Actual Performance and Future Projections through 2030



As a commuter service, ACE suffered a much worse impact from COVID-19 than the San Joaquins (intercity) service. ACE ridership in March 2023 was still less than 30 percent of the pre-pandemic level. Similar to the San Joaquins, however, ACE ridership began stabilizing and steadily increasing in 2022 along a similar monthly pattern as that observed prior to the pandemic in 2019. AECOM assumed that this pattern would continue and projected ridership trends through 2030 using the average growth rate in ACE ridership between March 2022 and March 2023. Based on this approach, annual ACE ridership in 2030 is projected to be 52 percent of ridership levels in 2019 (see Figure 4).

Figure 4: ACE Monthly Ridership – Actual Performance and Future Projections through 2030



Both ratios (84 percent and 52 percent, or 0.84 and 0.52, respectively) were assumed as the respective post-pandemic long-term ridership recovery factors for intercity and commuter service. These factors were then incorporated into the ACE Model when producing the ridership forecasts for 2030.

As described in more detail in the “Scenarios and Forecasts” section of this memorandum, the proposed Union City trains would be operated as an intercity service, and ridership for those trains is therefore forecasted to align with the higher recovery levels assumed for intercity trains. Similarly, the majority of the combined ACE and San Joaquins system in 2030 is proposed to consist of trains operated as intercity services, with commuter service largely focused on the existing ACE trains between Stockton and San Jose and select new or extended ACE trains in the future. As such, the overall ridership trend for the combined system is assumed to fall within the range of the two recovery factors, but generally aligns somewhat closer to the higher recovery levels for intercity service. More detail on the combined ACE and San Joaquins system and commuter vs. intercity service can be found later in this memorandum.

Demographic Assumptions

The demographic assumptions for the ACE Model and ACTC Model are described below.

ACE Model

The demographic forecasts used in the ACE Model for this ridership modeling effort are long-term socio-economic forecasts by county published by the Transportation Economics Branch of the California Department of Transportation (“Caltrans”). These socio-economic forecasts have been used in developing ridership forecasts for other megaregional and statewide rail planning efforts, including the latest ridership model developed for the CHSRA to support its 2023 Project Update Report on the statewide HSR system.

The Caltrans data are published annually and include both historical data (starting from 2000) and long-term socio-economic forecasts for population, employment, and income. The latest available release of this data (published in 2022) was used, reflecting historical data up through 2021 and forecasts for 2022 through to a horizon year of 2050. Because the dataset includes historical data through 2021, it can be considered to account, at least partially, for some of the effects of the COVID-19 pandemic on overall demographic trends. The demographic forecasts for 2030 were incorporated into the ACE Model, as that data corresponds with the forecast year for this ridership modeling effort.

The ACE Model, however, requires demographic data for catchment areas around each station, as ridership is forecasted at the station-pair level. To translate county-level demographic data to station catchment-level data, the county-level forecasts were first broken down to the Census county division (CCD) level—a subcounty geographic unit defined by the Census Bureau—using Census data on the ratios of population and employment within each CCD and the corresponding county as a whole. AECOM then employed a custom geographic information system (GIS) application to calculate the population and employment contained within buffers around each station. Buffers ranging in radius from five to twenty miles around stations were used, and the weighted average population and employment for each buffer were inputted into the ACE Model.

As shown in Figure 1 and Figure 2, a sizeable share of existing ACE passengers reported places of residence and employment well beyond walking distance of stations in the SJRRC 2014 ACE passenger survey. Some passengers, for example, reported places of residence in Modesto (20 miles from Lathrop–Manteca Station), Brentwood (20 miles from Vasco Road Station), and Danville (15 miles from Pleasanton Station). The inclusion of station buffers as large as 20 miles in radius therefore ensures that the total population and employment adequately reflect the actual catchment area of stations.

Table 7 below summarizes population and employment growth between the base year (2019) and horizon year (2030) for representative counties along or near the future expanded ACE system.

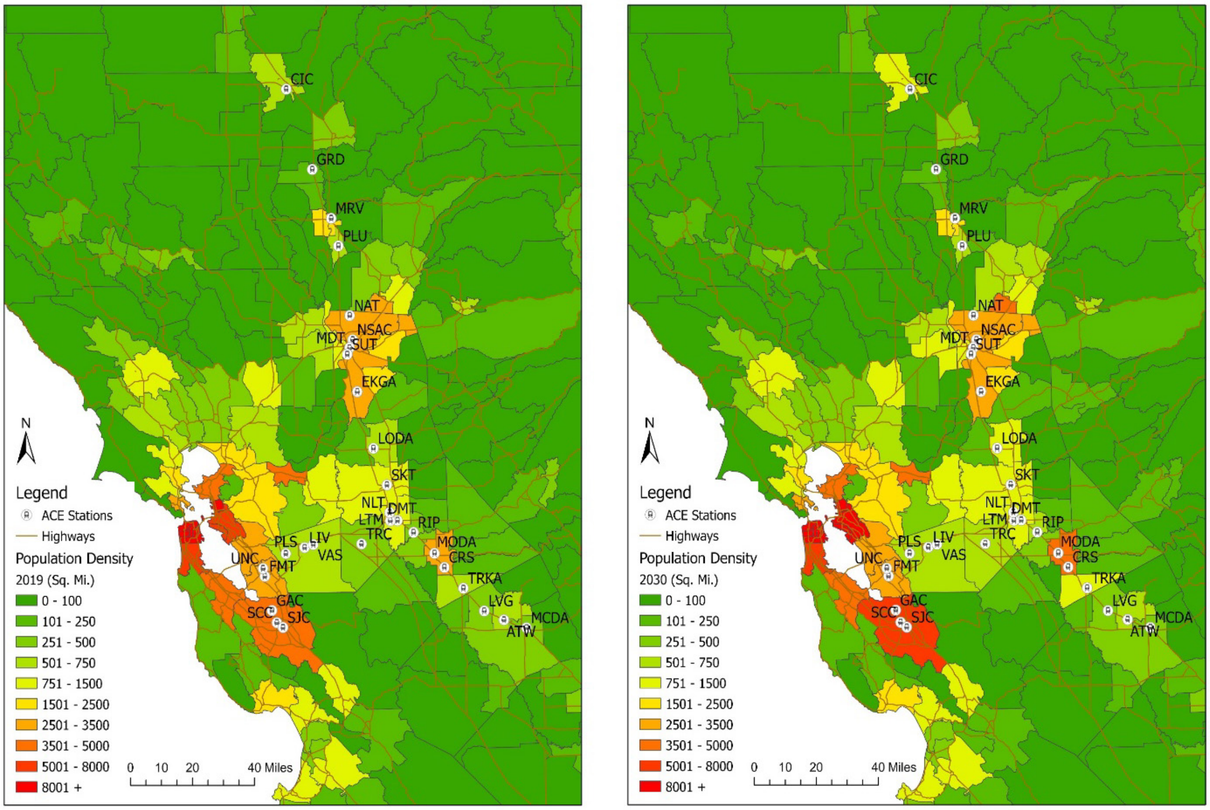
Table 7: Population and Employment Growth by County

Region	County	Population (in thousands)			Employment (in thousands)		
		2019	2030	Growth	2019	2030	Growth
San Francisco Bay Area	Alameda	1,654	1,727	4%	811	889	10%
	Contra Costa	1,137	1,181	4%	374	413	11%
	San Francisco	888	910	2%	763	881	15%
	San Mateo	768	763	-1%	415	462	11%
	Santa Clara	1,942	2,041	5%	1,132	1,281	13%
San Joaquin Valley	Merced	279	308	10%	70	79	12%
	San Joaquin	761	838	10%	247	296	20%
	Stanislaus	549	598	9%	181	207	14%
Sacramento Area	Placer	391	458	17%	175	208	19%
	Sacramento	1,535	1,697	11%	675	767	14%
	Yolo	219	233	7%	110	122	11%
North Valley	Butte	213	223	5%	81	85	6%
	Sutter	102	107	5%	28	30	9%
	Yuba	77	86	11%	19	21	10%

As the ACE Model uses a finer level of geography than the county level, it is also useful to visualize this growth on a map. Figure 5, for example, illustrates population density (people per square mile) for the base year (2019) and horizon year (2030), showing population growth in the Central Valley (e.g., Tracy, Modesto, Turlock, Lodi, and Chico) that will help support the expanded ACE system.

Figure 5: Population Density

2019 **2030**



ACTC Model

The BLVX version of the ACTC Model used land use and socio-economic databases developed by ABAG and MTC as part of Plan Bay Area (PBA), which is the regionally adopted long-range plan for the nine-county Bay Area. Therefore, employment data for all Bay Area counties was readily available from the Plan Bay Area databases. The land use data were updated based on PBA40 forecasts (developed as part of Plan Bay Area 2040, adopted in 2017), as land use data for the latest PBA cycle (Plan Bay Area 2050) for the ACTC zone structure was still being developed and was not available for use at the time the ACTC Model inputs were under development for the SoCo Rail Study.

San Joaquin County, however, is outside the nine-county Bay Area, and is under the jurisdiction of SJCOG, a separate MPO from the Bay Area's MTC. Therefore, the employment numbers for this county were obtained from SJCOG's RTP[6]. The San Joaquin County demographic data

[6] BART to Livermore Ridership Projections Report, February 2018

was updated using SJCOG's 2018 RTP, which was the latest available data source at the time of the update.[7]

As described in further detail later in this memorandum, ridership forecasts were developed for an approximate opening year (assumed to be 2030). Demographics from the 2018 version of the ACTC Model, which contains data for 2020 and 2040 (based on PBA 2040), was utilized for this study, with the 2030 data derived by interpolating between the 2020 and 2040 data.

For TAZs within San Joaquin County (TAZs 2301–2326), demographic data published by San Joaquin County for 2024 and 2042 (based on the 2018 RTP) were interpolated to derive data for 2030. An equivalency between San Joaquin County zones and the TAZ system in the ACTC Model was then established, and the demographic data for the San Joaquin County zones in the ACTC Model was updated based on this equivalency.

Consistency Across Demographic Datasets

As described above, several different demographic datasets were used to develop the ridership forecasts due to the distinct geographies of the two models (ACE Model and ACTC Model) that comprise the joint model. Since work on the ridership forecasting effort began, MTC has also published and approved demographic projections for the latest Plan Bay Area cycle, Plan Bay Area 2050. To address potential concerns about consistency between the Caltrans socio-economic forecasts used in the ACE Model, the PBA40 forecasts used in the ACTC Model, and the PBA50 forecasts most recently developed by ABAG and MTC, AECOM conducted a consistency check in areas that are common to both the Caltrans and PBA datasets (i.e., where the geographies overlap).

Table 8 below compares the forecasts for 2030 from the Caltrans and PBA datasets, for each of the nine Bay Area counties. As PBA50 forecasts were only available for a 2015 base year and a 2035 horizon year, data from these two years were interpolated to obtain an estimate for a 2030 horizon year. PBA40 and PBA50 data were aggregated from the TAZ level to the county level to compare to the Caltrans data.

As shown in Table 8, the PBA40 and PBA50 forecasts are very similar overall, and both are generally slightly higher than the Caltrans Transportation Economics Branch forecasts used in the ACE Model, although the PBA40 employment forecasts for Santa Clara County are slightly lower than the corresponding Caltrans forecasts. Where the PBA forecasts are higher than the Caltrans forecasts, the difference is on the order of five to 10 percent above the Caltrans forecasts for the two most relevant counties for ACE service (Alameda and Santa Clara). To the extent that the Caltrans forecasts are less aggressive than the PBA40 or PBA50 forecasts, ridership forecasts produced by the ACE Model will therefore be slightly lower (and more conservative) than if demographic inputs were based on either of the PBA forecasts.

[7] SJCOG's 2022 RTP was published in late August of 2022, after modeling work for the SoCo Rail Study was well underway. Furthermore, the TAZ data was not yet fully approved at that time. Therefore, it was determined that for this effort, data from the 2018 RTP would be utilized.

Table 8: Comparison of Demographic Forecasts (2030) by County

County	Caltrans Transportation Economics Branch		Plan Bay Area 2040				Plan Bay Area 2050			
	Pop.	Emp.	Pop.	Diff.	Emp.	Diff.	Pop.	Diff.	Emp.	Diff.
Alameda	1,726,911	888,744	1,861,141	8%	911,513	3%	1,884,970	9%	963,467	8%
Contra Costa	1,180,586	413,250	1,257,081	6%	461,656	12%	1,249,211	6%	471,235	14%
Marin	250,484	127,370	269,274	8%	135,795	7%	301,022	20%	119,137	-6%
Napa	134,332	82,290	151,440	13%	75,712	-8%	142,270	6%	79,618	-3%
San Francisco	909,907	880,837	1,033,063	14%	832,732	-5%	1,003,059	10%	770,976	-12%
San Mateo	763,441	462,051	852,148	12%	419,342	-9%	847,235	11%	454,732	-2%
Santa Clara	2,041,475	1,281,191	2,212,883	8%	1,182,221	-8%	2,273,004	11%	1,325,985	3%
Solano	454,342	162,584	469,675	3%	147,419	-9%	436,478	-4%	163,050	0%
Sonoma	483,855	232,643	560,053	16%	238,736	3%	510,315	5%	243,014	4%
Total	**7,945,334**	**4,530,960**	**8,666,758**	**9%**	**4,405,126**	**-3%**	**8,647,562**	**9%**	**4,591,214**	**1%**

Note: pop. = population; emp. = employment; diff. = difference (relative to Caltrans data)

Scenarios and Forecasts

The last of the three primary inputs driving the ACE Model is the service plan. The assumed service plan scenarios and resulting forecasts are described below.[8] Ridership impacts, including passenger revenue (order-of-magnitude estimate only) and reduction in vehicle miles traveled (VMT), are also presented. All the numbers shown below represent the final forecasts after application of the long-term ridership recovery factors to both intercity and commuter rail services.

Service Plan Scenarios

As mentioned in the California High-Speed Rail Authority (CHSRA) 2022 Business Plan, service on the EOS between Merced and Bakersfield is scheduled to be operational by the end of 2030.[9] Therefore, HSR service between Merced and Bakersfield, together with the expanded Valley Rail Program, was included in the ridership forecasts for 2030 to appropriately capture the connections between HSR and ACE and between HSR and the San Joaquins. In addition,

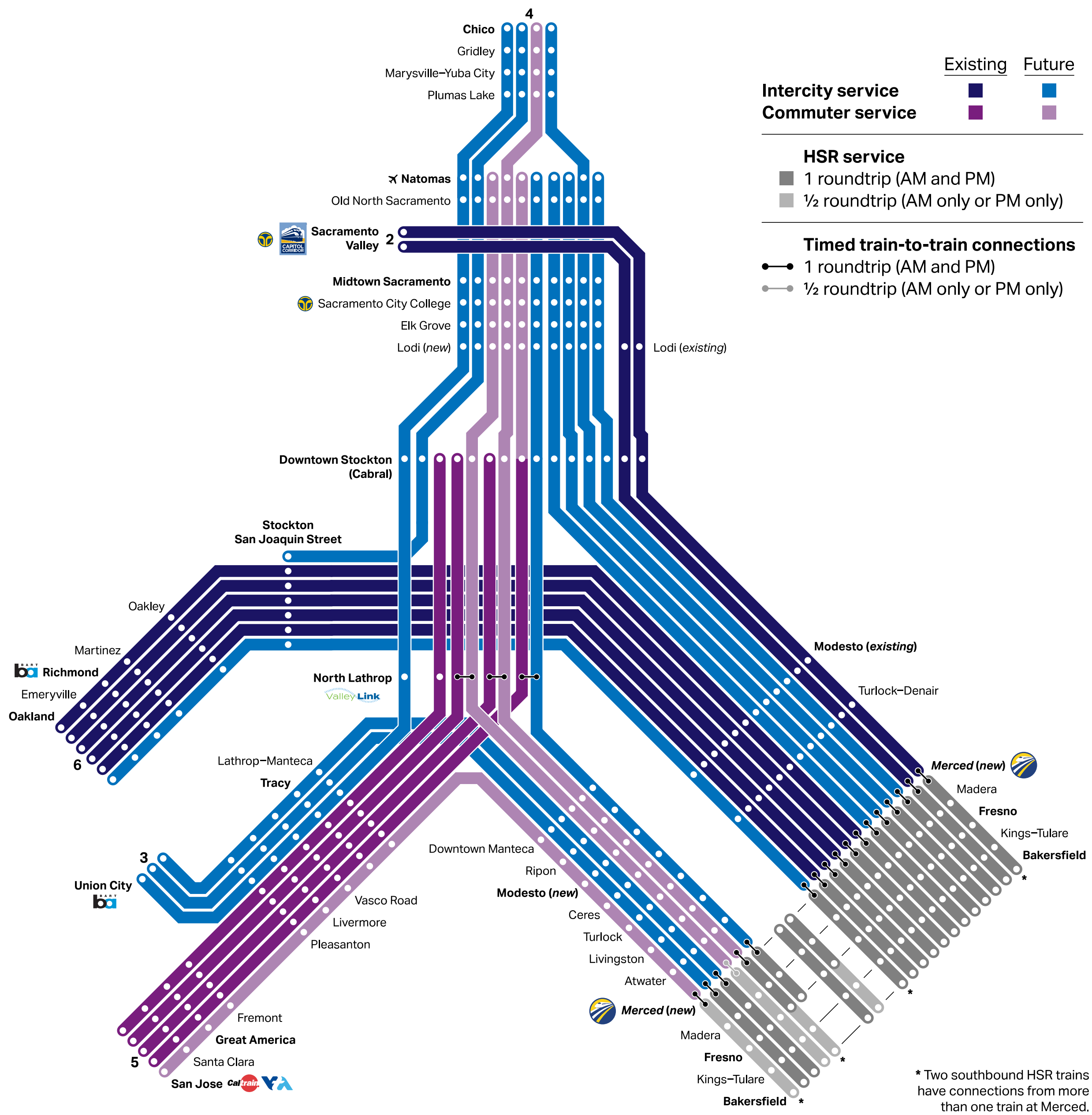
[8] The ridership forecasts in this technical memorandum are preliminary and intended only for the purposes of project planning and development. Refinements to the forecasts will be incorporated in subsequent stages of the project to support the project's environmental clearance phase.

[9] The CHSRA's 2023 Project Update Report, published on March 1, 2023, subsequently revised the start of service to an "envelope" between 2030 and 2033, recognizing that stable funding sources to achieve the 2030 opening ultimately feed into the risk in the overall project schedule. However, a 2030 forecast year was retained for the SoCo Rail Study, recognizing that it is critical to have the proposed Union City intercity service operational from Day 1 of the HSR EOS, which could take place as early as 2030 (or as late as 2033). Continuing to assume a 2030 horizon year generally results in a lower (and therefore more conservative) ridership forecast for the project due to demographic growth over time. If the project is operational before the HSR EOS, there may be some period of time during which the project operates a reduced or modified service commensurate with lower ridership demand due to the lack of connecting HSR service in Merced.

the ridership forecasts also include the North Valley Rail project, which would extend train service north of Natomas to Marysville–Yuba City and Chico.

Three proposed Union City intercity round trips were modeled as part of this ridership forecasting work. The Union City trains will include connections between ACE and BART and other local transit services at the Union City station. Of the three Union City trains, two will operate between Union City and Merced and connect with HSR at Merced; the other train will operate between Union City and Chico. A diagram of the integrated ACE and San Joaquins systems in 2030 is shown in Figure 6.

Figure 6: Integrated ACE and San Joaquins Network Diagram in 2030



The ridership modeling work includes both the No Build and Build scenarios for the forecast year of 2030. The assumptions for both No Build and Build are summarized in Table 9 and Table 10, with more detailed descriptions of each scenario below. The differences between the No Build and Build scenarios relate to the three ACE Union City trains. In both No Build and Build runs, all trains serving Merced are assumed to have direct timed connections with HSR, allowing connections to/from the Madera, Fresno, Kings-Tulare, and Bakersfield HSR stations. Thruway bus services between Bakersfield and Los Angeles are also included in the forecasts to account for continuing connections originating from or destined for Southern California.

Table 9: San Joaquins Service Descriptions in the No Build and Build Scenarios

2030 No Build/Build
• Existing seven daily round trips, all truncated at Merced • One additional train between Oakland and Merced • Three additional trains between Natomas and Merced • One additional train between Chico and Merced • Connecting to HSR at Merced

Table 10: ACE Service Descriptions in the No Build and Build Scenarios

2030 No Build	2030 Build
ACE Commuter Service: • Four existing ACE trains, with one of them extending to Natomas • One train between San Jose and Merced • One train between Natomas and Merced • One train between Chico and Merced	*ACE Commuter Service:* • Four existing ACE trains, with one of them extending to Natomas • One train between San Jose and Merced • One train between Natomas and Merced • One train between Chico and Merced
ACE Intercity Service: • One train between Natomas and Merced • One train between Chico and Stockton San Joaquin Street (with connections to San Joaquins trains) • One train between Chico and Downtown Stockton • Both commuter and intercity services connecting to HSR at Merced	*ACE Intercity Service:* • One train between Natomas and Merced • One train between Chico and Stockton San Joaquin Street (with connections to San Joaquins trains) • One train between Chico and Union City • Two additional trains between Union City and Merced • Both commuter and intercity services connecting to HSR at Merced

All round trips for ACE and the San Joaquins, including both commuter and intercity services, are assumed to operate daily in the future, for both the No Build and Build scenarios. Prior to the COVID-19 pandemic, SJRRC had already been operating limited event-day ACE service outside of the typical commute service to accommodate demand generated at Levi's Stadium in Santa Clara (including for San Francisco 49ers home games, typically held on Sundays). SJRRC also began operating a pilot Saturday ACE service with two round trips in September 2019, although the program was eventually suspended in March 2020 due to pandemic-related effects.

The weekend / holiday timetable is conservatively assumed to be the same as the weekday timetable, with only minor adjustments to shift some ACE trains to more attractive slots for weekend and holiday travelers. Under the Build scenario, adjustments for the proposed Union City trains on weekends and holidays are conservatively not assumed.

Union City Intercity Service

As mentioned above, the difference between No Build and Build scenarios is the three Union City trains. The No Build scenario includes one train that operates between Chico and Downtown Stockton, but the Build scenario extends this one train to Union City. Unlike the No Build scenario, the Build scenario also includes two new trains operating between Union City and Merced, each with HSR connections at Merced. As intercity services, the three Union City trains are assumed to run daily (including Saturdays, Sundays, and holidays, when intercity service markets are expected to be strong) to maintain HSR connectivity in Merced.[10] The conceptual timetables for the Union City Intercity Service trains in the inbound and outbound directions are shown in Table 11.

It should be noted that infrastructure improvements at certain points east of Niles Junction may be required for some trains to achieve the conceptual timetable shown in Table 11, including the running times and desired slots (times of day). The exact location and scope of such improvements will be determined in coordination with Union Pacific Railroad (“UP”) as part of more detailed operations planning in later phases of the project. The ridership forecasts conservatively assume slightly slower running times for some trains in the absence of assuming such potential infrastructure improvements.

[10] For the purposes of this ridership modeling effort, ACE and San Joaquins service on Saturdays, Sundays, and holidays is assumed to be the same as on weekdays, with the exception of some minor scheduling adjustments to improve HSR connections for ACE trains in Merced. These adjustments, however, do not affect the proposed timetable for the Union City trains, which are conservatively assumed to operate the same schedule on both weekdays and Saturdays, Sundays, and holidays.

Table 11: 2030 Union City Intercity Service Timetable

Station	Inbound (read down ↓)			Outbound (read up ↑)		
	W01	V01	W01	W02	V02	U02
Merced (new)		*9:50*	*18:50*		*18:56*	*9:56*
Atwater		*9:58*	*18:58*		*18:47*	*9:47*
Livingston		*10:06*	*19:06*		*18:40*	*9:40*
Turlock		*10:18*	*19:18*		*18:27*	*9:27*
Ceres		*10:28*	*19:28*		*18:17*	*9:17*
Modesto (new)		*10:35*	*19:35*		*18:10*	*9:10*
Ripon		*10:49*	*19:49*		*17:57*	*8:57*
Downtown Manteca		*10:58*	*19:58*		*17:48*	*8:48*
Chico	6:02	|	|	19:49	|	|
Gridley	6:26	|	|	19:25	|	|
Marysville–Yuba City	6:44	|	|	19:06	|	|
Plumas Lake	6:54	|	|	18:57	|	|
Natomas	7:17	|	|	18:34	|	|
Old North Sacramento	7:33	|	|	18:25	|	|
Midtown Sacramento	7:39	|	|	18:19	|	|
Sacramento City College	7:44	|	|	18:14	|	|
Elk Grove	7:54	|	|	18:05	|	|
Lodi (new)	8:20	|	|	17:39	|	|
Downtown Stockton (Cabral)	8:34	|	|	17:24	|	|
North Lathrop	*8:44*	|	|	*17:13*	|	|
Lathrop–Manteca	*8:51*	*11:06*	*20:06*	*17:07*	*17:41*	*8:41*
Tracy	*9:03*	*11:18*	*20:18*	*16:48*	*17:22*	*8:22*
Vasco Road	*9:32*	*11:47*	*20:47*	*16:19*	*16:53*	*7:53*
Livermore	*9:37*	*11:52*	*20:52*	*16:14*	*16:48*	*7:48*
Pleasanton	*9:45*	*12:00*	*21:00*	*16:05*	*16:39*	*7:39*
Union City	*10:09*	*12:24*	*21:24*	*15:40*	*16:14*	*7:14*

Note: Timestamps in *blue italic* are only available in the Build scenario

Forecast Results

The following subsections present the forecast results, including a high-level summary, a detailed station-level summary, and an ACE market flow summary. As mentioned previously, all results reflect application of the post-pandemic long-term ridership recovery factors described previously.

HIGH-LEVEL SUMMARY

The forecasted 2030 annual ridership and incremental ridership between No Build and Build is shown in Table 12 for ACE and the San Joaquins. Annual passenger miles travelled (PMT) and annual total and incremental automobile VMT avoided are also presented. For reference, actual pre-pandemic annual ridership was approximately 1,506,200 for ACE in 2019 and 1,059,000 for the San Joaquins in FY 2019.[11] The ridership forecasts in Table 12 have been thoroughly reviewed to assure reasonableness, including a comparison against forecasts produced by the Early Train Operator for the CHSRA's 2023 Project Update Report.

Overall, ridership across the ACE and San Joaquins network is forecasted to increase 17 percent as a result of the three Union City trains. Compared to the No Build scenario, annual rail trips not involving a transfer are 24 percent higher in the Build scenario. Relative to No Build, annual ridership involving a transfer is higher in the Build, including by approximately 2 percent for passengers connecting with HSR in Merced. Total annual revenue and PMT for the whole system are forecasted to be 3 percent and 13 percent higher, respectively, compared to the No Build scenario. ACE annual ridership, revenue, and PMT in the Build scenario are forecasted to be 36 percent, 36 percent, and 60 percent higher, respectively, than in the No Build scenario.

It should be noted that the Build scenario forecasts account for some competition between ACE and San Joaquins services due to overlapping sections of routes and because both services offer connections with HSR at Merced. In particular, the two trains between Union City and Merced provide more options for HSR connections at Merced and more frequent service to / from the Bay Area, while the Chico–Union City train competes (to a lesser extent) with San Joaquins services in the Chico–Sacramento–Stockton and Stockton–Bay Area markets. As a result of these effects, San Joaquins annual ridership in the Build scenario is forecasted to be about 5 percent lower and San Joaquins–HSR transfers are forecasted to be about 10 percent lower relative to the No Build scenario. Both annual revenue and PMT for the San Joaquins are forecasted to be 8 percent lower in the Build scenario compared to the No Build scenario.

Table 12 also includes a separate breakout for the total annual ridership, revenue, and PMT for the three Union City trains. The total annual ridership for these three trains accounts for about 34 percent of ACE annual ridership and 22 percent of the combined system (ACE and San Joaquins) annual ridership in the 2030 Build scenario.

[11] ACE ridership cited here is for 2019 from the Federal Transit Administration's National Transit Database. San Joaquins ridership cited here is from the latest (2022) business plan published by the San Joaquin Joint Powers Authority and represents Fiscal Year (FY) 2019 data (the fiscal year is based on Amtrak's fiscal year, which runs from October through September).

Table 12: 2030 Forecasted Ridership, Revenue, and Automobile VMT Avoided

	2030		
		Build	
	No Build	Total	Union City Trains Only
Combined System (ACE + San Joaquins)			
Annual Ridership	7,218,100	8,475,200	1,861,200
Train only (non-transfers)	*5,004,600*	*6,204,200*	*1,612,200*
ACE/San Joaquins–HSR Transfers	*2,007,700*	*2,056,900*	*244,500*
ACE–San Joaquins Transfers	*114,800*	*108,200*	—
ACE/San Joaquins–Thruway Bus Transfers	*91,000*	*105,900*	*4,500*
Average Daily Ridership (total)	19,776	23,220	5,099
*At Union City**	—	*1,647*	*1,647*
*Weekday Average Daily Ridership**	—	*1,575*	*1,575*
*Weekend Average Daily Ridership**	—	*1,811*	*1,811*
Annual Revenue**	103,762,000	106,532,900	11,048,700
Annual PMT	709,994,500	802,022,600	121,105,100
Annual Total Auto VMT Avoided	513,786,400	583,289,800	88,076,400
ACE			
Annual Ridership	3,976,600	5,410,700	1,861,200
Train only (non-transfers)	*3,602,000*	*4,803,000*	*1,612,200*
ACE–HSR Transfers	*222,300*	*445,200*	*244,500*
ACE–San Joaquins Transfers	*114,800*	*108,200*	—
ACE–Thruway Bus Transfers	*37,500*	*54,300*	*4,500*
Average Daily Ridership (total)	10,895	14,824	5,099
*At Union City**	—	*1,647*	*1,647*
*Weekday Average Daily Ridership**	—	*1,575*	*1,575*
*Weekend Average Daily Ridership**	—	*1,811*	*1,811*
Annual Revenue**	24,515,800	33,425,500	11,048,700
Annual PMT	220,286,500	352,398,600	121,105,100
Annual Total Auto VMT Avoided	160,208,400	256,289,800	88,076,400
San Joaquins			
Annual Ridership	3,356,300	3,172,700	—
Train only (non-transfers)	*1,402,600*	*1,401,200*	—
San Joaquins–HSR Transfers	*1,785,400*	*1,611,700*	—
San Joaquins–ACE Transfers	*114,800*	*108,200*	—
San Joaquins–Thruway Bus Transfers	*53,500*	*51,600*	—
Average Daily Ridership (total)	9,195	8,692	—
Weekday Average Daily Ridership	*8,573*	*8,105*	—
Weekend Average Daily Ridership	*10,601*	*10,001*	—
Annual Revenue**	79,246,200	73,107,400	—
Annual PMT	489,708,000	449,624,000	—
Annual Total Auto VMT Avoided	353,578,000	327,000,000	—

* Sum of boardings and alightings at the Union City station.

** Annual revenue is in 2013 dollars.

STATION-LEVEL DETAIL

Combined annual station boardings and alightings for both San Joaquins and ACE are summarized for the No Build and Build scenarios in Table 13. Ridership increases in the Build scenario are primarily on the Merced extension, Sacramento (Natomas) extension, and Chico extension, as well as at stations between Lathrop–Manteca and Pleasanton, as these areas have more frequent services connecting Merced and the Bay Area and have more options for HSR connections at Merced. In contrast, slight decreases in San Joaquins ridership are forecasted at stations served by both the San Joaquins and ACE due to passengers, including HSR transfers at Merced, switching to ACE.

Table 13: Annual Station Boardings and Alightings

Station	2030 No Build			2030 No Build		
	ACE	San Joaquins	Total	ACE	San Joaquins	Total
Merced (new)	379,200	2,075,400	2,454,600	751,000	1,875,600	2,626,600
Non-transfers	*156,900*	*290,000*	*446,900*	*305,800*	*263,900*	*569,700*
HSR Transfers	*222,300*	*1,785,400*	*2,007,700*	*445,200*	*1,611,700*	*2,056,900*
Atwater	56,500	—	56,500	122,300	—	122,300
Livingston	56,000	—	56,000	90,600	—	90,600
Turlock	132,000	—	132,000	221,500	—	221,500
Ceres	128,400	—	128,400	217,100	—	217,100
Modesto (new)	272,800	—	272,800	429,700	—	429,700
Ripon	179,700	—	179,700	296,700	—	296,700
Downtown Manteca	108,900	—	108,900	170,800	—	170,800
Chico	125,600	56,000	181,600	143,500	54,900	198,400
Gridley	56,000	26,400	82,400	66,200	25,700	91,900
Marysville–Yuba City	121,800	61,300	183,100	141,600	60,100	201,700
Plumas Lake	69,600	35,200	104,800	79,300	34,600	113,900
Natomas	314,600	200,900	515,500	345,500	195,600	541,100
Old North Sacramento	249,000	226,800	475,800	273,500	221,100	494,600
Midtown Sacramento	485,000	239,400	724,400	532,600	234,700	767,300
Sacramento City College	262,200	165,500	427,700	287,900	162,000	449,900
Elk Grove	394,500	113,000	507,500	460,200	112,600	572,800
Lodi (new)	149,100	79,400	228,500	162,200	76,400	238,600
Downtown Stockton	350,300	177,100	527,400	379,600	170,100	549,700
Stockton San Joaquin St.	88,600	598,700	687,300	84,600	587,000	671,600
Non-transfers	*31,200*	*541,300*	*572,500*	*30,500*	*532,900*	*563,400*
ACE–SJs Transfers	*57,400*	*57,400*	*114,800*	*54,100*	*54,100*	*108,200*
North Lathrop	186,100	—	186,100	219,900	—	219,900
Lathrop–Manteca	165,400	—	165,400	262,500	—	262,500
Tracy	634,900	—	634,900	871,100	—	871,100
Vasco Road	173,100	—	173,100	299,800	—	299,800
Livermore	198,900	—	198,900	291,200	—	291,200
Pleasanton	725,300	—	725,300	1,188,300	—	1,188,300
Union City	—	—	—	601,300	—	601,300
Fremont	386,900	—	386,900	373,300	—	373,300
Great America	952,000	—	952,000	925,300	—	925,300
Santa Clara	88,500	—	88,500	85,400	—	85,400
San Jose	398,300	—	398,300	385,300	—	385,300
Turlock–Denair	—	162,300	162,300	—	157,600	157,600
Modesto (existing)	—	412,200	412,200	—	404,200	404,200
Lodi (existing)	—	20,300	20,300	—	21,600	21,600
Sacramento	—	57,400	57,400	—	54,700	54,700
Oakley	—	127,900	127,900	—	126,000	126,000
Martinez	—	447,400	447,400	—	436,300	436,300
Richmond	—	155,900	155,900	—	155,400	155,400
Emeryville	—	234,100	234,100	—	232,200	232,200
Oakland	—	256,800	256,800	—	253,900	253,900
Total	**7,889,200**	**5,929,400**	**13,818,600**	**10,759,800**	**5,652,300**	**16,412,100**

Note: Reported ridership represents unconstrained values.

ACE MARKET FLOW ANALYSIS

To help characterize general ridership trends at the regional level for the Union City trains and the larger ACE system, a market-level flow summary was also prepared by aggregating station-pair ridership into discrete markets based on geography (e.g., Tri-Valley, Silicon Valley, Sacramento Area, etc.). The market-level flow summary for ACE passengers at Union City is provided below in Table 14.

Table 14: ACE Market Flow Analysis – Union City Summary

Market		Annual Ridership
Union City to / from	North Valley Chico, Gridley, Marysville–Yuba City, Plumas Lake	25,800
	Sacramento Area Natomas, Old North Sacramento, Midtown Sacramento, Sacramento City College, Elk Grove	61,900
	San Joaquin Valley North Lodi (new), Downtown Stockton, North Lathrop, Lathrop–Manteca, Tracy	83,900
	San Joaquin Valley Central Merced (new), Atwater, Livingston, Turlock, Ceres, Modesto (new), Ripon, Downtown Manteca	184,600
	Tri-Valley Vasco Road, Livermore, Pleasanton	114,100
	HSR* Madera, Fresno, Kings–Tulare, Bakersfield, Southern California	131,000
	Southern California *Los Angeles and other Thruway bus connections in Southern California*	*18,600*
	Total	**601,300**

*Includes Thruway bus transfers to / from Los Angeles and other locations in Southern California.

As shown in , the largest market flows to / from Union City are associated with the following station groups:

- "San Joaquin Valley Central" group, including Merced (new), Atwater, Livingston, Turlock, Ceres, Modesto (new), Ripon, and Downtown Manteca: 184,600
- "HSR" group, including Madera, Fresno, Kings–Tulare, Bakersfield, and Southern California (Los Angeles and other Thruway bus connections): 131,000
- "Tri-Valley" group, including Vasco Road, Livermore, and Pleasanton: 114,100
- "San Joaquin Valley North" group, including Lodi (new), Downtown Stockton, North Lathrop, Lathrop–Manteca, and Tracy: 83,900

Many of these stations are relatively close to Union City and are served by two or more of the proposed round trips. Other markets such as the Sacramento Area and North Valley are only served by one of the proposed round trips and are generally located farther out and / or require longer travel times.

Detailed forecasts showing market flows systemwide are provided in Table 15. Outside of trips to / from Union City, the three proposed round trips (shown under timetable patterns U, V, and W) would also serve other major geographic markets, including trips between the Tri-Valley and

San Joaquin Valley Central (296,500), the Sacramento Area (182,100), and San Joaquin Valley North (181,800). This trend reflects the significance of the Tri-Valley market, which is home to Lawrence Livermore National Laboratory (accessible via Vasco Road Station) and numerous office parks and is one of the largest hotspots for current and future residential development within the Bay Area.

METROPOLITAN TRANSPORTATION COMMISSION

Table 15: ACE Market Flow Analysis – Systemwide Detail

		2030 No Build									2030 Build										
		Existing route Lathrop–Ceres, Ceres–Merced, Sacramento (Natomas), and North Valley (Chico) Extensions HSR connections at Merced ACE–San Joaquins transfers available at Stockton San Joaquin Street									2030 No Build + 2 additional Union City trains between Merced and Union City + Chico–Downtown Stockton train extended to Union City										
Timetable pattern		A		B	A+C	C		D	W		A		B	A+C	C		D	U / V	W	
Route		Stockton–San Jose	Natomas–San Jose	Merced–San Jose (direct)	(transfer)	Merced–Natomas	Merced–Chico	Chico–Stockton San Jqn. St. **	Chico–Down-town Stockton	Total	Stockton–San Jose	Natomas–San Jose	Merced–San Jose (direct)	(transfer)	Merced–Natomas	Merced–Chico	Chico–Stockton San Jqn. St. **	Union City–Merced	Union City–Chico	Total
Daily round trips		3	1	1	*	2	1	1	1	10	3	1	1	*	2	1	1	2	1	12
Sacto. Area	Internal	—	32,500	—	—	90,600	49,300	108,900	34,200	315,500	—	32,500	—	—	90,600	49,300	108,900	—	34,200	315,500
	t/f SJV North	—	11,600	—	—	16,400	7,200	35,600	7,000	77,800	—	8,700	—	—	16,000	7,200	35,600	—	16,900	84,400
	t/f SJV Central	—	—	—	—	140,500	77,200	8,100	—	225,800	—	—	—	—	139,900	84,300	7,800	—	—	232,000
	t/f Tri-Valley	—	161,800	—	—	—	—	—	—	161,800	—	105,000	—	—	—	—	—	—	182,100	287,100
	t/f Fremont	—	24,600	—	—	—	—	—	—	24,600	—	24,600	—	—	—	—	—	—	—	24,600
	t/f Silicon Valley	—	268,300	—	—	—	—	—	—	268,300	—	268,300	—	—	—	—	—	—	—	268,300
SJV Central	Internal	—	—	24,800	—	57,100	31,300	—	—	113,200	—	—	20,300	—	39,100	25,500	—	119,700	—	204,600
	t/f SJV North	—	—	46,100	900	113,900	60,100	900	—	221,900	100	—	25,900	900	113,600	63,200	900	120,500	—	325,100
	t/f Tri-Valley	—	—	126,100	900	—	—	—	—	127,000	100	—	74,500	700	—	—	—	296,500	—	371,800
	t/f Fremont	—	—	21,700	400	—	—	—	—	22,100	100	—	21,800	400	—	—	—	—	—	22,300
	t/f Silicon Valley	—	—	213,600	1,200	—	—	—	—	214,800	200	—	213,700	1,300	—	—	—	—	—	215,200
SJV North	Internal	62,100	32,200	3,600	4,900	18,400	10,400	10,900	6,900	149,400	54,100	24,100	2,700	3,700	15,400	10,500	11,000	16,800	53,600	191,900
	t/f Tri-Valley	127,700	58,800	34,600	48,300	—	—	—	—	269,400	107,700	40,300	25,800	32,300	—	—	—	118,000	63,800	387,900
	t/f Fremont	51,100	21,700	15,600	22,000	—	—	—	—	110,400	51,200	21,600	15,500	18,200	—	—	—	—	—	106,500
	t/f Silicon Valley	248,400	110,500	47,200	68,800	—	—	—	—	474,900	248,600	110,400	47,100	52,300	—	—	—	—	—	458,400
Tri-Valley	Internal	25,900	10,700	9,300	13,300	—	—	—	—	59,200	21,500	7,200	7,000	8,800	—	—	—	32,100	9,800	86,400
	t/f Fremont	76,000	30,000	27,000	38,900	—	—	—	—	171,900	76,300	29,900	26,800	31,900	—	—	—	—	—	164,900
	t/f Silicon Valley	101,000	38,900	36,500	53,500	—	—	—	—	229,900	101,300	38,800	36,400	41,700	—	—	—	—	—	218,200
Fremont	t/f Silicon Valley	23,600	8,600	8,700	12,200	—	—	—	—	53,100	23,500	8,600	8,600	8,900	—	—	—	—	—	49,600
Union City	t/f North Valley	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	25,800	25,800
	t/f Sacto. Area	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	61,900	61,900
	t/f SJV North	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	40,500	43,400	83,900
	t/f SJV Central	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	184,600	—	184,600
	t/f Tri-Valley	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	77,700	36,400	114,100
North Valley	t/f Sacto. Area	—	2,800	—	—	7,100	48,100	63,400	34,500	155,900	—	2,800	—	—	7,100	48,100	63,300	—	34,500	155,800
	t/f SJV North	—	2,000	—	—	1,200	5,900	10,000	3,000	22,100	—	1,000	—	—	1,200	4,700	9,500	—	17,500	33,900
	t/f SJV Central	—	—	—	—	5,800	29,800	2,700	—	38,300	—	—	—	—	5,800	29,900	2,600	—	—	38,300
	t/f Tri-Valley	—	3,600	—	—	—	—	—	—	3,600	—	1,500	—	—	—	—	—	—	25,200	26,700
Silicon Valley	Internal	40,900	15,100	14,900	21,100	—	—	—	—	92,000	40,800	15,000	14,800	15,200	—	—	—	—	—	85,800
Connections (HSR, San Joaquins, Thruway bus)		—	—	28,400	35,800	42,600	63,200	186,800	16,900	373,700	—	—	22,400	37,100	41,800	55,000	178,900	232,900	17,100	585,200
Total		**756,700**	**833,700**	**658,100**	**322,200**	**493,600**	**382,500**	**427,300**	**102,500**	**3,976,600**	**725,500**	**740,300**	**563,300**	**253,400**	**470,500**	**377,700**	**418,500**	**1,239,300**	**622,200**	**5,410,700**

t/f = to / from; SJV = San Joaquin Valley; Sacto. = Sacramento; Jqn. = Joaquin

* 3 Natomas/Chico–Merced trains (Pattern C) connect with 3 Stockton–San Jose trains (Pattern A) at North Lathrop to allow for one-transfer service between the Merced and San Jose branches

** Pattern D connects with San Joaquins trains at Stockton San Joaquin Street

Train Capacity Analysis

In addition to the ridership forecasts, the ridership modeling effort included an analysis of passenger load between adjacent stations served by Union City trains to identify potential capacity issues related to using different trainset equipment. Due to the desire to retain as much land in the Waste Consolidation Area (WCA) as possible for future redevelopment, the City of Union City has indicated a preference for a platform and layover tracks that are designed for trainsets shorter than the design standard being used elsewhere in the Valley Rail Program.

Assuming ACE's current locomotive-hauled trains with Bombardier Bi-Level passenger coaches, for example, the proposed maximum-length trainset for the Union City Intercity Service at the Union City Intermodal Station would be restricted to 8 passenger coaches (instead of the 10 passenger coaches being assumed at other new stations). This is consistent with a recent decision by Butte County Association of Governments and SJRRC to limit trains to a maximum of 8 passenger coaches for the planned stations associated with the North Valley Rail project.

The exact type of trainset(s) to be used on the Union City Intercity Rail Service is not known at this time, but could consist of one or more models that are currently being considered across the future ACE and San Joaquins systems. For the purposes of this train capacity analysis, three trainset types have been evaluated: Bombardier Bi-Level (8-car) train with a total capacity of 1,056 passengers; Siemens Venture (7-car) train with a total capacity of 456 passengers; and Stadler FLIRT (3-unit) train with a total capacity of 672 passengers. The maximum number of cars or units for the Siemens Venture and Stadler FLIRT trainsets is based on the same maximum platform length determined for the 8-car Bombardier Bi-Level trainset, which is 745 feet.

A focused link load analysis was conducted for the three Union City trains to quantify potential crowding levels inside trains. For this analysis, screenlines were placed between each adjacent station pair on a given train's route. A screenline represents an imaginary cordon placed at a given location along a transit route, usually for the purpose of evaluating passenger loads and capacity inside transit vehicles as they pass through the screenline.

For example, if a train serves four stations (A, B, C, and D, in that order) and the passenger load ("link load") is desired for the segment of the line between Station B and Station C, a screenline is placed at that location and the ridership is aggregated between the relevant station pairs passing through the screenline. In this case, the link load would consist of passengers going from A to C, from A to D, from B to C, and from B to D. Passengers going from A to B or from C to D do not pass through the screenline and are therefore not counted.

This process can then be repeated by placing screenlines between the remaining adjacent station pairs for the train (i.e., between A and B and between C and D) to calculate the respective link loads at those locations. Taking the highest passenger load across all of the screenlines yields the maximum link load for that train. When planning a transit service, it is useful to compare the maximum link load to the actual capacity of the transit vehicle to quantify the level of crowding inside the vehicle and confirm that there is sufficient capacity to accommodate the load.

The results of this analysis for the six Union City trains (three trains in each direction) are summarized in Table 16.

Table 16: Link Load Analysis for Union City Trains

Train	Average Daily Ridership	Maximum Link Load*	Capacity Utilization at Maximum Link Load		
			Bombar-dier BiLevel (8-car)	Siemens Venture (7-car)	Stadler FLIRT (3-unit)
W01 (Chico → Union City)	919	682	65%	150%	101%
U01 (Merced → Union City, morning)	909	593	56%	130%	88%
V01 (Merced → Union City, evening)	891	685	65%	150%	102%
W02 (Union City → Chico)	785	519	49%	114%	77%
U02 (Union City → Merced, evening)	695	444	42%	97%	66%
V02 (Union City → Merced, morning)	898	756	72%	166%	113%

* Note: Because the maximum link load reflects an average daily value, the actual load on a given day may be higher or lower due to day-to-day variability and other factors. The maximum link load for most of the six trains is based on weekend daily ridership, which is forecasted to generally be higher than weekday ridership for the Union City trains.

As shown in Table 16, capacity utilization would be highest on the Siemens Venture trainsets due to lower passenger capacity, with five of the six trains well above the trainset capacity and the remaining train effectively at capacity. With the 3-unit Stadler FLIRT trainsets, three of the trains would exceed the trainset capacity. The capacity utilization for the Bombardier BiLevel trainsets would range from 42 percent to 72 percent, but none of the six trains would exceed the trainset capacity.

Maximum load points for the six trains are generally located along the trunk portion of the ACE system, in the section between the Altamont Pass and Lathrop Wye:

- U01, V01, and W01 / W02: Between Tracy and Vasco Road
- U02: Between Tracy and Lathrop–Manteca and between Lathrop–Manteca and Downtown Manteca
- V02: Between Lathrop–Manteca and Downtown Manteca

This passenger load analysis is based on annual ridership forecasts for each of the six trains; the annual forecasts were converted to daily station-to-station ridership estimates that were used to determine passenger load between adjacent stations served by the Union City trains. It is possible that day-to-day variation in demand may exceed the maximum passenger load between stations for a given train reported in Table 16.

Ridership and Revenue Forecasting Disclaimer

AECOM's findings represent its reasonable judgments within the time and budget context of its scope and utilizing the information available to it at the time. Deliverables may include "forward-looking statements." These statements relate to AECOM's expectations, beliefs, intentions, or strategies regarding the future. These statements may be identified by the use of words like "anticipate," "believe," "estimate," "expect," "intend," "may," "plan," "project," "will," "should," "seek," and similar expressions. All forward-looking statements, recommendations, strategies, and approaches reflect AECOM's views and assumptions with respect to future events and are subject to future economic conditions, and other risks and uncertainties. Actual and future results and trends could differ materially from those set forth in such statements due to various factors.

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