WCCTAC
West Contra Costa Transportation Advisory Committee

West Contra Costa High-Capacity Transit Study

FINAL TECHNICAL MEMORANDUM #7

Travel Markets

January 2016

WSP | PARSONS BRINCKERHOFF

With

Kimley-Horn

Kittelson & Associates

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Document Review

Revision Date	Updated By	Organization	Description of Revision
12/31/15	Rebecca Kohlstrand	WSP| Parsons Brinckerhoff	Final corrections per consultant team

Document Sign-off

Name	Date	Signature
Rebecca Kohlstrand	1/7/16	

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Acronyms and Abbreviations

BART	San Francisco Bay Area Rapid Transit
CCTA	Contra Costa Transportation Authority
GIS	Geographical Informational System
GPS	Global Positioning System
HCT	High-Capacity Transit
I-80	Interstate 80
I-580	Interstate 580
MTC	Metropolitan Transportation Commission
O-D	Origin-Destination
TAZ	Traffic Analysis Zone
TSI	Transit Suitability Index
WCCTAC	West Contra Costa Transportation Advisory Committee

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1 INTRODUCTION

1.1 West Contra Costa County Transportation Setting

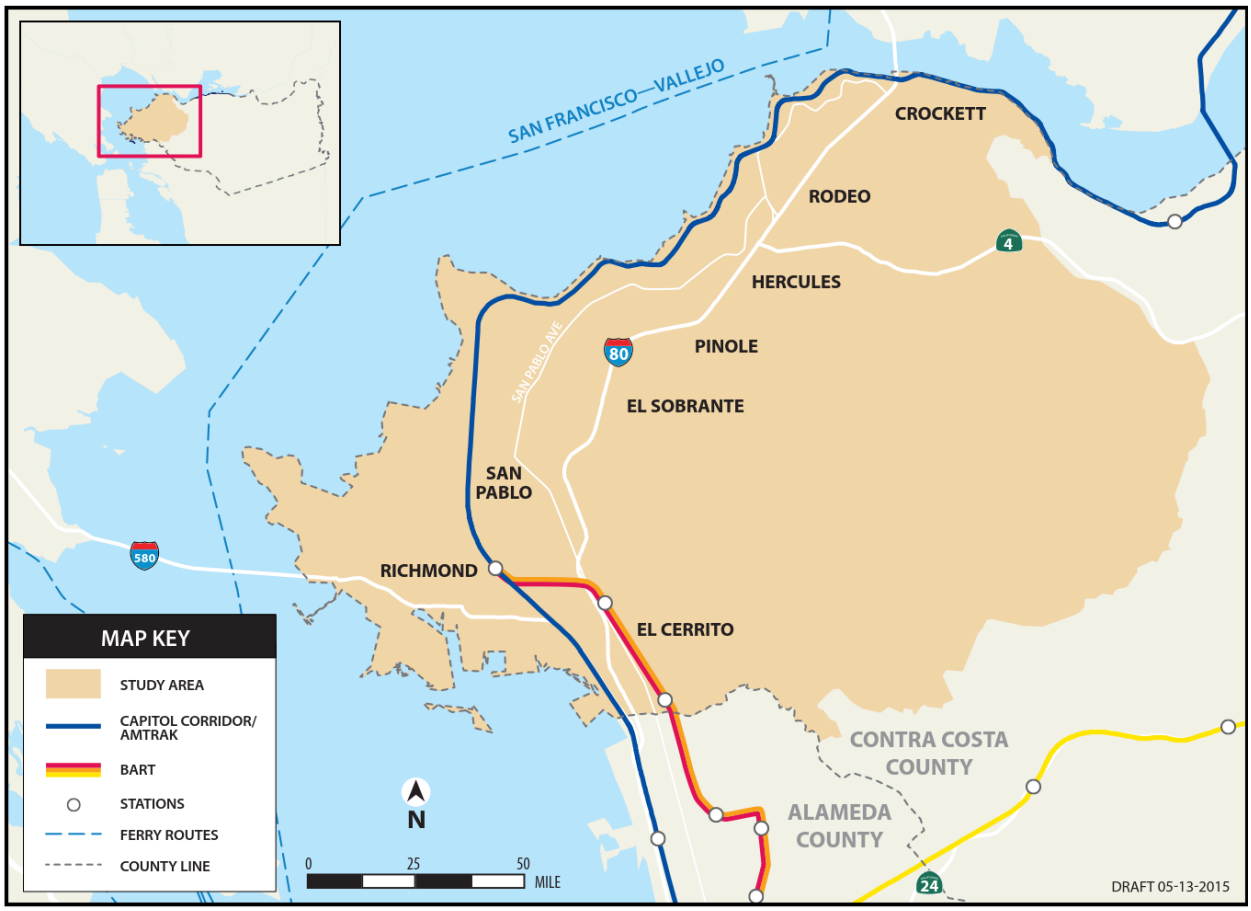
West Contra Costa County is a distinctive sub-region within the Bay Area set between the San Francisco Bay and the East Bay hills. Interstate 80 (I-80), the primary vehicular route running north-south through this sub-region, has major regional significance to Bay Area commuters, and is considered one of the most congested freeway corridors in the region. San Pablo Avenue is a major arterial that runs parallel and functions as a possible alternative to I-80. 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, Highway 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 State Route 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 HCT options in West Contra Costa County for WCCTAC's consideration. This will require 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 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 efforts for WCCTAC.

Figure 1-1: Study Area



Source: WSP | Parsons Brinckerhoff, Kimley Horn, 2015

1.3 Purpose of this Technical Memorandum

This technical memorandum documents the methodology and findings of a two-step process that identified the most competitive transit markets. The analysis involved the following steps:

1. **Origin-Destination Analysis:** This step involved the use of AirSage origin-destination (O-D) data to validate the Contra Costa Transportation Authority's (CCTA) Countywide regional model origin-destination data.[1] The origin-destination data was collected for the nine-county Bay Area and counties to the north (Yolo and Sacramento) at an aggregate level to document the key travel markets within and through western Contra Costa County, including local, regional, and inter-regional trips.

[1] AirSage analyzes mobile phone data from two of the largest cell phone providers and summarizes it into trip matrices to provide origin-destination data. The AirSage data provides a much larger sample of travel data than has been available through travel behavior surveys that have traditionally been used in the past to populate travel demand models.

2. **Market Analysis:** The Transit Suitability Index (TSI) sketch-planning tool was used to assess the competitiveness of transit for the major travel markets that affect the I-80 corridor. The TSI provides a transit suitability assessment based on factors, including: population density, employment density, household income, and vehicle ownership. The analysis considers both existing (2013) and future (2040) conditions for transit, represented in a series of maps.

The combined findings of this two-part analysis are summarized at the end of this tech memo.

2 ANALYSIS OF ORIGIN-DESTINATION DATA

2.1 Assumptions for Data Comparison

Compilation of Zones for Comparison

The data comparison involved O-D data from the CCTA Countywide Travel Demand Model and AirSage mobile source data. The CCTA model divides the Bay Area into traffic analysis zones (TAZs) for analytical purposes. There are a total of 3,121 TAZs in the model, of which 1,495 are within Contra Costa County, and 374 are within the Study Area. While the HCT study will be conducted using the TAZ level of detail built into the model, AirSage data uses cellular towers that in many cases have a two- to three-mile overlapping coverage, which can be larger than the finer West County TAZs.

To account for these differences in data detail at the individual TAZ level and the cost and logistic implications of using a big data set, the two data sets were structured for comparison purposes at an aggregated 38-zone level. This zonal aggregation included the nine Bay Area counties as well as Yolo and Sacramento counties to the north of the Study Area. These 38 districts were included by the study team to capture finer detail within West Contra Costa and less detail outside. Therefore, districts within West Contra Costa ranged from a few TAZs (a total of 15 around key transit corridors) to larger aggregations of TAZs outside of West County representing MTC super-districts or even counties.

The 38-district system is shown is **Figure 2-1** below. **Table A-1** in the Appendix identifies the corresponding geographies for each of the 38 districts. These districts enable a more streamlined comparison between the model and the AirSage data.

Figure 2-1: Origin-Destination Districts, 1-38

Source: CCTA Model and MTC Regional Model

Purpose of O-D Data Comparisons

Since the model was originally calibrated to a smaller sample set from the MTC Household Survey (about 15,000 households for the entire Bay Area) with the focus being on regional county-to-county origin-destinations, the intent of the comparison is to determine whether a re-calibration of the base year model based on the millions of observed daily AirSage O-D data points is warranted to better conform to observed travel patterns. By having a better representation of the travel demand patterns, the travel demand model will be able to better assess the key highway and transit origin-destinations influencing West Contra Costa and the I-80 corridor.

2.2 Model and AirSage Origin-Destination Data

CCTA Travel Demand Model

The CCTA Travel Demand model was developed by CCTA in 1990 and is implemented using the TransCAD software. The model has a 2013 base year and a 2040 long-range forecast year. The model was originally calibrated to MTC household survey data at the regional and county level. This calibration was then refined based on a model validation task to improve transit and highway volumes at key screenlines within and around Contra Costa. The calibration was based on household travel survey data from the year 2000. The AirSage data, collected in 2015 for daily, AM peak period, and PM peak period, provides a more up-to-date and comprehensive set of data and shows how Study Area travel patterns have changed over time. The AirSage data will allow appropriate adjustments to the model travel demand patterns to be more representative of current travel patterns. For comparison purposes, the model O-D trips were summarized by a total of 38 districts, as previously noted, for daily, AM and PM peak hour conditions. The focus of this discussion is on the difference in daily trip percentages as the adjustments in the model will be applied to daily trips, prior to application of the mode choice step in the model.

AirSage Mobile Source Data

There are a variety of emerging big data sources that provide useful data to enhance the traditional approaches to transportation planning. These range from cellular data to Bluetooth and GPS-based data collection. AirSage is one company providing access to such data. The company provides aggregated O-D data sourced from cellular phone data. The process relies on the regular communication between cellular devices and cell towers, which is used to estimate travel patterns suitable for use in travel demand forecasting.

Collecting this data is comparatively inexpensive since it relies on existing infrastructure. It is also superior to survey data because it is based on observed travel behavior rather than stated behavior. Another advantage of this data source is the richness of the dataset – AirSage reports

that its data sources cover 25 to 30 percent of the traveling public, and the minimum sample size includes a month of travel data.

For use in this study, AirSage O-D data was purchased for the San Francisco Bay Area's nine counties: Sonoma, Napa, Solano, Marin, Contra Costa, San Francisco, Alameda, San Mateo, and Santa Clara counties and an additional two counties to the north: Yolo and Sacramento counties. The data was compiled into 38 zones across the eleven counties. This O-D data was used to compare to the O-D data in the CCTA model to determine the need for potential model adjustments to better reflect observed travel patterns. In essence, the AirSage data provides a calibration check of the demand model originally calibrated to household survey data at a very coarse countywide level.

The travel demand data from the CCTA model, across the 38 aggregated zones, shows a much lower magnitude of trips than the AirSage data for all time periods. This is likely due to two factors: 1) the potential multiple readings of mobile devices captured at cellular towers within the Study Area by AirSage likely results in an overestimation of the number of actual trips, and 2) the model may not effectively capture many of the shorter trips that occur in real life as they may not be reported in a travel behavior survey.[2] The latter includes short trips such as walking to a nearby restaurant for lunch or walking to visit a neighbor. While the absolute number of trips reported by AirSage may be higher than reported in the model, the relative share of trips from origins to destinations is still relevant for making a comparison between the model results and the AirSage results, assuming that there is consistent over-reporting of trips in all zones. In addition, during the peak, the model data was reported for the peak hour while the AirSage data was for the peak period. Therefore, a comparison was conducted primarily using O-D trip percent shares instead of actual trips, which should accurately reflect the relative travel shares in each market during each of the time periods evaluated.

Comparisons between the model and AirSage data were produced for the following scenarios:

- Percent share of trips for all 38 zones;
- Percent share of trips with both origins and destinations internal to the Study Area;
- Percent share of trips with both origins and destinations external to the Study Area;
- Percent share of trips destined to the Study Area and originating outside the Study Area; and
- Percent share of trips originating in the Study Area with destinations outside the Study Area.

[2] AirSage picks up multiple pings from mobile devices that are switched on, which may lead to an absolute number higher than the actual number of trips.

This comparison will serve as the basis for recommending model adjustments to re-calibrate the model prior to conducting travel forecasting and transit ridership analysis.

2.3 Recommended Revisions to the Model

Model trip percent shares compared relatively well for many of the 38 districts, but some key O-Ds did show larger variation. Based on the comparison of base year model results to AirSage data for the 38 districts shown in **Figure 2-1**, certain revisions or adjustments are recommended to ensure the travel demand model better matches observed O-D trip data.

To account for these observed variations, adjustments are recommended to the daily person origin-destination trips in the model based on the relative percent differences compared with the AirSage data. These adjustments will be done following the trip distribution step and prior to capturing the selection of travel mode (auto, transit, walk, and bike) in the mode choice step. It is expected that the calibration adjustments would remain accurate for the peaks as well. These will be verified during the model validation step and, if necessary, additional adjustments may be made to the peak hour trips prior to the trip assignment step. Adjustments are recommended for all trip purposes in the model, including home-based work, home-based shop/other, home-based social/recreation and non-home based. Adjustments made for the base year will then be carried forward to the future year 2040 model. The districts proposed for O-D adjustments include internal West Contra districts 1-15, and outside districts 16-38 that pass through or directly influence the Study Area.

Adjustments will only be done for O-D's that directly involve West Contra Costa County. Trips patterns outside of the Study Area or trips from/to counties not traveling within West Contra Costa will not be adjusted.

Based on this, adjustments are recommended for the following O-D districts:

1. Trips originating in West Contra Costa and destined to West Contra Costa (internal-internal) from districts 1-15 to districts 1-15.

2. Trips originating in West Contra Costa and destined outside West Contra Costa (internal-external) from districts 1-15 to districts 16-38 (outside of West Contra Costa).

3. Trips originating outside West Contra Costa and destined to West Contra Costa (external-internal) from districts 16-38 to districts 1-15.

4. Trips originating in Counties north and passing through West Contra Costa destined to select destinations south of West Contra Costa (external-external) from districts 32-33 (Solano County), 37-38 (Napa and Yolo counties) to districts 21-30 (Alameda, Contra Costa, and San Francisco counties) and 35 (San Mateo County).

The recommended daily trip adjustments (in percent) for the above O-Ds are shown as excerpts in **Table 2-1** through **Table 2-4** below. Adjustments will be made for all O-D pairs that do not have an exact match (i.e., 0 percent difference). Recommended changes are shown as the percent differences for each O-D in the tables.

Table 2-1: Excerpt of Comparison Showing Daily 2013 CCTA Model versus AirSage Data Percents for Trips within West Contra Costa (Districts 1-15 to 1-15)

Model

STUDY AREA TOTAL		Destination Zone															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Origin Tota
Origin Zone	1	0.3%	0.0%	0.0%	0.1%	0.2%	0.2%	0.1%	0.0%	0.0%	0.2%	0.1%	0.3%	0.2%	0.8%	0.1%	**2.6%**
	2	0.0%	0.4%	0.4%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	**1.5%**
	3	0.0%	0.2%	0.8%	0.2%	0.1%	0.0%	0.4%	0.0%	0.0%	0.2%	0.2%	0.2%	0.1%	0.1%	0.0%	**2.6%**
	4	0.1%	0.2%	0.9%	1.0%	0.2%	0.1%	0.4%	0.1%	0.3%	0.6%	0.3%	0.6%	0.3%	0.9%	0.1%	**6.2%**
	5	0.1%	0.1%	0.1%	0.2%	3.9%	0.9%	0.3%	0.1%	0.3%	0.7%	0.5%	1.7%	1.0%	1.4%	0.6%	**11.9%**
	6	0.2%	0.0%	0.1%	0.1%	0.9%	1.8%	0.2%	0.0%	0.1%	0.4%	0.2%	0.8%	0.4%	0.8%	0.5%	**6.5%**
	7	0.0%	0.4%	1.6%	0.4%	0.2%	0.1%	2.5%	0.2%	0.3%	0.7%	0.8%	0.6%	0.3%	0.3%	0.1%	**8.5%**
	8	0.0%	0.0%	0.4%	0.1%	0.1%	0.0%	0.2%	0.3%	0.1%	0.5%	0.2%	0.3%	0.1%	0.1%	0.0%	**2.7%**
	9	0.0%	0.1%	0.1%	0.1%	0.1%	0.0%	0.2%	0.1%	0.5%	0.8%	0.4%	0.3%	0.2%	0.1%	0.0%	**3.2%**
	10	0.1%	0.2%	0.7%	0.6%	0.5%	0.2%	0.8%	0.4%	1.3%	4.0%	1.2%	1.5%	1.2%	0.8%	0.2%	**13.7%**
	11	0.0%	0.2%	0.6%	0.2%	0.2%	0.1%	0.9%	0.1%	1.0%	1.1%	3.1%	1.1%	0.5%	0.2%	0.1%	**9.3%**
	12	0.1%	0.1%	0.1%	0.2%	0.7%	0.3%	0.4%	0.1%	0.9%	1.2%	0.8%	2.5%	1.3%	0.6%	0.2%	**9.7%**
	13	0.1%	0.1%	0.2%	0.2%	0.4%	0.1%	0.3%	0.1%	0.7%	1.1%	0.5%	1.7%	2.0%	0.5%	0.1%	**8.1%**
	14	0.3%	0.0%	0.1%	0.5%	0.7%	0.3%	0.3%	0.1%	0.4%	0.7%	0.4%	1.1%	0.7%	3.9%	0.2%	**9.8%**
	15	0.1%	0.0%	0.0%	0.1%	0.5%	0.4%	0.1%	0.0%	0.0%	0.2%	0.1%	0.5%	0.2%	0.4%	1.3%	**4.0%**
	Dest. Total	**1.4%**	**2.0%**	**6.2%**	**4.0%**	**8.5%**	**4.5%**	**7.5%**	**1.8%**	**6.0%**	**12.6%**	**9.0%**	**13.4%**	**8.6%**	**11.0%**	**3.5%**	**100.0%**

Airsage

STUDY AREA TOTAL		Destination Zone															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Origin Tota
Origin Zone	1	2.5%	0.1%	0.0%	0.5%	0.2%	0.2%	0.0%	0.1%	0.0%	0.3%	0.1%	0.3%	0.3%	0.5%	0.0%	**5.0%**
	2	0.1%	1.6%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	**2.5%**
	3	0.0%	0.1%	0.6%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	**1.2%**
	4	0.4%	0.2%	0.2%	4.4%	0.2%	0.1%	0.1%	0.2%	0.1%	0.5%	0.3%	0.4%	0.2%	0.7%	0.1%	**8.1%**
	5	0.2%	0.1%	0.1%	0.3%	4.9%	0.5%	0.0%	0.1%	0.1%	0.9%	0.4%	1.1%	0.4%	0.8%	0.6%	**10.4%**
	6	0.2%	0.0%	0.1%	0.3%	0.7%	3.3%	0.0%	0.1%	0.1%	0.6%	0.3%	0.9%	0.4%	0.6%	0.7%	**8.3%**
	7	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.2%	0.0%	0.0%	0.2%	0.1%	0.1%	0.1%	0.1%	0.0%	**0.8%**
	8	0.0%	0.1%	0.1%	0.3%	0.1%	0.0%	0.0%	0.6%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	**1.6%**
	9	0.0%	0.1%	0.0%	0.3%	0.1%	0.1%	0.1%	0.0%	1.4%	0.2%	0.1%	0.4%	0.1%	0.2%	0.0%	**3.3%**
	10	0.1%	0.2%	0.2%	0.9%	0.8%	0.4%	0.1%	0.1%	0.2%	6.0%	0.9%	1.5%	0.5%	1.3%	0.2%	**13.4%**
	11	0.0%	0.0%	0.1%	0.5%	0.1%	0.1%	0.0%	0.1%	0.1%	0.9%	2.9%	0.5%	0.4%	0.3%	0.1%	**6.2%**
	12	0.1%	0.0%	0.0%	0.3%	0.6%	0.3%	0.1%	0.1%	0.1%	0.8%	0.4%	4.7%	0.3%	0.8%	0.2%	**9.0%**
	13	0.1%	0.1%	0.1%	0.4%	0.5%	0.3%	0.1%	0.0%	0.2%	0.5%	0.6%	0.5%	3.5%	1.0%	0.1%	**8.0%**
	14	0.4%	0.2%	0.1%	1.0%	1.2%	0.5%	0.1%	0.1%	0.1%	1.3%	0.7%	1.0%	0.9%	6.4%	0.2%	**14.2%**
	15	0.1%	0.0%	0.0%	0.2%	1.0%	0.5%	0.0%	0.0%	0.1%	0.4%	0.2%	0.4%	0.2%	0.6%	4.2%	**7.9%**
	Dest. Total	**4.3%**	**2.8%**	**1.7%**	**9.8%**	**10.5%**	**6.3%**	**0.9%**	**1.6%**	**2.7%**	**13.0%**	**7.2%**	**11.9%**	**7.5%**	**13.3%**	**6.4%**	**100.0%**

Compare Difference

STUDY AREA TOTAL		Destination Zone															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Origin Tota
Origin Zone	1	-2.1%	-0.1%	0.0%	-0.3%	0.0%	0.0%	0.1%	0.0%	0.0%	-0.1%	0.0%	0.1%	-0.1%	0.3%	0.0%	**-2.4%**
	2	-0.1%	-1.2%	0.4%	-0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	**-1.0%**
	3	0.0%	0.1%	0.2%	0.1%	0.0%	0.0%	0.4%	0.0%	0.0%	0.1%	0.2%	0.1%	0.1%	0.1%	0.0%	**1.4%**
	4	-0.3%	0.0%	0.7%	-3.5%	0.0%	0.0%	0.3%	-0.1%	0.2%	0.2%	0.0%	0.2%	0.1%	0.2%	0.0%	**-2.0%**
	5	0.0%	0.0%	0.0%	-0.1%	-1.0%	0.4%	0.3%	0.0%	0.2%	-0.1%	0.0%	0.7%	0.6%	0.6%	0.0%	**1.5%**
	6	0.1%	0.0%	0.0%	-0.2%	0.1%	-1.5%	0.1%	0.0%	0.0%	-0.2%	0.0%	0.0%	-0.1%	0.1%	-0.2%	**-1.8%**
	7	0.0%	0.4%	1.6%	0.3%	0.1%	0.1%	2.3%	0.2%	0.3%	0.6%	0.7%	0.6%	0.2%	0.2%	0.1%	**7.7%**
	8	0.0%	0.0%	0.4%	-0.2%	0.0%	0.0%	0.2%	-0.2%	0.1%	0.3%	0.1%	0.2%	0.1%	0.1%	0.0%	**1.1%**
	9	0.0%	0.0%	0.0%	-0.3%	0.0%	0.0%	0.2%	0.1%	-0.9%	0.6%	0.3%	0.0%	0.1%	-0.1%	0.0%	**-0.1%**
	10	0.0%	0.0%	0.5%	-0.4%	-0.3%	-0.2%	0.7%	0.3%	1.1%	-1.9%	0.3%	0.1%	0.7%	-0.5%	0.0%	**0.3%**
	11	0.0%	0.1%	0.5%	-0.3%	0.1%	0.0%	0.9%	0.1%	0.8%	0.1%	0.2%	0.5%	0.2%	-0.1%	0.0%	**3.1%**
	12	0.0%	0.0%	0.1%	0.0%	0.1%	-0.1%	0.4%	0.0%	0.8%	0.4%	0.4%	-2.2%	1.0%	-0.2%	0.0%	**0.7%**
	13	-0.1%	0.0%	0.0%	-0.2%	0.0%	-0.2%	0.2%	0.0%	0.5%	0.6%	0.0%	1.2%	-1.5%	-0.5%	0.0%	**0.1%**
	14	-0.1%	-0.1%	0.0%	-0.5%	-0.4%	-0.2%	0.2%	0.0%	0.3%	-0.6%	-0.3%	0.1%	-0.3%	-2.5%	0.0%	**-4.5%**
	15	-0.1%	0.0%	0.0%	-0.1%	-0.5%	-0.1%	0.1%	0.0%	0.0%	-0.2%	0.0%	0.0%	0.0%	-0.2%	-2.8%	**-3.9%**
	Dest. Total	**-2.8%**	**-0.8%**	**4.5%**	**-5.8%**	**-2.0%**	**-1.9%**	**6.6%**	**0.2%**	**3.3%**	**-0.3%**	**1.8%**	**1.5%**	**1.1%**	**-2.3%**	**-2.9%**	**0.0%**

Table 2-1: Excerpt of Comparison Showing Daily 2013 CCTA Model versus AirSage Data Percents for Trips within West Contra Costa (Districts 1-15 to 1-15) (Continued)

Model

STUDY AREA TOTAL		Destination Zone															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Origin Total
Origin Zone	1	0.3%	0.0%	0.0%	0.1%	0.1%	0.2%	0.0%	0.0%	0.0%	0.1%	0.0%	0.2%	0.1%	0.4%	0.1%	**1.7%**
	2	0.0%	0.4%	0.2%	0.2%	0.0%	0.0%	0.3%	0.0%	0.0%	0.1%	0.2%	0.1%	0.1%	0.0%	0.0%	**1.8%**
	3	0.0%	0.3%	0.7%	0.7%	0.1%	0.0%	1.3%	0.3%	0.1%	0.6%	0.5%	0.2%	0.1%	0.1%	0.0%	**5.1%**
	4	0.1%	0.1%	0.2%	1.1%	0.2%	0.1%	0.4%	0.1%	0.1%	0.6%	0.2%	0.4%	0.2%	0.6%	0.1%	**4.5%**
	5	0.2%	0.0%	0.1%	0.2%	4.2%	0.9%	0.2%	0.1%	0.1%	0.5%	0.2%	1.1%	0.5%	0.8%	0.5%	**9.4%**
	6	0.2%	0.0%	0.0%	0.1%	0.9%	1.9%	0.1%	0.0%	0.0%	0.3%	0.1%	0.5%	0.2%	0.4%	0.4%	**5.0%**
	7	0.1%	0.2%	0.6%	0.4%	0.3%	0.1%	2.7%	0.2%	0.2%	0.8%	0.9%	0.5%	0.3%	0.3%	0.1%	**7.8%**
	8	0.0%	0.0%	0.1%	0.1%	0.1%	0.0%	0.2%	0.3%	0.1%	0.4%	0.1%	0.2%	0.1%	0.1%	0.0%	**2.0%**
	9	0.0%	0.0%	0.1%	0.2%	0.2%	0.1%	0.3%	0.1%	0.4%	1.1%	0.8%	0.7%	0.5%	0.3%	0.0%	**4.9%**
	10	0.2%	0.1%	0.2%	0.7%	0.7%	0.4%	0.8%	0.5%	0.8%	4.0%	1.1%	1.4%	1.1%	0.8%	0.2%	**12.7%**
	11	0.1%	0.1%	0.2%	0.3%	0.3%	0.2%	0.8%	0.2%	0.4%	1.1%	3.4%	1.0%	0.4%	0.3%	0.1%	**8.8%**
	12	0.3%	0.1%	0.2%	0.5%	1.7%	0.8%	0.6%	0.3%	0.3%	1.5%	1.1%	3.1%	1.7%	1.1%	0.5%	**13.8%**
	13	0.1%	0.0%	0.1%	0.3%	0.8%	0.3%	0.3%	0.1%	0.2%	1.1%	0.5%	1.5%	1.8%	0.6%	0.2%	**8.0%**
	14	0.7%	0.0%	0.1%	0.9%	1.2%	0.7%	0.3%	0.1%	0.1%	0.8%	0.2%	0.9%	0.5%	4.1%	0.3%	**10.9%**
	15	0.1%	0.0%	0.0%	0.1%	0.6%	0.5%	0.1%	0.0%	0.0%	0.2%	0.0%	0.3%	0.1%	0.3%	1.3%	**3.5%**
	Dest. Total	**2.4%**	**1.4%**	**2.7%**	**5.8%**	**11.4%**	**6.1%**	**8.5%**	**2.5%**	**3.0%**	**13.5%**	**9.2%**	**12.0%**	**7.6%**	**10.1%**	**3.8%**	**100.0%**

Airsage

STUDY AREA TOTAL		Destination Zone															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Origin Total
Origin Zone	1	2.0%	0.1%	0.0%	0.3%	0.3%	0.1%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.5%	0.1%	**4.0%**
	2	0.2%	1.4%	0.0%	0.3%	0.1%	0.1%	0.0%	0.1%	0.1%	0.3%	0.1%	0.1%	0.1%	0.1%	0.1%	**3.0%**
	3	0.0%	0.0%	0.7%	0.1%	0.1%	0.0%	0.0%	0.0%	0.1%	0.4%	0.1%	0.1%	0.1%	0.1%	0.1%	**2.0%**
	4	0.5%	0.3%	0.1%	3.0%	0.2%	0.2%	0.1%	0.4%	0.3%	0.9%	0.4%	0.4%	0.4%	1.2%	0.1%	**8.5%**
	5	0.3%	0.1%	0.0%	0.3%	3.4%	0.9%	0.1%	0.2%	0.2%	1.0%	0.2%	0.9%	0.7%	1.1%	1.1%	**10.2%**
	6	0.1%	0.0%	0.0%	0.1%	0.6%	2.2%	0.0%	0.0%	0.0%	0.5%	0.1%	0.6%	0.3%	0.9%	0.7%	**6.3%**
	7	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.2%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%	**0.9%**
	8	0.0%	0.1%	0.1%	0.2%	0.1%	0.1%	0.0%	0.3%	0.0%	0.2%	0.2%	0.2%	0.0%	0.2%	0.0%	**1.8%**
	9	0.1%	0.0%	0.0%	0.2%	0.1%	0.1%	0.0%	0.0%	0.9%	0.2%	0.1%	0.3%	0.3%	0.2%	0.1%	**2.5%**
	10	0.2%	0.2%	0.3%	0.7%	1.2%	0.6%	0.1%	0.1%	0.2%	4.5%	1.2%	1.7%	0.6%	2.1%	0.5%	**14.1%**
	11	0.1%	0.0%	0.0%	0.3%	0.4%	0.2%	0.0%	0.1%	0.1%	1.0%	1.8%	0.6%	0.6%	0.6%	0.1%	**6.0%**
	12	0.2%	0.2%	0.1%	0.4%	1.0%	1.0%	0.1%	0.1%	0.4%	1.9%	0.9%	3.3%	0.3%	1.0%	0.6%	**11.3%**
	13	0.2%	0.2%	0.1%	0.4%	0.9%	0.4%	0.1%	0.1%	0.2%	0.6%	0.4%	0.3%	2.9%	1.6%	0.2%	**8.6%**
	14	0.6%	0.1%	0.1%	0.9%	0.8%	1.0%	0.1%	0.1%	0.3%	1.8%	0.4%	1.0%	1.3%	5.7%	0.9%	**15.1%**
	15	0.1%	0.0%	0.0%	0.1%	0.8%	0.6%	0.0%	0.0%	0.0%	0.3%	0.1%	0.3%	0.1%	0.5%	3.1%	**5.9%**
	Dest. Total	**4.6%**	**2.6%**	**1.7%**	**7.2%**	**10.1%**	**7.6%**	**0.9%**	**1.6%**	**2.8%**	**13.7%**	**5.8%**	**10.1%**	**7.8%**	**16.0%**	**7.5%**	**100.0%**

		2.4%	1.4%	2.7%	5.8%	11.4%	6.1%	8.5%	2.5%	3.0%	13.5%	9.2%	12.0%	7.6%	10.1%	3.8%	100.0%

Compare Difference

STUDY AREA TOTAL		Destination Zone															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Origin Total
Origin Zone	1	-1.7%	-0.1%	0.0%	-0.2%	-0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	-0.2%	-0.1%	**-2.2%**
	2	-0.2%	-1.0%	0.1%	-0.1%	0.0%	0.0%	0.3%	-0.1%	0.0%	-0.1%	0.1%	0.0%	0.0%	-0.1%	0.0%	**-1.2%**
	3	0.0%	0.3%	0.0%	0.5%	0.0%	0.0%	1.3%	0.3%	0.0%	0.2%	0.4%	0.1%	0.0%	0.0%	0.0%	**3.1%**
	4	-0.4%	-0.1%	0.1%	-1.9%	0.0%	-0.1%	0.3%	-0.2%	-0.2%	-0.3%	-0.1%	0.0%	-0.3%	-0.7%	-0.1%	**-4.0%**
	5	-0.1%	0.0%	0.0%	-0.1%	0.7%	0.0%	0.2%	-0.1%	-0.1%	-0.4%	0.0%	0.2%	-0.2%	-0.3%	-0.6%	**-0.8%**
	6	0.1%	0.0%	0.0%	0.0%	0.3%	-0.4%	0.1%	0.0%	0.0%	-0.2%	0.0%	-0.1%	-0.1%	-0.5%	-0.3%	**-1.3%**
	7	0.1%	0.2%	0.5%	0.4%	0.2%	0.1%	2.5%	0.2%	0.2%	0.8%	0.8%	0.5%	0.2%	0.2%	0.1%	**7.0%**
	8	0.0%	0.0%	0.0%	-0.1%	0.0%	0.0%	0.2%	0.0%	0.1%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	**0.2%**
	9	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.3%	0.1%	-0.4%	1.0%	0.7%	0.4%	0.3%	0.1%	0.0%	**2.4%**
	10	0.0%	-0.1%	-0.1%	0.0%	-0.5%	-0.3%	0.7%	0.4%	0.6%	-0.5%	-0.2%	-0.3%	0.5%	-1.3%	-0.3%	**-1.4%**
	11	0.0%	0.1%	0.2%	0.0%	0.0%	-0.1%	0.8%	0.0%	0.3%	0.1%	1.6%	0.4%	-0.1%	-0.3%	0.0%	**2.8%**
	12	0.1%	-0.1%	0.1%	0.2%	0.7%	-0.2%	0.5%	0.2%	-0.1%	-0.3%	0.2%	-0.2%	1.5%	0.1%	-0.1%	**2.6%**
	13	-0.1%	-0.1%	0.0%	-0.1%	0.0%	-0.1%	0.1%	0.0%	0.0%	0.5%	0.1%	1.2%	-1.1%	-1.0%	0.0%	**-0.6%**
	14	0.1%	0.0%	0.0%	0.0%	0.4%	-0.3%	0.2%	0.0%	-0.2%	-1.0%	-0.2%	-0.1%	-0.8%	-1.6%	-0.5%	**-4.2%**
	15	0.0%	0.0%	0.0%	0.0%	-0.2%	-0.1%	0.1%	0.0%	0.0%	-0.2%	0.0%	0.0%	0.0%	-0.3%	-1.8%	**-2.4%**
	Dest. Total	**-2.2%**	**-1.2%**	**1.0%**	**-1.5%**	**1.3%**	**-1.5%**	**7.6%**	**0.9%**	**0.2%**	**-0.2%**	**3.3%**	**1.9%**	**-0.2%**	**-5.9%**	**-3.8%**	**0.0%**

Table 2-1: Excerpt of Comparison Showing Daily 2013 CCTA Model versus AirSage Data Percents for Trips within West Contra Costa (Districts 1-15 to 1-15) (Continued)

Model

STUDY AREA TOTAL		Destination Zone															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Origin Total
Origin Zone	1	0.3%	0.0%	0.0%	0.1%	0.2%	0.2%	0.1%	0.0%	0.0%	0.2%	0.1%	0.3%	0.1%	0.5%	0.1%	**2.0%**
	2	0.0%	0.4%	0.2%	0.2%	0.0%	0.0%	0.3%	0.0%	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	**1.5%**
	3	0.0%	0.2%	0.7%	0.4%	0.1%	0.0%	0.9%	0.2%	0.1%	0.4%	0.3%	0.2%	0.1%	0.1%	0.0%	**3.7%**
	4	0.1%	0.2%	0.4%	1.1%	0.2%	0.1%	0.4%	0.1%	0.1%	0.6%	0.3%	0.5%	0.2%	0.7%	0.1%	**5.1%**
	5	0.2%	0.0%	0.1%	0.2%	4.2%	0.9%	0.3%	0.1%	0.1%	0.6%	0.3%	1.4%	0.6%	1.0%	0.5%	**10.6%**
	6	0.2%	0.0%	0.0%	0.1%	0.9%	1.8%	0.1%	0.0%	0.0%	0.3%	0.1%	0.7%	0.2%	0.5%	0.5%	**5.5%**
	7	0.1%	0.3%	0.9%	0.5%	0.3%	0.1%	2.7%	0.2%	0.3%	0.8%	0.9%	0.6%	0.3%	0.3%	0.1%	**8.3%**
	8	0.0%	0.0%	0.2%	0.1%	0.1%	0.0%	0.2%	0.3%	0.1%	0.5%	0.2%	0.2%	0.1%	0.1%	0.0%	**2.2%**
	9	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.3%	0.1%	0.4%	0.9%	0.5%	0.5%	0.3%	0.2%	0.0%	**3.6%**
	10	0.2%	0.1%	0.4%	0.7%	0.6%	0.3%	0.8%	0.5%	0.9%	3.9%	1.1%	1.5%	1.1%	0.8%	0.2%	**13.1%**
	11	0.1%	0.1%	0.3%	0.3%	0.3%	0.1%	0.9%	0.2%	0.5%	1.1%	3.4%	1.1%	0.5%	0.3%	0.1%	**9.1%**
	12	0.3%	0.1%	0.2%	0.5%	1.5%	0.7%	0.6%	0.2%	0.5%	1.6%	1.1%	3.3%	1.7%	1.1%	0.4%	**13.8%**
	13	0.1%	0.0%	0.1%	0.2%	0.6%	0.2%	0.3%	0.1%	0.3%	1.0%	0.4%	1.6%	1.6%	0.5%	0.1%	**7.4%**
	14	0.5%	0.0%	0.1%	0.7%	1.0%	0.6%	0.3%	0.1%	0.2%	0.8%	0.3%	1.0%	0.5%	4.0%	0.3%	**10.5%**
	15	0.1%	0.0%	0.0%	0.1%	0.5%	0.5%	0.1%	0.0%	0.0%	0.2%	0.1%	0.4%	0.1%	0.3%	1.2%	**3.6%**
	Dest. Total	**2.1%**	**1.5%**	**3.6%**	**5.2%**	**10.7%**	**5.7%**	**8.2%**	**2.3%**	**3.6%**	**13.1%**	**9.1%**	**13.3%**	**7.5%**	**10.6%**	**3.6%**	**100.0%**

Airsage

STUDY AREA TOTAL		Destination Zone															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Origin Total
Origin Zone	1	2.3%	0.1%	0.0%	0.4%	0.2%	0.2%	0.0%	0.0%	0.1%	0.2%	0.1%	0.2%	0.2%	0.5%	0.1%	**4.0%**
	2	0.2%	1.5%	0.0%	0.2%	0.1%	0.1%	0.0%	0.1%	0.1%	0.2%	0.1%	0.1%	0.1%	0.1%	0.0%	**3.0%**
	3	0.0%	0.0%	0.7%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.3%	0.1%	0.1%	0.1%	0.1%	0.0%	**2.0%**
	4	0.5%	0.2%	0.1%	4.0%	0.2%	0.2%	0.1%	0.2%	0.2%	0.8%	0.4%	0.4%	0.4%	0.9%	0.1%	**8.5%**
	5	0.2%	0.1%	0.1%	0.3%	4.2%	0.6%	0.1%	0.1%	0.1%	0.9%	0.3%	0.9%	0.6%	0.9%	0.9%	**10.2%**
	6	0.1%	0.0%	0.0%	0.2%	0.6%	2.7%	0.0%	0.1%	0.1%	0.5%	0.2%	0.6%	0.3%	0.7%	0.7%	**6.3%**
	7	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.2%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	**0.9%**
	8	0.0%	0.1%	0.1%	0.2%	0.1%	0.1%	0.0%	0.5%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	**1.8%**
	9	0.0%	0.1%	0.0%	0.2%	0.1%	0.1%	0.0%	0.0%	1.0%	0.1%	0.1%	0.3%	0.2%	0.2%	0.0%	**2.5%**
	10	0.2%	0.2%	0.3%	0.7%	0.9%	0.5%	0.1%	0.1%	0.2%	5.2%	1.1%	1.5%	0.5%	1.6%	0.3%	**14.1%**
	11	0.1%	0.1%	0.1%	0.4%	0.3%	0.1%	0.0%	0.1%	0.1%	1.0%	2.6%	0.6%	0.5%	0.5%	0.1%	**6.0%**
	12	0.1%	0.1%	0.1%	0.4%	0.8%	0.6%	0.1%	0.1%	0.3%	1.4%	0.7%	4.1%	0.3%	1.0%	0.3%	**11.3%**
	13	0.2%	0.1%	0.1%	0.4%	0.6%	0.4%	0.1%	0.1%	0.2%	0.5%	0.5%	0.4%	3.3%	1.2%	0.2%	**8.6%**
	14	0.5%	0.1%	0.1%	0.9%	0.9%	0.8%	0.1%	0.1%	0.2%	1.6%	0.5%	1.0%	1.2%	6.1%	0.5%	**15.1%**
	15	0.1%	0.0%	0.0%	0.1%	0.9%	0.6%	0.0%	0.0%	0.0%	0.3%	0.1%	0.3%	0.2%	0.5%	3.7%	**5.9%**
	Dest. Total	**4.6%**	**2.6%**	**1.7%**	**7.2%**	**10.1%**	**7.6%**	**0.9%**	**1.6%**	**2.8%**	**13.7%**	**5.8%**	**10.1%**	**7.8%**	**16.0%**	**7.5%**	**100.0%**

Compare Difference

STUDY AREA TOTAL		Destination Zone															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Origin Total
Origin Zone	1	-2.0%	-0.1%	0.0%	-0.3%	-0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	-0.1%	0.0%	0.0%	**-2.6%**
	2	-0.1%	-1.1%	0.2%	-0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	-0.1%	0.0%	0.0%	-0.1%	-0.1%	0.0%	**-1.3%**
	3	0.0%	0.2%	0.0%	0.3%	0.0%	0.0%	0.9%	0.1%	0.0%	0.1%	0.3%	0.1%	0.0%	0.0%	0.0%	**2.0%**
	4	-0.4%	-0.1%	0.3%	-2.9%	0.0%	-0.1%	0.3%	-0.1%	-0.1%	-0.1%	-0.1%	0.1%	-0.1%	-0.2%	-0.1%	**-3.6%**
	5	0.0%	0.0%	0.0%	-0.1%	-0.1%	0.3%	0.2%	0.0%	0.0%	-0.3%	0.0%	0.6%	0.0%	0.1%	-0.4%	**0.3%**
	6	0.0%	0.0%	0.0%	-0.1%	0.2%	-0.9%	0.1%	0.0%	0.0%	-0.2%	0.0%	0.0%	-0.1%	-0.2%	-0.2%	**-1.4%**
	7	0.1%	0.2%	0.9%	0.4%	0.2%	0.1%	2.5%	0.2%	0.2%	0.7%	0.8%	0.5%	0.2%	0.2%	0.1%	**7.4%**
	8	0.0%	0.0%	0.1%	-0.1%	0.0%	0.0%	0.2%	-0.2%	0.1%	0.3%	0.1%	0.1%	0.0%	0.0%	0.0%	**0.6%**
	9	0.0%	0.0%	0.0%	-0.1%	0.0%	0.0%	0.2%	0.1%	-0.6%	0.8%	0.4%	0.2%	0.1%	0.0%	0.0%	**1.0%**
	10	0.0%	-0.1%	0.1%	-0.1%	-0.3%	-0.2%	0.7%	0.3%	0.7%	-1.3%	0.0%	0.0%	0.5%	-0.8%	-0.1%	**-0.4%**
	11	0.0%	0.1%	0.2%	-0.2%	0.0%	0.0%	0.8%	0.1%	0.5%	0.1%	0.8%	0.5%	-0.1%	-0.2%	0.0%	**2.5%**
	12	0.2%	0.0%	0.1%	0.1%	0.8%	0.1%	0.6%	0.1%	0.2%	0.1%	0.4%	-0.8%	1.4%	0.1%	0.1%	**3.4%**
	13	-0.1%	0.0%	0.0%	-0.1%	0.0%	-0.2%	0.2%	0.0%	0.1%	0.5%	0.0%	1.2%	-1.6%	-0.7%	0.0%	**-0.7%**
	14	0.0%	-0.1%	0.0%	-0.1%	0.1%	-0.2%	0.2%	0.0%	0.0%	-0.8%	-0.2%	0.0%	-0.6%	-2.1%	-0.2%	**-4.0%**
	15	0.0%	0.0%	0.0%	0.0%	-0.3%	-0.1%	0.1%	0.0%	0.0%	-0.1%	0.0%	0.1%	0.0%	-0.2%	-2.5%	**-3.3%**
	Dest. Total	**-2.4%**	**-1.2%**	**2.0%**	**-3.4%**	**0.6%**	**-1.2%**	**7.3%**	**0.6%**	**1.0%**	**-0.4%**	**2.4%**	**2.7%**	**-0.5%**	**-4.0%**	**-3.5%**	**0.0%**

Source: Kittelson & Associates, Inc. 2015

Table 2-2: Excerpt of Comparison Showing Daily 2013 CCTA Model versus AirSage Data Percents – West Contra Costa to External O-D Districts (Districts 1-15 to 16-38)

	Share of Total Trip Destinations Originating from the WCCTAC Study Area, 24-Hour Period																								
	Destination Zone ID	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	Total Trips Originating from Study Area
Model (Peak Hour)	# of trips	7,248	4,192	1,665	2,981	1,202	1,038	2,763	12,642	4,627	2,233	5,513	28,535	5,795	1,862	3,084	622	12,087	3,854	7,726	2,930	2,345	5,467	1,296	121,706
Vehicle Trips	% of total	6.0%	3.4%	1.4%	2.4%	1.0%	0.9%	2.3%	10.4%	3.8%	1.8%	4.5%	23.4%	4.8%	1.5%	2.5%	0.5%	9.9%	3.2%	6.3%	2.4%	1.9%	4.5%	1.1%	100.0%
Airsage (Peak Period)	# of trips	29,109	13,718	3,344	11,252	3,717	3,349	10,542	37,859	10,567	3,797	4,699	55,960	22,393	8,658	13,775	2,582	18,868	12,307	19,910	11,526	5,526	8,529	5,199	317,186
Pings to Tower	% of total	9.2%	4.3%	1.1%	3.5%	1.2%	1.1%	3.3%	11.9%	3.3%	1.2%	1.5%	17.6%	7.1%	2.7%	4.3%	0.8%	5.9%	3.9%	6.3%	3.6%	1.7%	2.7%	1.6%	100%
Diff	# of trips	(21,862)	(9,526)	(1,679)	(8,270)	(2,515)	(2,311)	(7,779)	(25,217)	(5,940)	(1,564)	813	(27,425)	(16,598)	(6,796)	(10,691)	(1,960)	(6,781)	(8,453)	(12,184)	(8,596)	(3,181)	(3,062)	(3,903)	(195,480)
Percent Diff	% of total	-3.2%	-0.9%	0.3%	-1.1%	-0.2%	-0.2%	-1.1%	-1.5%	0.5%	0.6%	3.0%	5.8%	-2.3%	-1.2%	-1.8%	-0.3%	4.0%	-0.7%	0.1%	-1.2%	0.2%	1.8%	-0.6%	0.0%

Source: Kittelson & Associates, Inc. 2015

Table 2-3: Excerpt of Comparison Showing Daily 2013 CCTA Model versus AirSage Data Percents – External O-D Districts to West Contra Costa (Districts 16-38 to 1-15)

	Share of Total Trip Origins Destined for the WCCTAC Study Area, 24-Hour Period																								
	Destination Zone ID	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	Total Trips Destined for the Study Area
Model	# of trips	7,842	4,245	1,632	2,929	1,153	964	2,660	12,437	4,548	2,157	5,764	29,650	4,989	1,668	2,795	571	11,705	3,995	7,227	2,604	2,552	5,403	1,934	121,421
	% of total	6.5%	3.5%	1.3%	2.4%	0.9%	0.8%	2.2%	10.2%	3.7%	1.8%	4.7%	24.4%	4.1%	1.4%	2.3%	0.5%	9.6%	3.3%	6.0%	2.1%	2.1%	4.4%	1.6%	-
Airsage	# of trips	28,452	14,289	3,329	10,399	3,899	3,265	10,863	39,188	10,568	3,994	5,340	59,292	23,874	8,687	14,792	2,695	17,680	11,117	21,387	11,851	5,885	7,629	4,432	322,906
	% of total	8.8%	4.4%	1.0%	3.2%	1.2%	1.0%	3.4%	12.1%	3.3%	1.2%	1.7%	18.4%	7.4%	2.7%	4.6%	0.8%	5.5%	3.4%	6.6%	3.7%	1.8%	2.4%	1.4%	-
Diff	# of trips	(20,610)	(10,044)	(1,697)	(7,470)	(2,746)	(2,301)	(8,203)	(26,751)	(6,020)	(1,838)	424	(29,643)	(18,885)	(7,019)	(11,997)	(2,125)	(5,975)	(7,122)	(14,160)	(9,247)	(3,332)	(2,226)	(2,498)	(201,485)
Percent Diff	% of total	-2.4%	-0.9%	0.3%	-0.8%	-0.3%	-0.2%	-1.2%	-1.9%	0.5%	0.5%	3.1%	6.1%	-3.3%	-1.3%	-2.3%	-0.4%	4.2%	-0.2%	-0.7%	-1.5%	0.3%	2.1%	0.2%	-

Source: Kittelson & Associates, Inc. 2015

Table 2-4: Excerpt of Comparison Showing Daily 2013 CCTA Model versus AirSage Data Percents – External OD Districts to West Contra Costa (Districts 32-33 and 37-38 to 21-30, 35)

DAILY Peak	Model	**Percent Through Trips**											
STUDY AREA TOTAL		**Destination Zone**											
		21	22	23	24	25	26	27	28	29	30	35	Origin Total
Origin Zone	32	1.2%	2.9%	18.4%	4.0%	2.7%	1.4%	12.7%	42.7%	3.2%	4.8%	6.1%	**100%**
	33	2.9%	4.7%	22.0%	3.5%	2.8%	0.8%	9.4%	30.2%	3.9%	6.3%	13.3%	**100%**
	37	2.0%	3.5%	12.3%	2.5%	2.0%	1.4%	18.6%	22.9%	9.5%	10.8%	14.5%	**100%**
	38	1.6%	1.7%	43.5%	9.8%	7.7%	0.1%	1.1%	13.2%	4.4%	5.0%	11.8%	**100%**
	Dest. Total	**8%**	**13%**	**96%**	**20%**	**15%**	**4%**	**42%**	**109%**	**21%**	**27%**	**46%**	**400%**
DAILY Peak	Airsage												
STUDY AREA TOTAL		**Destination Zone**											
		21	22	23	24	25	26	27	28	29	30	35	Origin Total
Origin Zone	32	3.4%	6.6%	21.2%	3.8%	2.0%	0.7%	14.3%	19.1%	6.7%	10.6%	11.6%	**100%**
	33	4.6%	8.6%	21.8%	3.8%	2.6%	1.0%	11.6%	14.6%	7.3%	9.3%	14.8%	**100%**
	37	2.1%	4.1%	12.2%	2.5%	1.3%	0.4%	6.7%	22.3%	16.8%	10.0%	21.6%	**100%**
	38	9.2%	10.3%	17.0%	3.4%	1.9%	0.2%	7.0%	14.9%	7.3%	8.1%	20.7%	**100%**
	Dest. Total	**19%**	**30%**	**72%**	**14%**	**8%**	**2%**	**40%**	**71%**	**38%**	**38%**	**69%**	**400%**
Compare	Difference												
DAILY Peak													
STUDY AREA TOTAL		**Destination Zone**											
		21	22	23	24	25	26	27	28	29	30	35	Origin Total
Origin Zone	32	-2.1%	-3.8%	-2.9%	0.1%	0.8%	0.7%	-1.6%	23.6%	-3.5%	-5.8%	-5.5%	**0%**
	33	-1.6%	-3.9%	0.3%	-0.3%	0.2%	-0.2%	-2.3%	15.7%	-3.3%	-3.0%	-1.6%	**0%**
	37	-0.1%	-0.5%	0.1%	0.0%	0.7%	1.0%	11.9%	0.6%	-7.3%	0.8%	-7.2%	**0%**
	38	-7.6%	-8.5%	26.5%	6.4%	5.8%	-0.1%	-5.9%	-1.7%	-2.9%	-3.1%	-8.9%	**0%**
	Dest. Total	**-12%**	**-17%**	**24%**	**6%**	**8%**	**1%**	**2%**	**38%**	**-17%**	**-11%**	**-23%**	**0%**

Source: Kittelson & Associates, Inc. 2015

Below are some comparative examples for key origin-destinations showing the variations between the two data sets:

- The model predicts O-D trip percents very close to AirSage for trips originating and staying within West County for all time periods (in the range -3 percent to +3 percent).
- The model predicts 14 percent of AM trips originating from West County and traveling to Central Contra Costa County, while AirSage shows 7.4 percent.
- The model predicts only 4 percent of AM trips originating from West County and traveling to San Francisco's financial district, while AirSage predicts 10.1 percent.
- The model predicts 23.4 percent of trips originating in Vallejo and Benicia passing though West County destined to San Francisco, while AirSage shows 44.8 percent

These examples reflect the variation between the two data sources, and show the benefit of adjusting the model to real conditions prior to analyzing the transit alternatives.

The demand model is calibrated using only 15,000 survey responses over the entire Bay Area, while Air Sage represents millions of digital observations on a daily basis. While sampling is never 100 percent accurate, the larger the sample size, the greater the potential for accuracy. Given the larger sample size of AirSage data, there is high level of confidence that the results are reasonably accurate on a percentage basis at the aggregate District level and sufficiently represent observed data via a digital snap shot of daily travel. The adjustments to the model using the AirSage data, however, require a test of reasonableness before adjustments are made. For example, there are a limited number of trip zonal interchanges that are showing up blank in the AirSage data and it is assumed that this is not an accurate representation of the travel. The consultant team is making selective adjustments, based on a test of reasonableness.

Following the recommended adjustments to the O-D trip distributions, a revised 2013 model run will be completed. The adjustments will propagate through the model to the key steps of mode choice and trip assignment that are needed for predicting highway, transit, bike and pedestrian trips. The model results will be reviewed to assess the resulting transit ridership and vehicle trips as compared to actual observed data at key screenlines and bridges. Once the model is calibrated to 2013 conditions, similar adjustments will be made to the 2040 no-build model and carried through all 2040 alternatives. This ensures that the model adjustments still maintain the integrity and validity of the model at key corridors.

2.4 Origin-Destination Analysis Findings

The CCTA travel demand model data was aggregated for the 15-zone Study Area to summarize all vehicle trips originating from and destined to the Study Area. The results are presented as the percent share of total vehicle trips (all trip purposes) for the nine-county region. The majority of vehicle trips during both the AM and PM peak hour are internal trips to the Study

Area, with a smaller share of trips either beginning or ending outside of the Study Area. This suggests that there are two distinct transit markets – one serving trips internal to the Study Area and the second serving trips that are external to the Study Area.

During the AM peak hour, 65.2 percent of all vehicle trips that originate within the Study Area remain within the Study Area, while 34.8 percent of the trips originating in the Study Area have destinations outside the Study Area. During the same period, 84.6 percent of vehicle trips destined for the Study Area originate within the Study Area, while the remaining 15.4 percent start at origins outside of the Study Area. The AM peak hour vehicle trips beginning in the Study Area are shown in **Figure 2-2**, and AM peak hour vehicle trips ending in the Study Area are shown in **Figure 2-3**.

The PM peak hour is similar with the majority of vehicle trips internal to the Study Area, but is generally a reverse of the AM peak. In the PM peak, 82.8 percent of trips originating in the Study Area remain within the Study Area (compared to the 84.6 percent internal trips destined for the Study Area in the AM), while 70.6 percent of PM peak hour vehicle trips destined to the Study Area also originated within the Study Area (compared to the 65.2 percent internal trips originating in the Study Area in the AM). The PM peak hour vehicle trips beginning in the Study Area are shown in **Figure 2-5** and vehicle trips ending in the Study Area are shown in **Figure 2-4**.

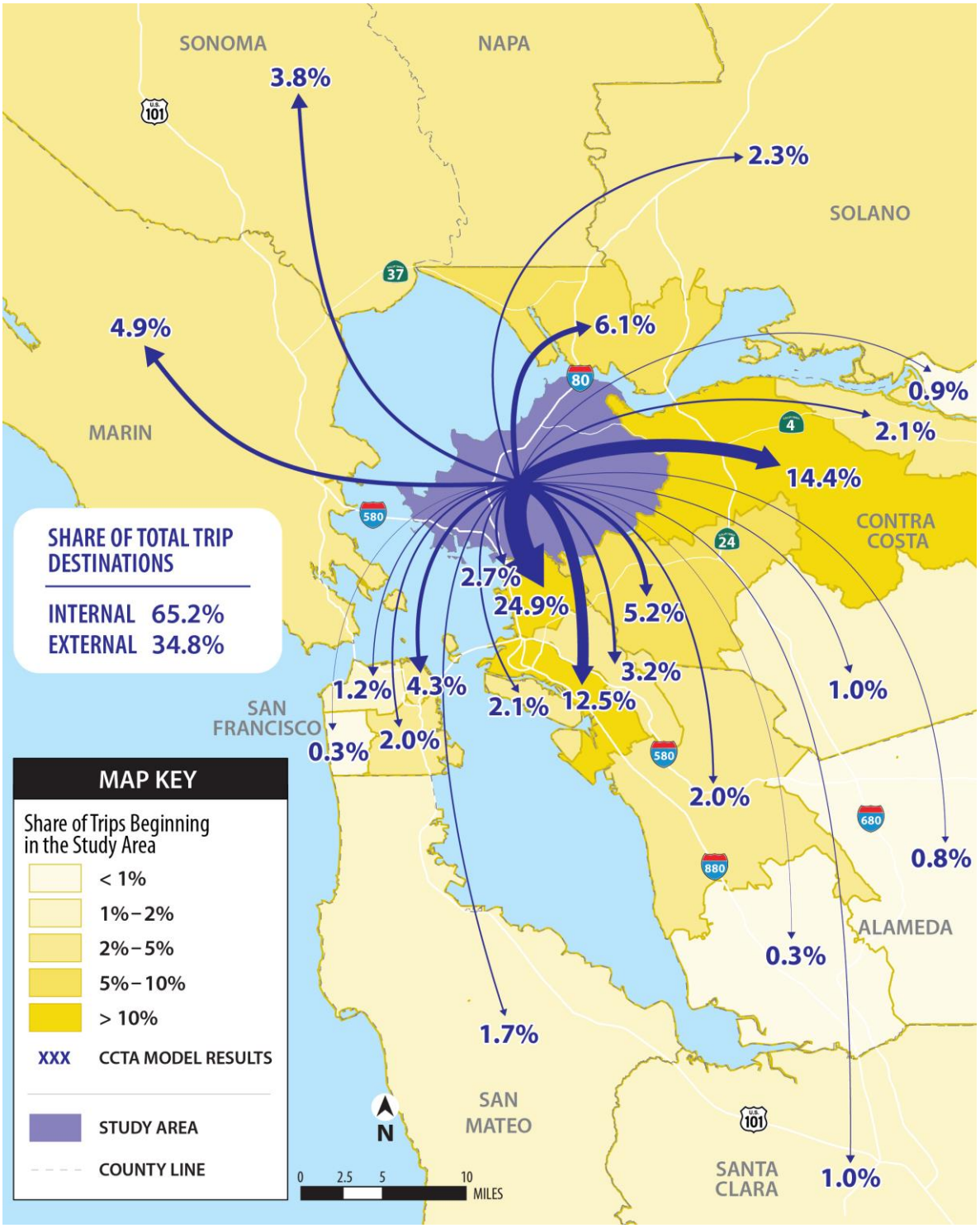
Trips Beginning in the Study Area with External Destinations

In general, the majority of trips beginning in the Study Area during the AM peak hour are traveling south and east to cities adjacent to the Study Area in other parts of Contra Costa County as well as Alameda County. The highest shares of AM peak hour vehicle trips beginning in the Study Area follow the I-80 corridor to destinations in Berkeley and Emeryville (24.9 percent) and to Oakland (15.6 percent). Another significant share of trips are destined along SR 4 to Central Contra Costa County to the cities of Martinez, Concord, and Pleasant Hill (14.4 percent). These O-D travel patterns are consistent with current congested southbound traffic conditions during the AM peak period through the I-80 corridor. Also notable is the 6.1 percent share of trips crossing the Carquinez Bridge north to Vallejo and Benicia. See **Figure 2-2**.

Roughly 4 percent of vehicle trips end in downtown San Francisco, with even fewer trips heading to other areas in the city. The low volumes for San Francisco trips may reflect the fact that many of the trips to San Francisco are captured by transit, resulting in low vehicular travel to San Francisco. Few vehicle trips begin in the Study Area and end in San Mateo and Santa Clara counties during the AM peak hour (less than 3 percent combined).

During the PM peak hour, the inbound trips generally reflect the reverse of this pattern, though there is some variation in percentages. The largest percentage of inbound trips, originate in Berkeley and Emeryville (29.4 percent) and Oakland (16.3 percent), followed by trips originating in Central Contra Costa County (14.3 percent). See **Table 2-4**.

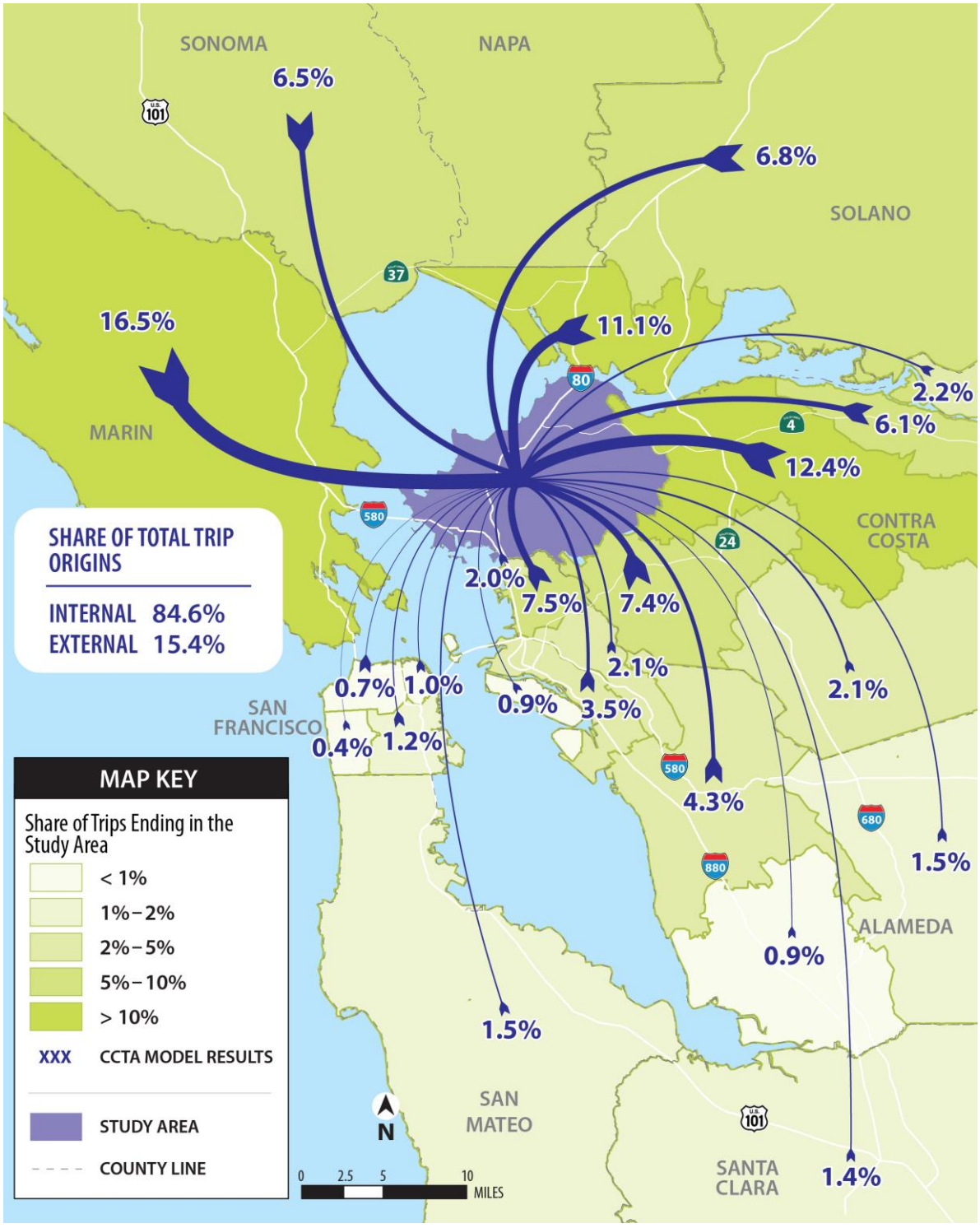
Figure 2-2: Destinations for All External Vehicle Trips Beginning in the Study Area, Unadjusted AM – Peak Hour



Source: CCTA Travel Demand Model, 2013

Note: In the AM peak hour, 65.2 percent of the trips originating in the Study Area stay within the Study Area and the remaining 34.8 percent are external trips.

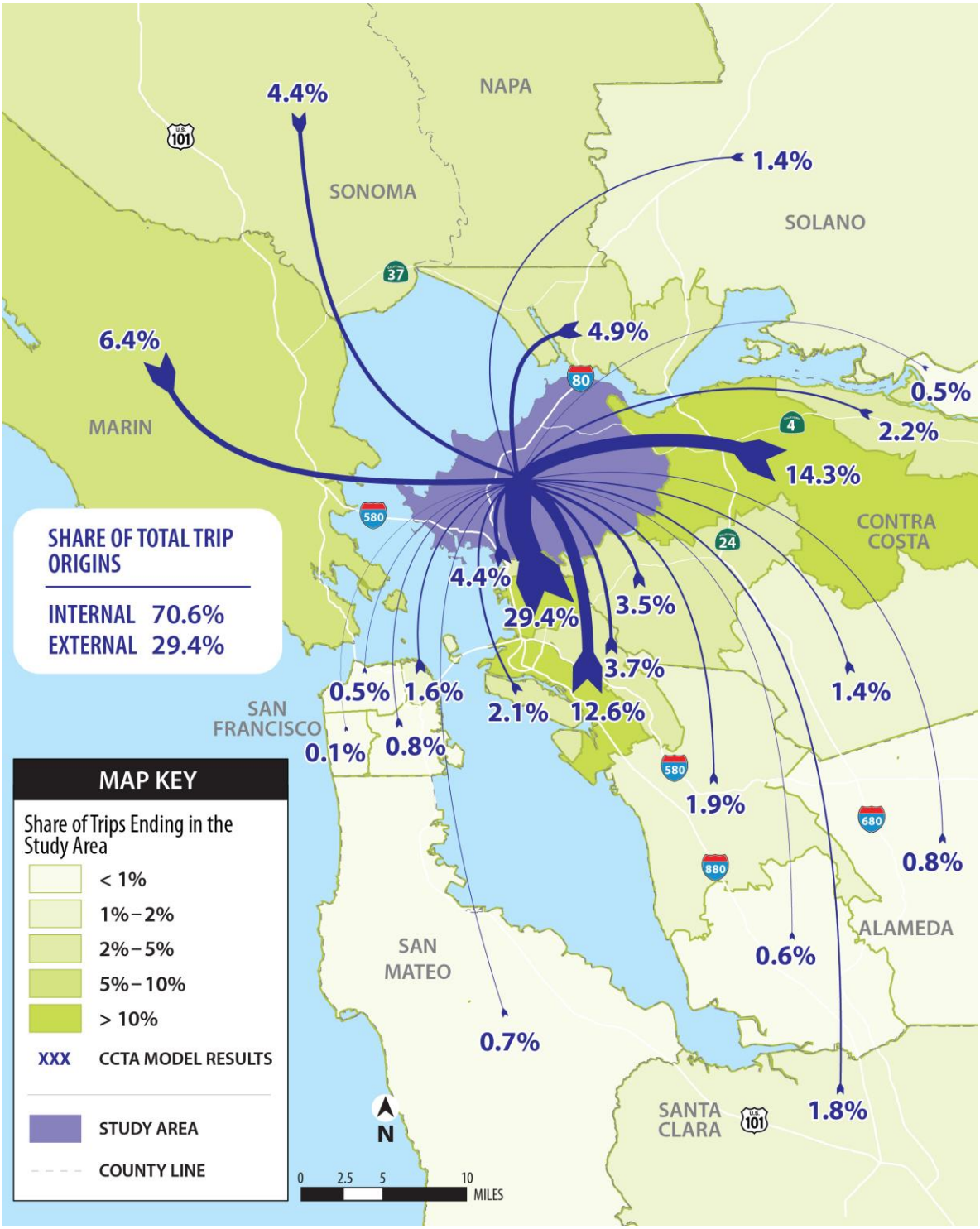
Figure 2-3: Origins of All External Vehicle Trips Ending in the Study Area, Unadjusted AM – Peak Hour



Source: CCTA Travel Demand Model, 2013

Note: In the AM peak hour, 84.6 percent of the trips destined for the Study Area stay within the Study Area and the remaining 15.4 percent are external trips.

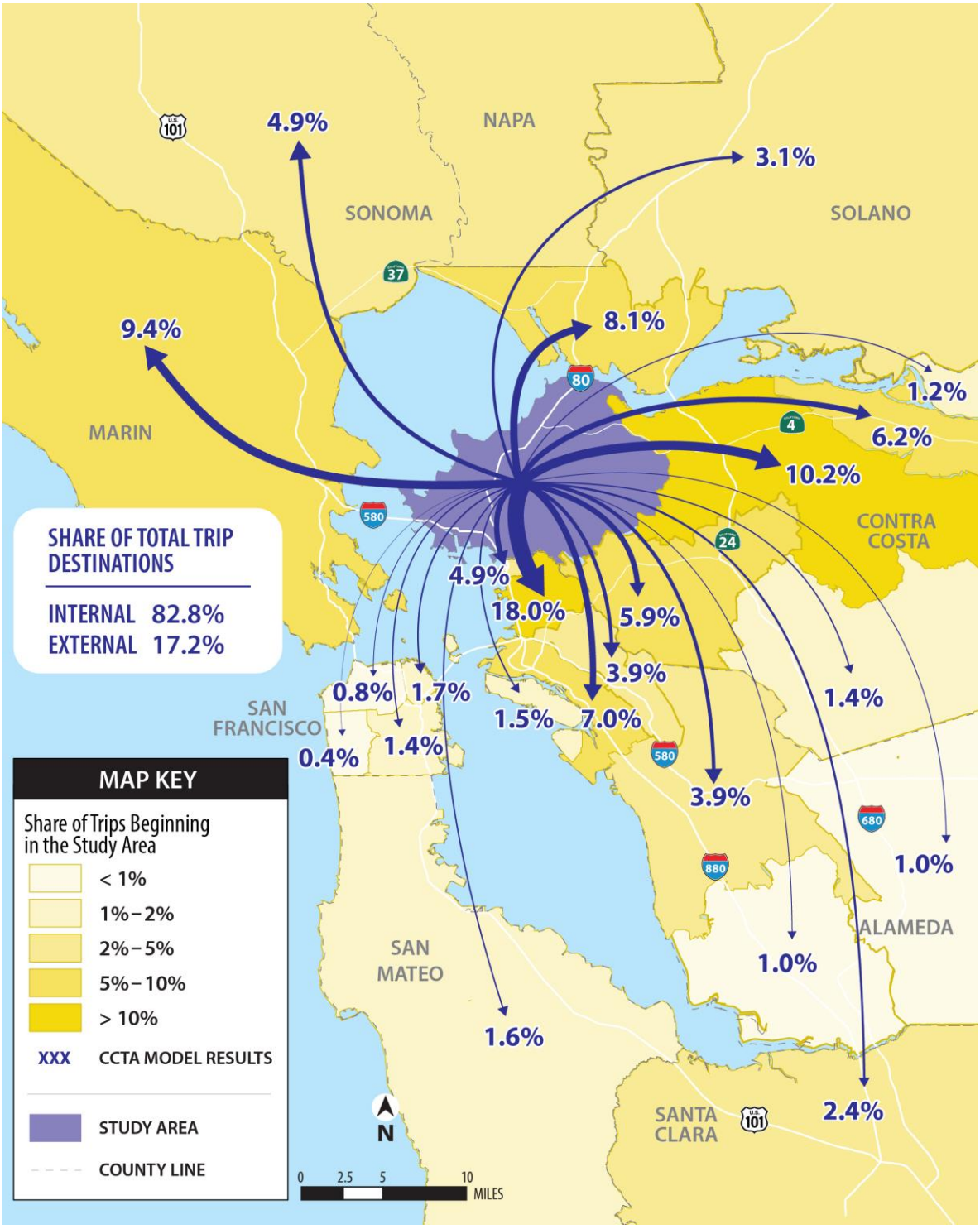
Figure 2-4: Origins of All External Vehicle Trips Ending in the Study Area, Unadjusted PM – Peak Hour



Source: CCTA Travel Demand Model, 2013

Note: In the PM peak hour, 82.8 percent of the trips originating in the Study Area stay within the Study Area and the remaining 17.2 percent are external trips.

Figure 2-5: Destinations of All External Vehicle Trips Beginning in the Study Area, Unadjusted PM – Peak Hour



Source: CCTA Travel Demand Model, 2013

Note: In the PM peak period, 70.6 percent of the trips destined for the Study Area stay within the Study Area and the remaining 29.4 percent are external trips.

Trips Ending in the Study Area with External Origins

The majority of AM peak hour trips ending in the Study Area have origins in zones immediately adjacent to the Study Area, with the highest shares of trips coming from cities in Marin County (16.5 percent), southwestern Solano County (11.1 percent), and Central Contra Costa County (12.4 percent). In contrast with the small share of AM trips beginning in the Study Area and ending in Marin County, a large share of trips ending in the Study Area are traveling from Marin County, likely traveling on I-580 across the Richmond Bridge, and coming south from Solano County and Central Contra Costa County on I-80. See **Figure 2-3.**

Few trips begin in San Francisco and other cities along the peninsula and end in the Study Area (less than 5 percent total). Similar results are seen for Santa Clara County (less than 2 percent) as well as southeast Alameda County.

During the PM peak hour, a slightly different travel pattern was identified. The largest single out commute was to Berkeley and Emeryville (18 percent), with Oakland being the second largest destination (10.9 percent), followed by Central Contra Costa County (10.2 percent), Marin County (9.4 percent), and southwestern Solano County (8.2 percent). See **Figure 2-5.**

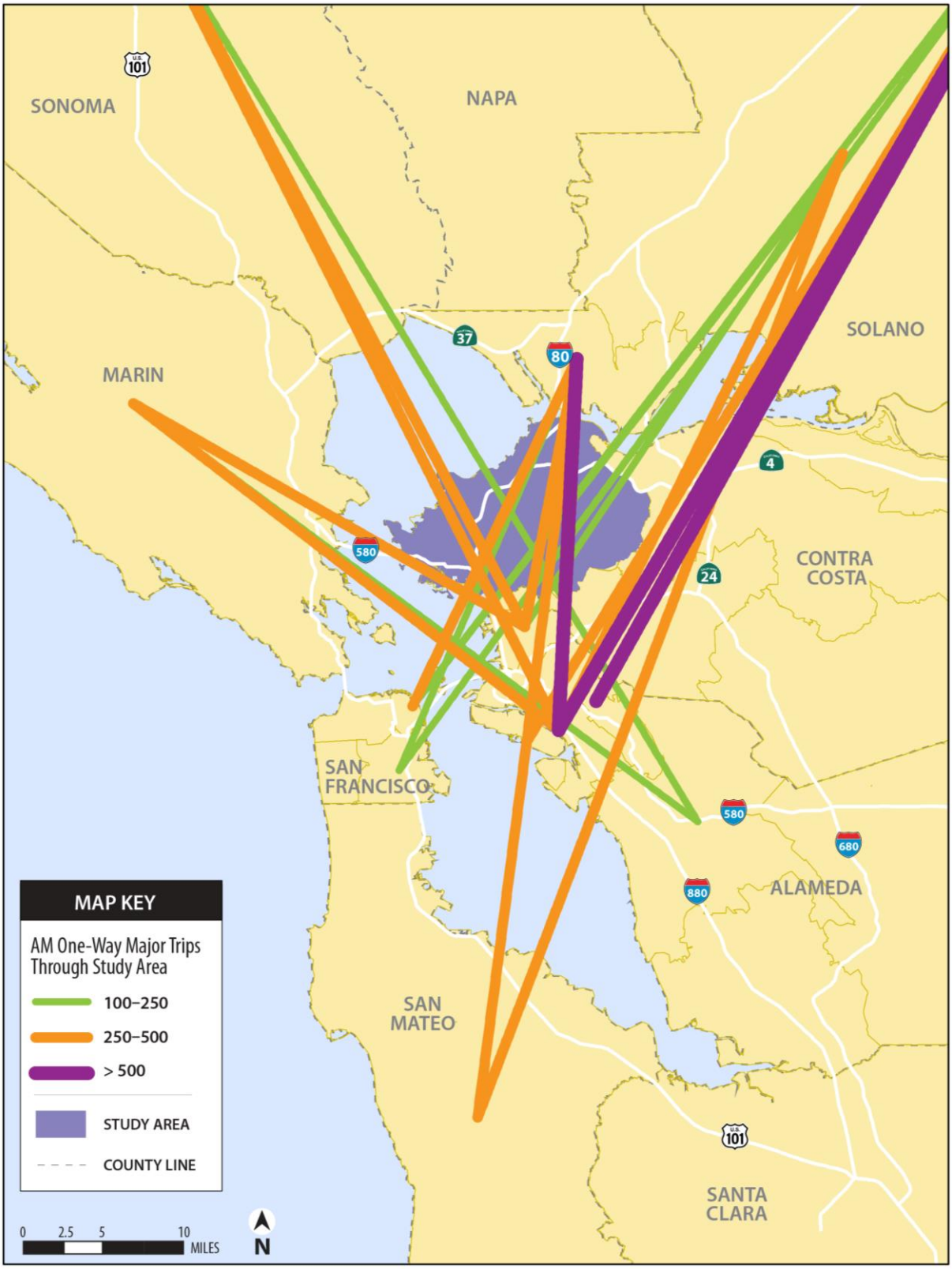
Through Trips

It is often difficult to estimate trips passing through a region from an origin-destination matrix alone, since origin-destination matrices do not contain information about the pathway used for travel between zones. However, since the Study Area is bounded by bays on the west and north, travel flows between certain zones can be assumed to predominantly travel through the Study Area comprising West Contra Costa County.

Figure 2-6 shows the estimated major travel flows through the Study Area during the AM peak hour. The heaviest travel patterns occur between Solano and Yolo counties in the northeast and Oakland and other parts of western Alameda County. Strong travel flows are also evident between the northwest and Alameda County and the northeast to regions south and west of the Study Area.

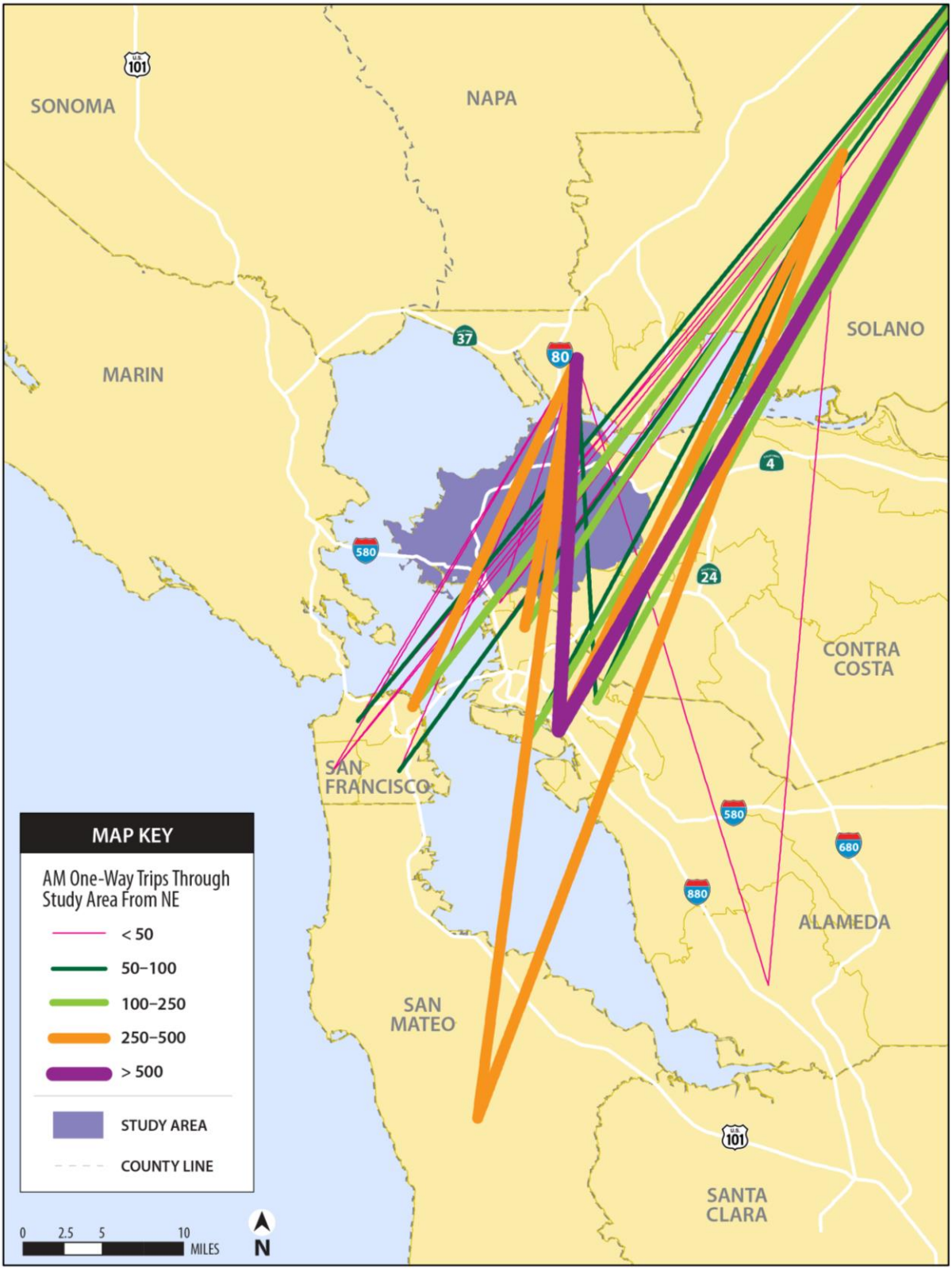
Figure 2-7 shows only AM peak hour travel flows originating in the northeastern part of the region, from Solano and Yolo counties. As illustrated in the previous figure, the heaviest flows are to Oakland in west Alameda County. However, strong travel patterns are evident between Solano County and Berkeley, downtown San Francisco, and San Mateo County. Moderate flows are also evident between Yolo County and San Francisco, Berkeley, and Alameda. **Figure 2-8** shows AM peak hour travel flows from Marin, Sonoma, and Napa counties. Since Sonoma and Napa counties are contained in a single model zone, flows from Napa County are combined with Sonoma County. The strongest flows from these counties through the Study Area are destined to Berkeley and Oakland, with all other flows through the Study Area having a considerably lower magnitude.

Figure 2-6: One-way All Major Vehicle Trips through Study Area, Unadjusted AM Peak Hour



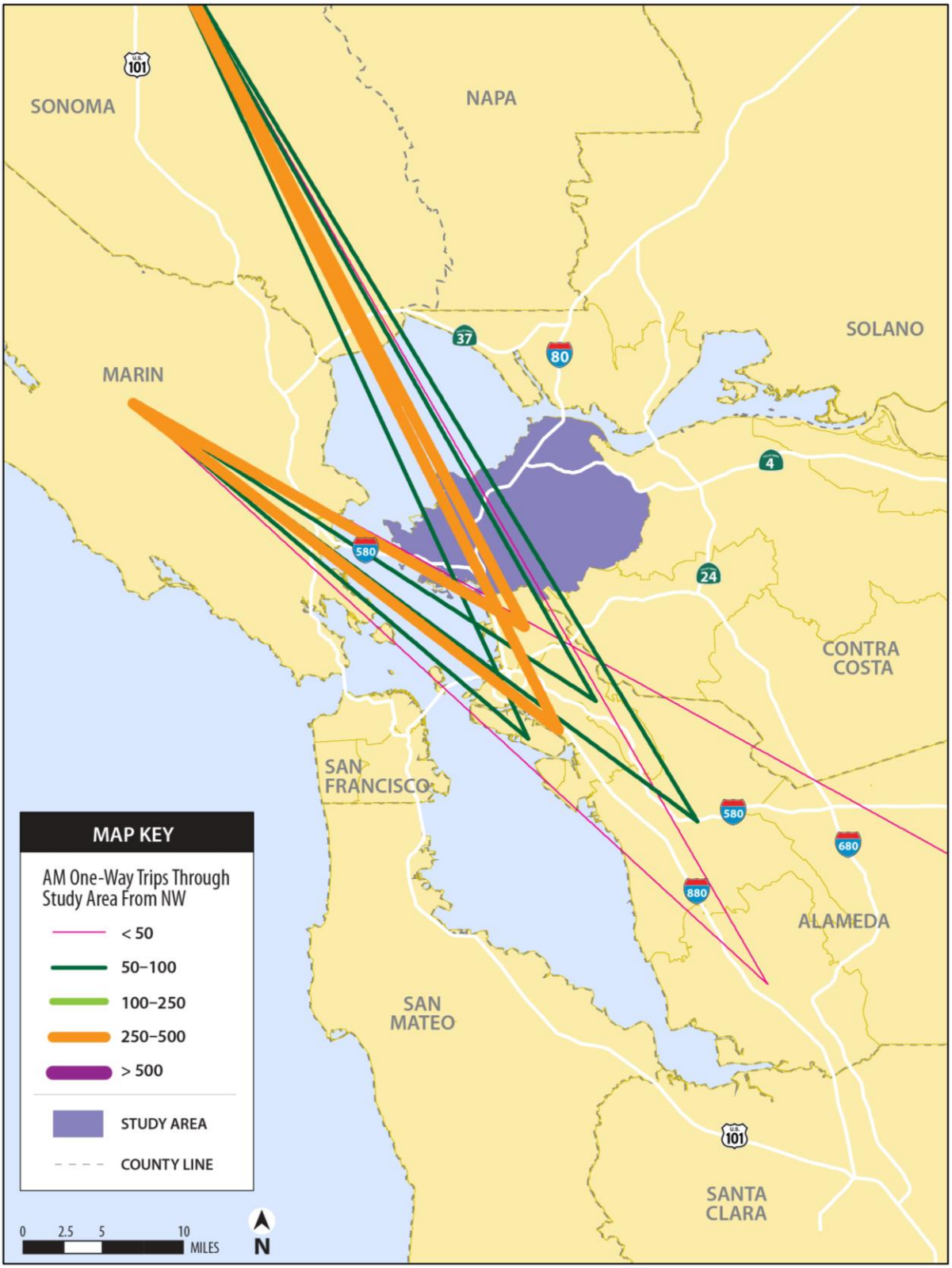
Source: CCTA Travel Demand Model, 2013

Figure 2-7: One-way All Vehicle Trips through Study Area from the Northeast, Unadjusted AM Peak Hour



Source: CCTA Travel Demand Model, 2013

Figure 2-8: One-way All Vehicle Trips through Study Area from the Northwest, Unadjusted AM Peak Hour



Source: CCTA Travel Demand Model, 2013

3 TRANSIT SUITABILITY INDEX

The Transit Suitability Index (TSI) is a sketch planning tool utilized to identify locations of markets most suitable to serve transit. Spatial analysis tools in a Geographical Information System (GIS) are applied to evaluate the cumulative relationship of variables that are indicative of transit riders. The TSI provides a transit assessment based on population density, employment density, household income and vehicle ownership. These four variables are identified as strong indicators of transit ridership:

- **Population density** is an indicator of fairly dense urban development essential for successful public transit system.[3] Thresholds of population densities necessary to result in a higher level of transit ridership are dependent on the densities found within the boundaries of the area under study. In the case of this analysis, for the nine counties in the Bay Area, traffic analysis zones (TAZ) with population densities above 60,000 people per square mile will obtain the highest score for population density in the suitability index. The high population density threshold for the Bay Area is reflective of the City of San Francisco being the second densest in the United States;
- **Employment density** is argued to have a stronger association and impact on transit ridership for its higher trip generation.[4] Thresholds of employment densities required for a higher level of transit ridership are dependent on the densities found within the boundaries of the area under study. For the nine Bay Area counties, TAZs with employment densities above 100,000 jobs per square mile will obtain the highest score for employment density;
- **Household income** is indicative of transit ridership because members of low income households are more likely to be dependent on transit for their mobility needs.[5] For this analysis, household income was quantified by the percentage of households in the lowest income quartile per TAZ. A TAZ with a high percentage of low income households scored a higher level of potential transit ridership;
- **Automobile ownership** is indicative of transit ridership because transit riders are less likely to own an automobile.[6] Automobile ownership was quantified by the percentage of households with no automobiles available per TAZ. A TAZ with a high percentage of households without automobiles scored a higher level of potential transit ridership.

[3] Cervero, Robert, and Erick Guerra. Urban densities and transit: A multi-dimensional perspective. Institute of Transportation Studies, University of California, Berkeley, 2011.
[4] Kolko, Jed. Making the most of transit: Density, employment growth, and ridership around new stations. Public Policy Institute of CA, 2011.
[5] Black, A. (1995). Urban Mass Transportation Planning.
[6] Taylor, Brian D., and Camille NY Fink. "The factors influencing transit ridership: A review and analysis of the ridership literature." University of California Transportation Center (2003). See also, Black, A. (1995). Urban Mass Transportation Planning.

Parking pricing is another variable that reflects the suitability for transit. Higher parking cost has been associated with an increase in public transit miles in larger cities.[7] Parking pricing was initially integrated into this TSI, but had to be removed because of the limited data. The parking pricing data available was concentrated around the downtowns of major cities, and did not capture the cost of parking through the area under study.

The analysis utilized demographic data from the CCTA travel demand model[8] to analyze the transit suitability for existing and future 2040 conditions for transit. This TSI is a complementary assessment of the competiveness of transit for the major travel markers that affect the Study Area, as well as areas north to the Carquinez Bridge and south to the Bay Bridge.

3.1 Methodology

The TSI analysis was performed with ArcGIS software by ESRI. The Contra Costa County model data was analyzed at the TAZ level, the geographical unit most commonly used in transportation planning models, for the nine counties in the Bay Area: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma. **Figure 3-1** displays the distribution of TAZs in the Bay Area's nine counties.

The TSI is a composite of four separate analyses of the following socio-economic factors:

- Population density (persons per square mile)
- Employment density (jobs per square mile)
- Household income (percent of low income households per TAZ)
- Car ownership (percent of zero-vehicle households per TAZ)

[7] Auchincloss, Amy H., Rachel Weinberger, Semra Aytur, Alexa Namba, and Andrew Ricchezza. "Public parking fees and fines: A survey of US cities." Public Works Management & Policy (2014): 1087724X13514380.
[8] CCTA Travel Demand model was developed by CCTA in 1990 and is implemented using the TransCAD software.

Figure 3-2 through **Figure 3-5** show the distribution of existing (2013) conditions for these four socioeconomic variables in the Bay Area's nine counties, as identified in the TSI.

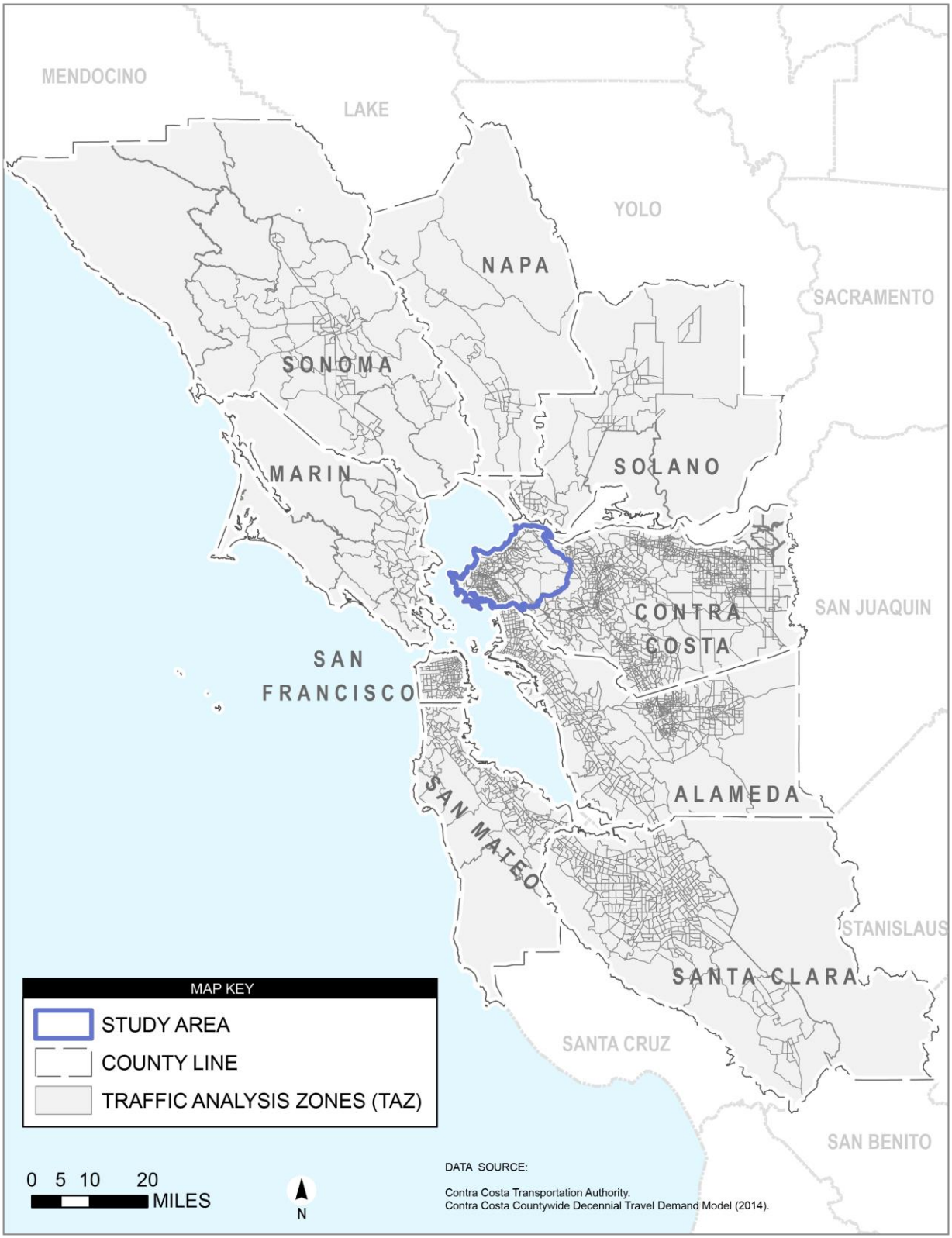
Figure 3-6 through **Figure 3-9** show the distribution of these socioeconomic variables for future 2040 conditions. For the population and employment density factors, high values (densities) corresponded to high scores on the scale (since high density supports transit ridership potential); for auto ownership and household income, high percentages of low-income and zero-vehicle households corresponded to high scores on the scale (since transit ridership is correlated with households with lower income and low auto ownership).[9] TAZs with high transit suitability will have a better combination of high population and employment densities, high percentage of low-income households, and high percentage of households without an automobile.

The vector-based data (files of polygons or shapes) of each variable displayed in **Figure 3-6** through **Figure 3-9** was converted to raster files (i.e., files made up of a grid of pixels) and reclassified utilizing spatial analytical tools. With the objective of combining these four factors into one, an index was created by classifying the data in each of the four factors into five categories (from low to high) and then assigning each category a corresponding "score" on a scale of 1 to 5. The scales from each factor were then added to create a combined index with values ranging from 4 to 20, with lower scores indicating less "transit suitability" and higher scores indicating more.

This TSI is represented graphically on a "heat map" using a blue color scale, with lighter shades indicating TAZs with lower transit suitability (and lower ridership potential) and darker shades highlighting TAZs with higher transit suitability (and higher ridership potential). The TSI analysis was done for existing (2013) and future 2040 conditions.

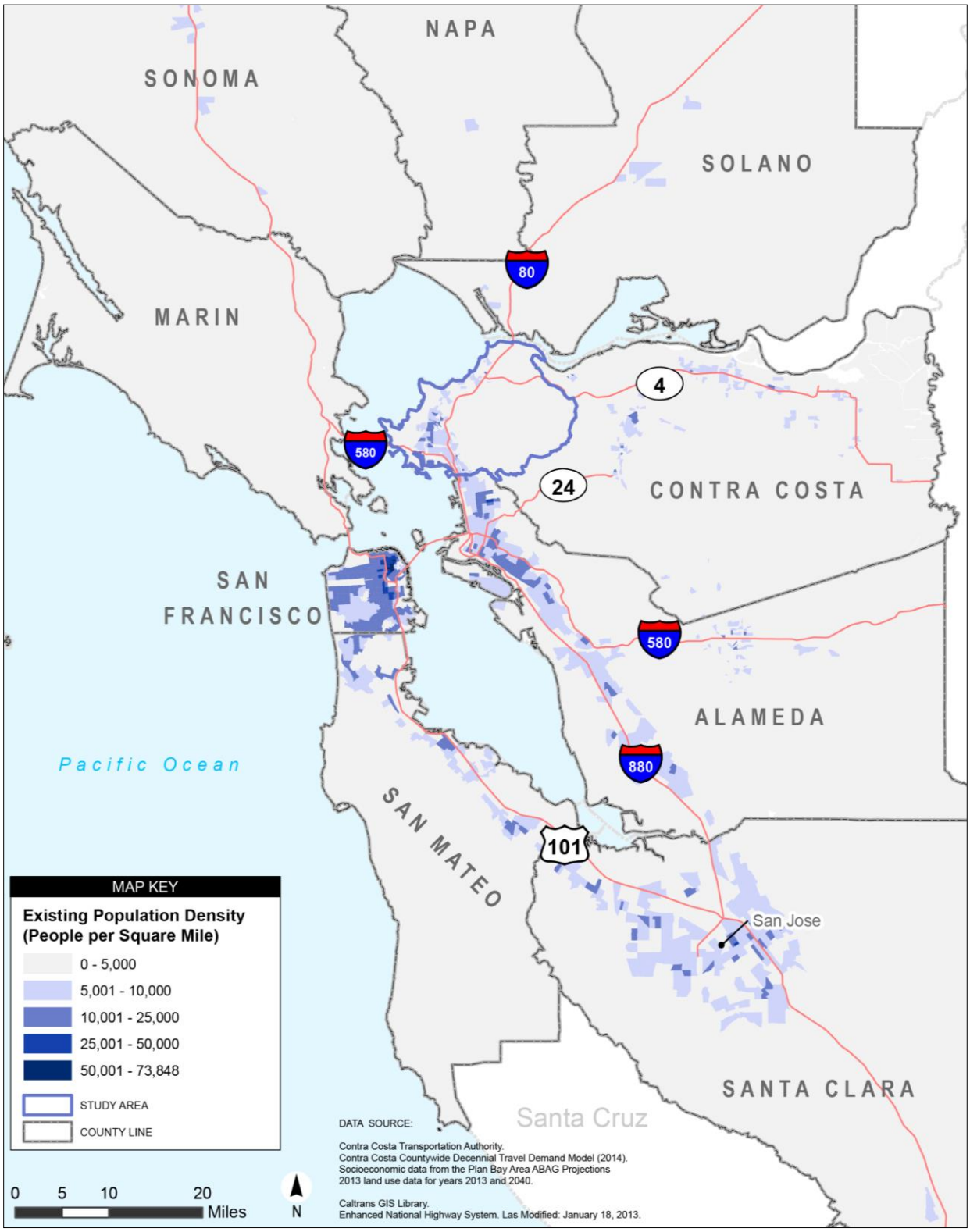
[9] Note: "Low income" is defined as all households with income under $20,000 (2013 $).

Figure 3-1: Bay Area Nine Counties Traffic Analysis Zones (TAZ)



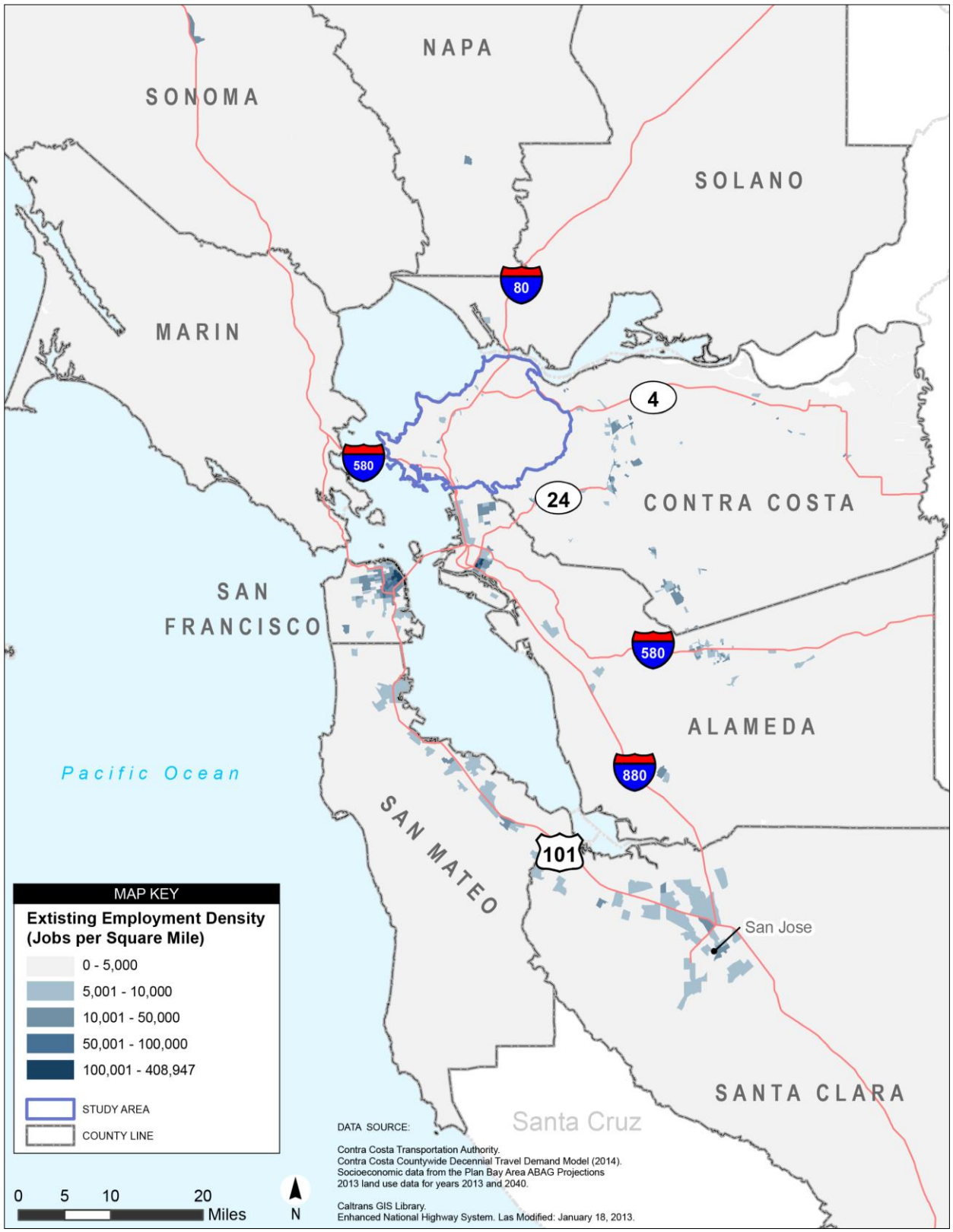
Source: WSP | Parsons Brinckerhoff, 2015

Figure 3-2: Existing Population Density in the Bay Area's Nine Counties



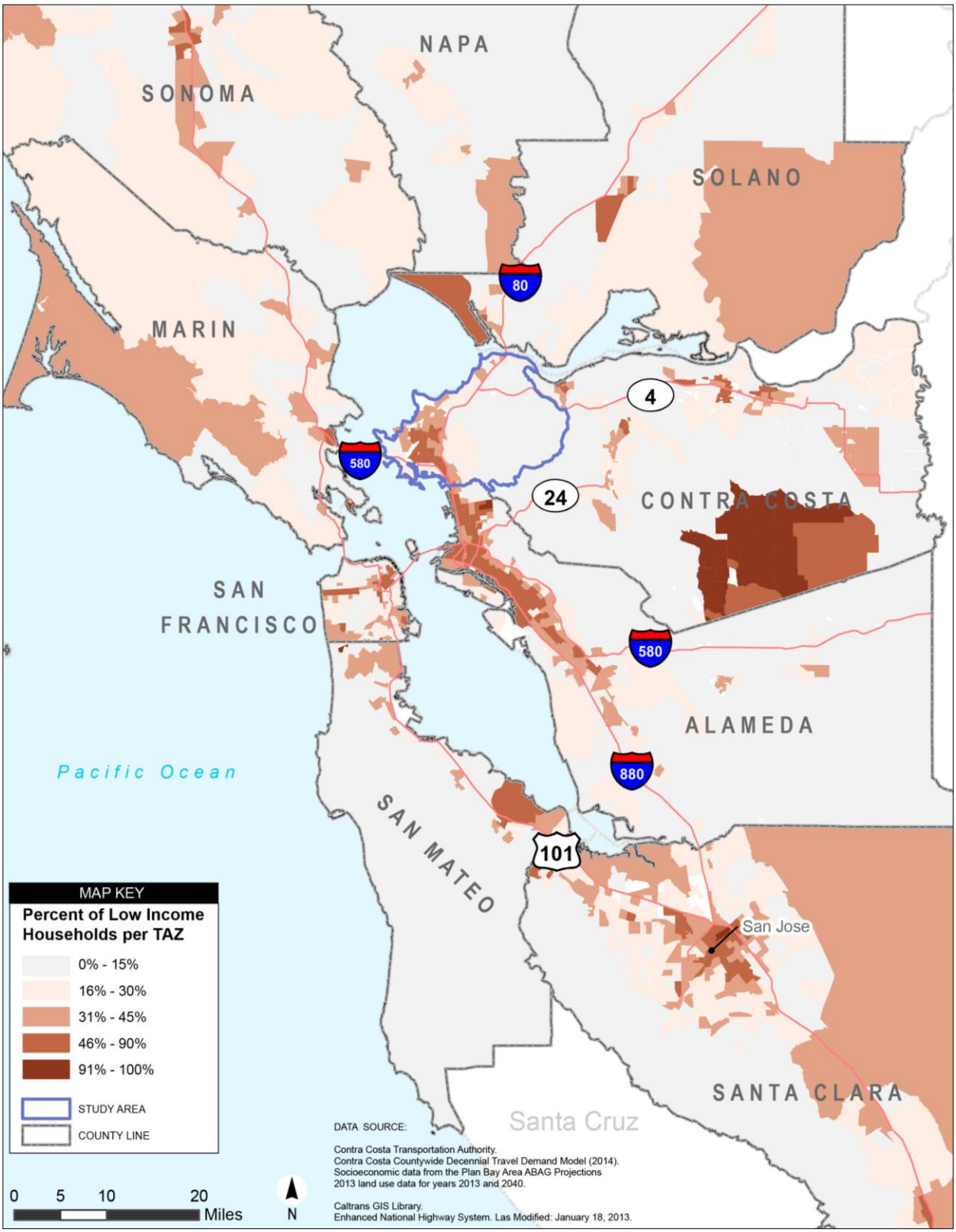
Source: WSP | Parsons Brinckerhoff, 2015

Figure 3-3: Existing Employment Density in the Bay Area's Nine Counties



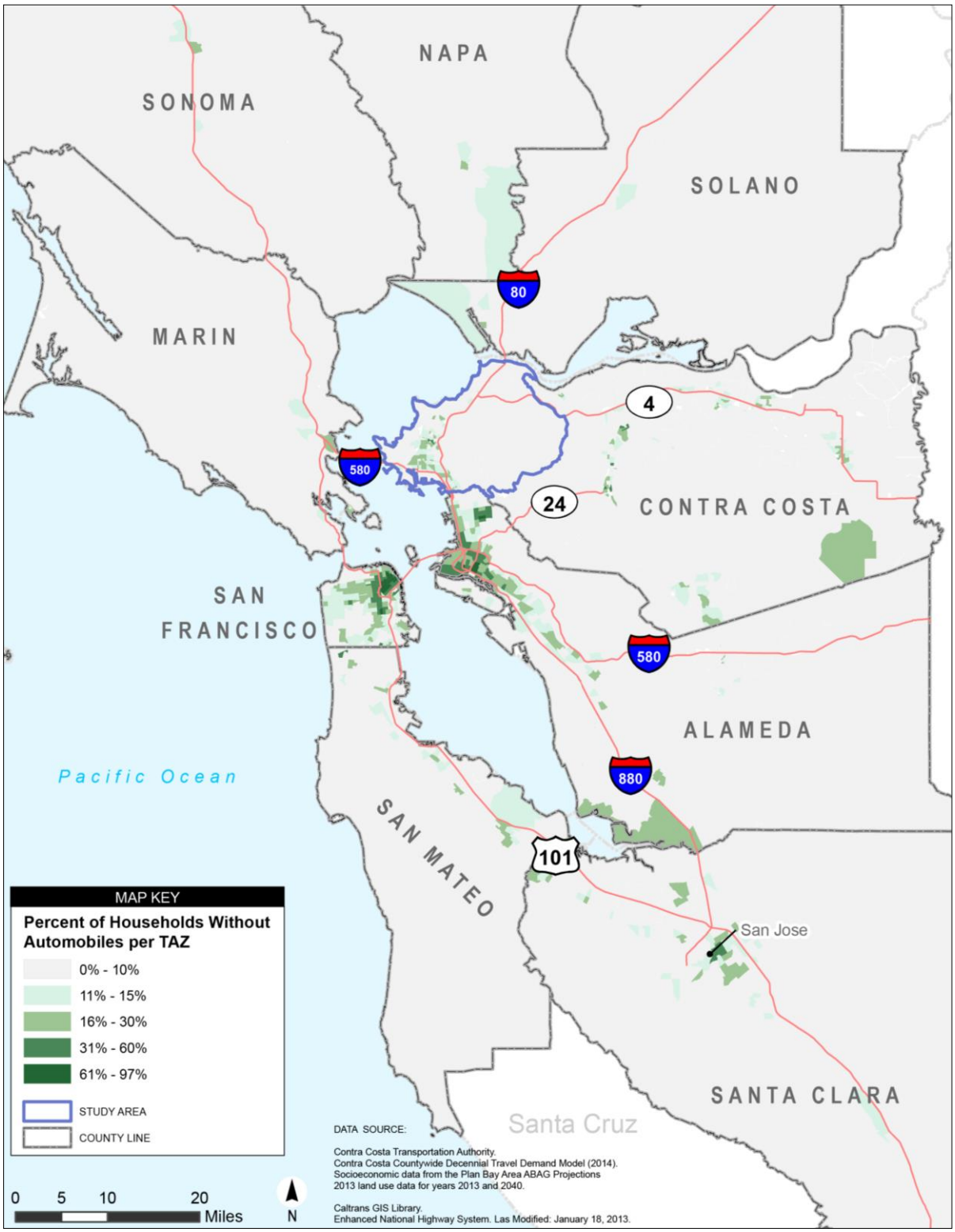
Source: WSP | Parsons Brinckerhoff, 2015

Figure 3-4: Existing Percent of Low Income Households per TAZ in the Bay Area's Nine Counties



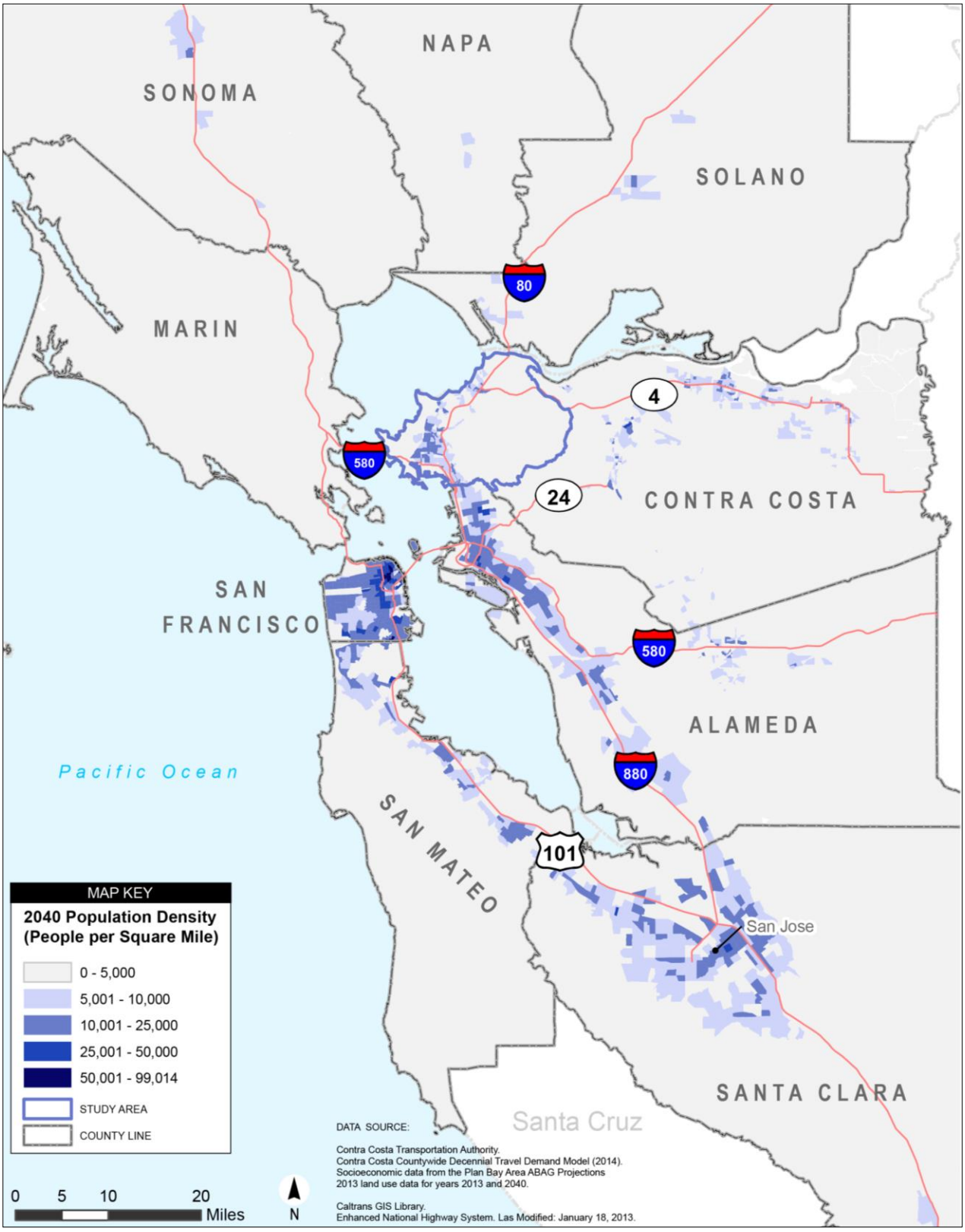
Source: WSP | Parsons Brinckerhoff, 2015

Figure 3-5: Existing Percent of Zero-Vehicle Households per TAZ in the Bay Area's Nine Counties



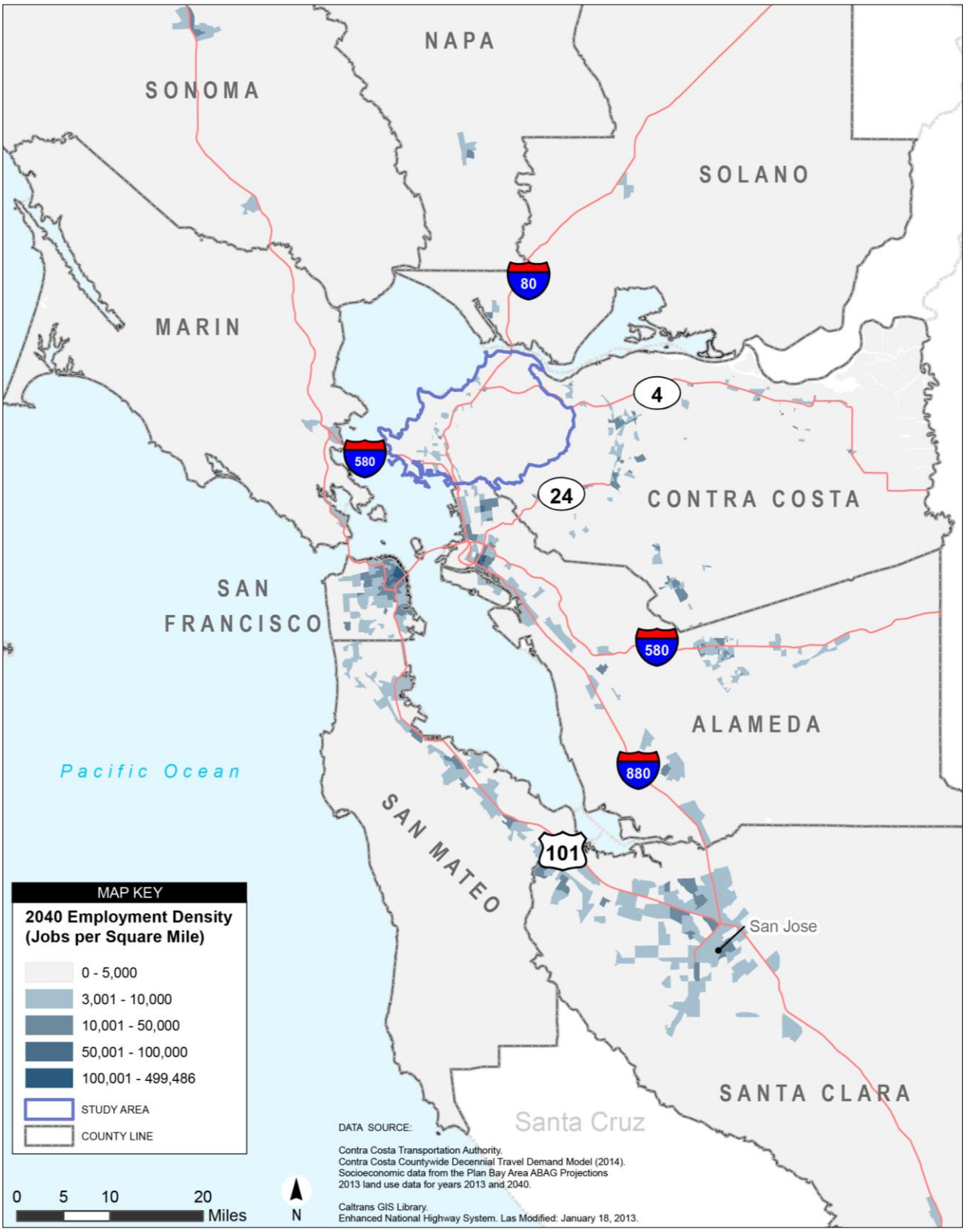
Source: WSP | Parsons Brinckerhoff, 2015

Figure 3-6: Future (2040) Population Density in the Bay Area's Nine Counties



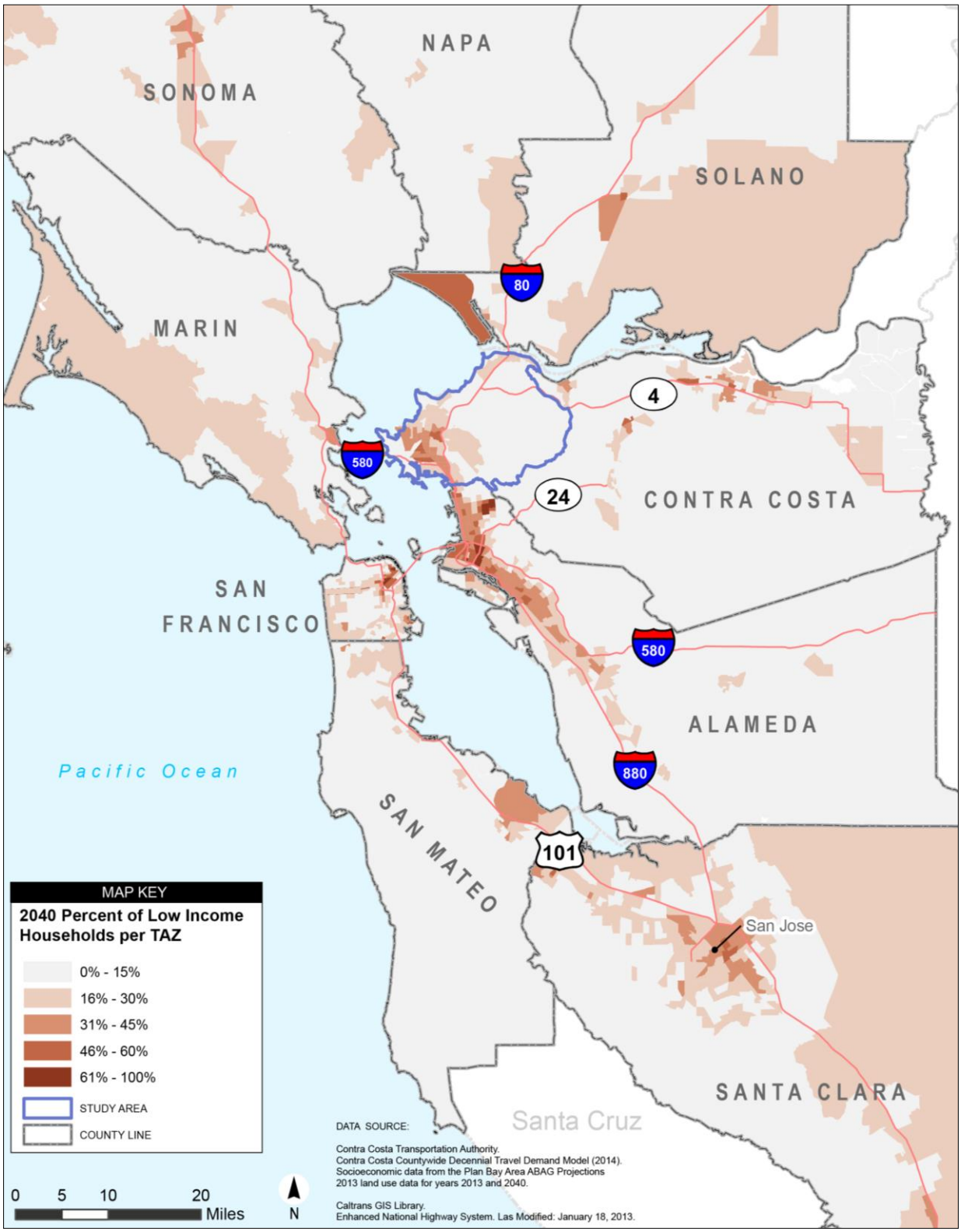
Source: WSP | Parsons Brinckerhoff, 2015

Figure 3-7: Future (2040) Employment Density in the Bay Area's Nine Counties



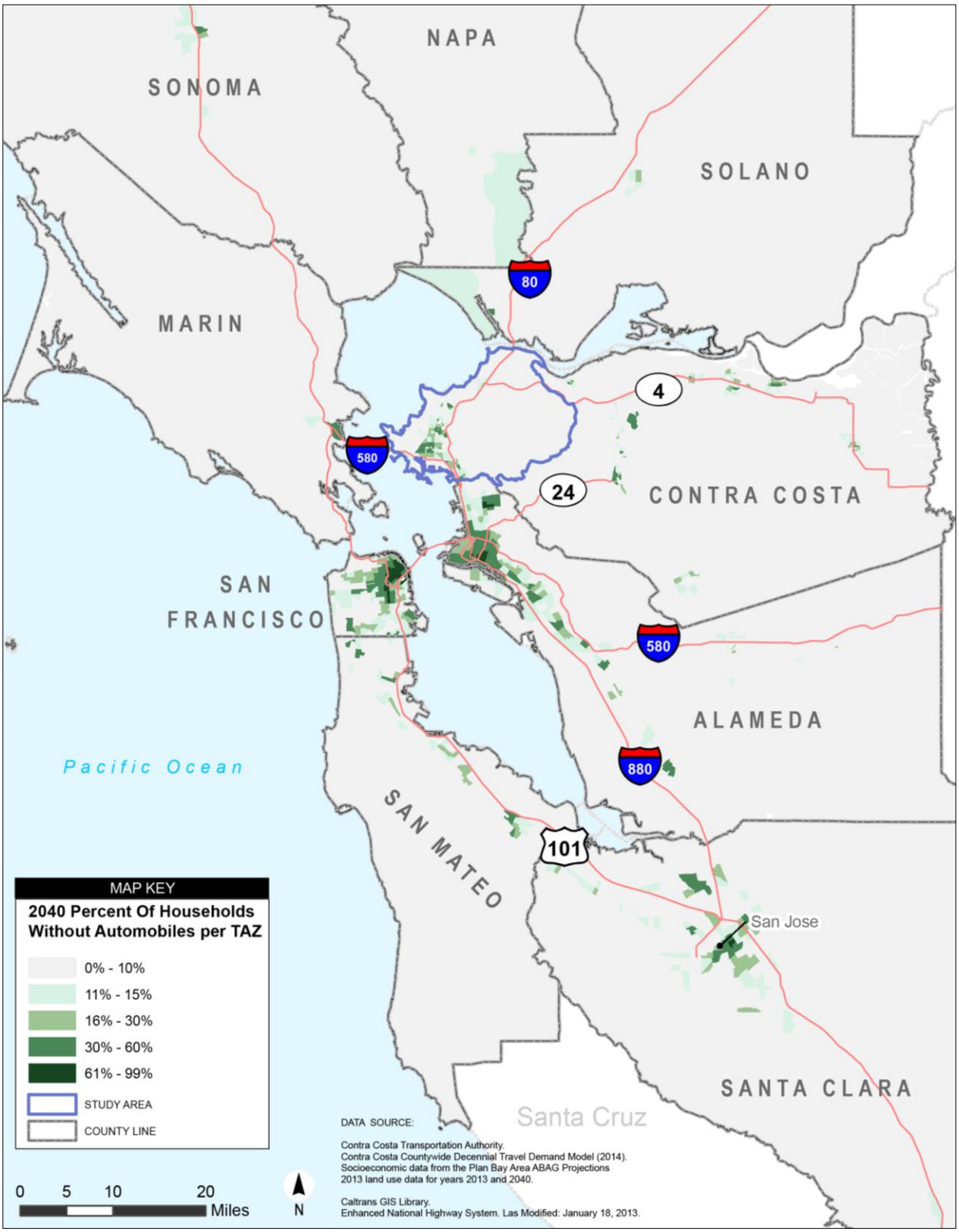
Source: WSP | Parsons Brinckerhoff, 2015

Figure 3-8: Future (2040) Percent of Low Income Households per TAZ in the Bay Area's Nine Counties



Source: WSP | Parsons Brinckerhoff

Figure 3-9: Future (2040) Percent of Zero-Vehicle Households per TAZ in the Bay Area's Nine Counties



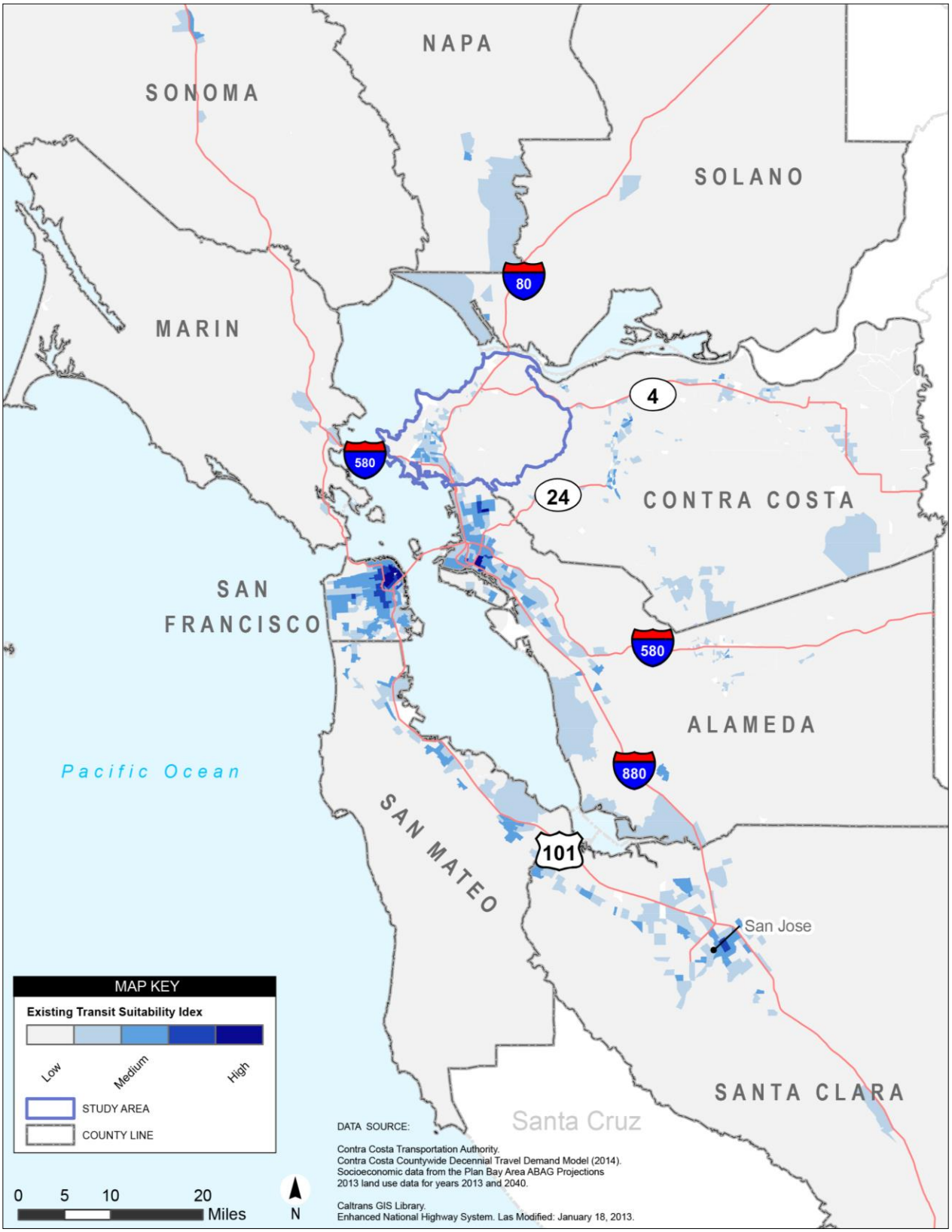
Source: WSP | Parsons Brinckerhoff, 2015

3.2 TSI Findings

The TSI maps in **Figure 3-10** and **Figure 3-12** show where current (2013) socioeconomic factors indicate the location of markets most suitable to serve transit. Figure 3-10 demonstrates that in the nine counties of the Bay Area, the most suitable markets are in the cities of San Francisco, Oakland, Berkeley, San Jose, Emeryville and Richmond. **Figure 3-12** shows that within the Study Area the most significant concentrations of TAZs best suitable to serve transit are to the east and south of the Richmond BART Station and around the City of San Pablo's City Hall.

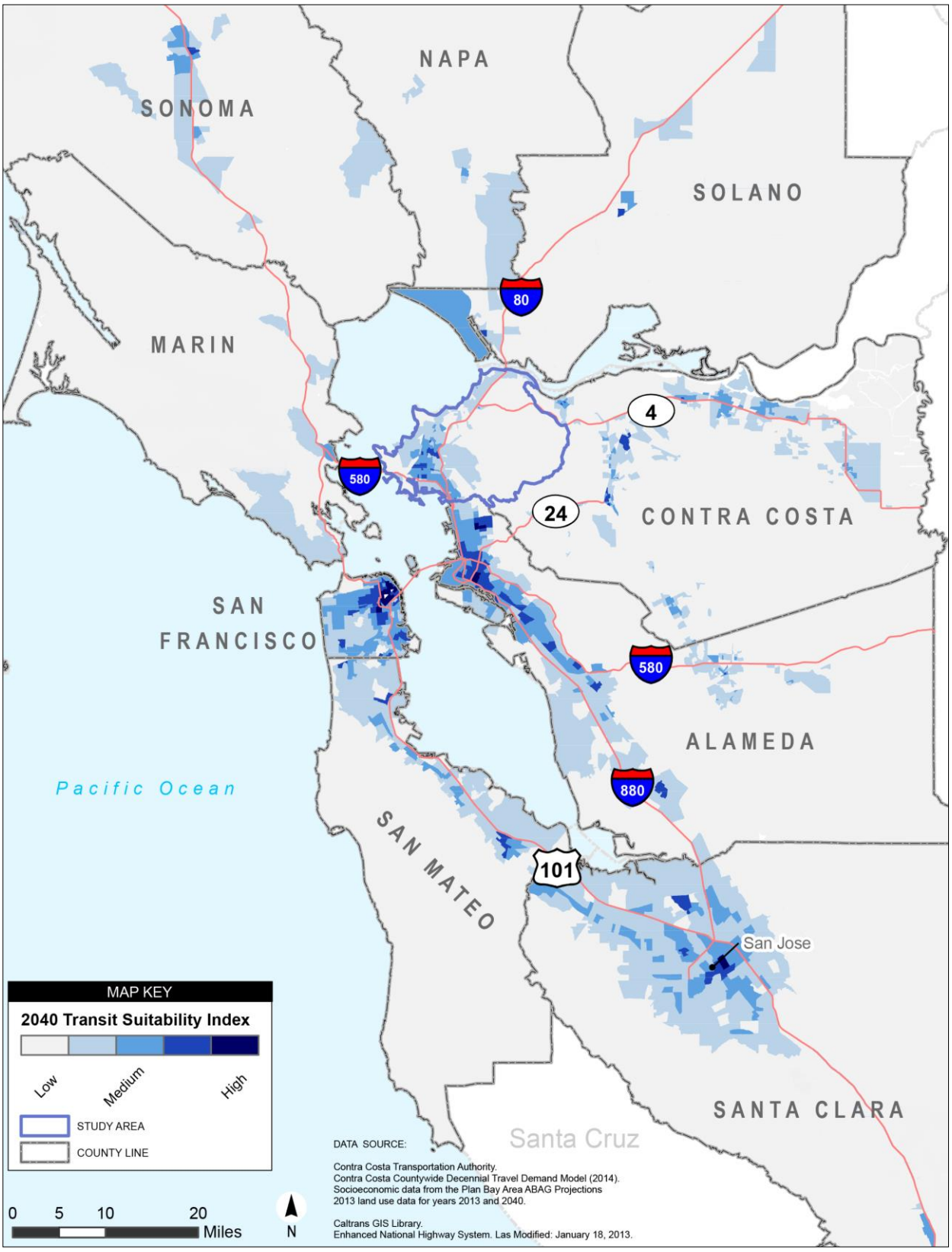
The TSI map in **Figure 3-13** shows where future 2040 socioeconomic factors indicate the location of markers most suitable to serve transit. **Figure 3-11** shows that in the nine counties of the Bay Area in future 2040 conditions the most suitable markets will continue to be San Francisco, Oakland, Berkeley, San Jose, Emeryville and Richmond. It appears the location of TAZs with high transit suitability will be more densely concentrated around these cities. **Figure 3-13** demonstrates that within the Study Area in future 2040 conditions the most significant concentrations of TAZs best suited to transit will extend out from the Richmond BART station to include San Pablo and El Cerrito as well as new areas of Richmond. A change to note is that in the northern part of the Study Area, there is a more apparent concentration of low to medium suitability TAZs, extending to Pinole and Hercules.

Figure 3-10: Transit Suitability Index in Bay Area Counties (Existing Conditions)



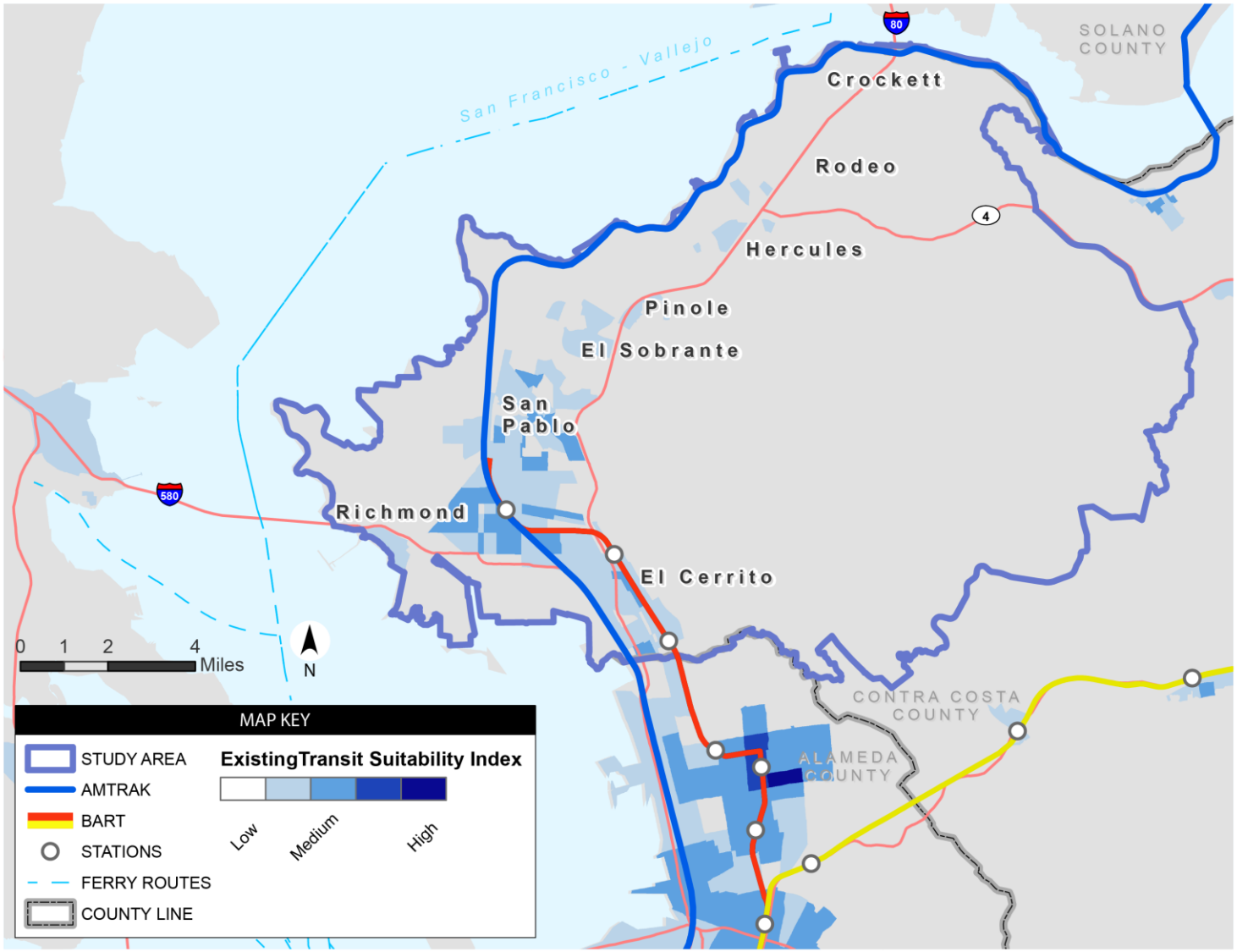
Source: WSP | Parsons Brinckerhoff, 2015

Figure 3-11: Transit Suitability Index in Bay Area Counties (2040)



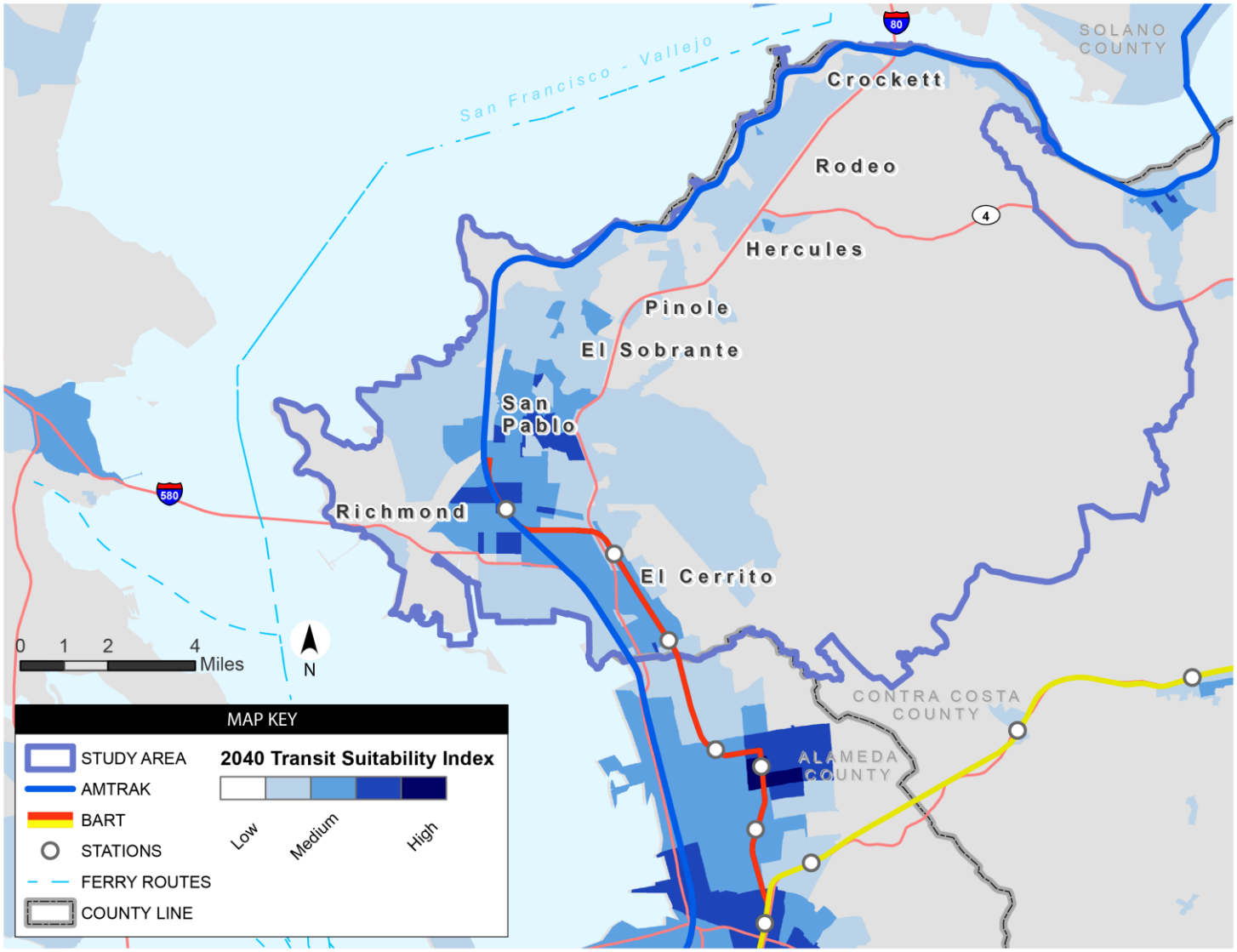
Source: WSP | Parsons Brinckerhoff, 2015

Figure 3-12: Transit Suitability Index in West Contra Costa (Existing Conditions)



Source: WSP | Parsons Brinckerhoff, 2015

Figure 3-13: Transit Suitability Index in West Contra Costa (2040)



Source: WSP | Parsons Brinckerhoff, 2015

4 SUMMARY

4.1 Synthesis of Origin-Destination Data and TSI Findings

An analysis of trip origins, destinations, and socioeconomic characteristics of the Study Area and the nine-county region provides an indication of the corridors most suitable for future transit investments based not only on their transit suitability, but also on how well they link to the demand for travel either from the Study Area or travelling through the Study Area.

To integrate the TSI findings with the travel demand findings in a way that can assist in providing guidance on the development of alternatives, an additional analytical step was undertaking. The total daily trip volumes between zones was analyzed to assess trip density for purposes of comparing it to the TSI findings.

Existing daily trip densities are summarized in **Table 4-1**. For trips originating and ending in the Study Area, the destinations with the greatest number of trips are Districts 12, 10, 14, 13, 7, 11, and 5. These Districts represent Richmond, San Pablo, El Cerrito, Pinole, El Sobrante, and Hercules. These districts are also significant trip generators and are consistent with the findings of where the most viable transit markets are within the Study Area.

Future daily trip densities are summarized in **Table 4-2**. The trip densities increase from the existing trips, but the patterns are similar in terms of where the greatest travel demand occurs and where the most suitable transit areas exist.

As mentioned previously, the majority of trips during both the AM and PM peak hour are internal trips to the Study Area. In order to better understand the high percentage of trips occurring within the Study Area, the daily person trips from the CCTA model were analyzed for both 2013 and 2040 forecast years.

Table 4-1 ranks the top five origin and destination zones that account for the greatest number of trips, excluding intrazonal trips (having an origin and destination within the same zone). Additionally, the top five most frequent trip patterns, excluding intrazonal trips, are ranked in **Table 4-2**.

Based on the unadjusted model runs, the majority of internal trip patterns occur in the western half of the Study Area originating from the cities and unincorporated areas of Pinole, Hercules, San Pablo, Richmond, and El Sobrante with destinations primarily in north and west Richmond. Refer to the O-D district map shown in **Figure 2-1** to see the geography that corresponds with each district number.

Table 4-1: Frequent Origins and Destinations Internal to the Study Area Excluding Intrazonal Trips, Daily Person Trips (2013 unadjusted model)

Top 5 Origin Zones		Top 5 Destination Zones	
Zone ID	*Description*	*Zone ID*	*Description*
10	Richmond, San Pablo	12	Richmond
5	Pinole, Hercules	10	Richmond, San Pablo
13	San Pablo, Richmond	14	Richmond, El Sobrante
14	Richmond, El Sobrante	13	San Pablo, Richmond
11	Richmond	7	El Cerrito, Richmond

Source: WSP | Parsons Brinckerhoff, 2015

Table 4-2: Most frequent Trip Patterns Internal to the Study Area, Daily Person Trips (2013 unadjusted model)

Top 5 Internal Trip Patterns	
Zone ID	*Description*
5 to 12	Pinole, Hercules to Richmond
13 to 12	San Pablo to Richmond
10 to 12	San Pablo, Richmond to Richmond
14 to 12	Richmond, El Sobrante to Richmond
11 to 12	Richmond to Richmond

Source: WSP | Parsons Brinckerhoff, 2015

Table 4-3 and **Table 4-4** on the pages following include the number of trips for all Study Area origins and destinations for both 2013 and 2040 forecast years. Origin-destination trip patterns internal to the Study Area in the forecast year of 2040 are similar to the existing 2013 model trips.

The analysis of internal trip patterns suggest that future transit investments should prioritize serving trips originating in the central and northwest end of the Study Area in cities such as Pinole, Hercules, and San Pablo, traveling to destinations primarily in the western half of the Study Area, including Richmond, San Pablo, and El Cerrito. These patterns are consistent with the findings of the Transit Suitability index, as discussed in the next section.

Table 4-3: Daily 2013 Person Trips within West Contra Costa, CCTA Unadjusted Model

2013		Destination Zone														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Origin Zone	1	1373	45	146	698	980	975	412	154	197	1251	361	2381	714	3392	351
	2	12	2094	737	563	104	31	1062	87	100	438	434	556	109	192	24
	3	38	691	2799	815	295	96	3248	246	268	1164	914	1235	331	515	71
	4	345	1017	1495	5817	937	338	2675	613	567	3976	1398	3539	1395	4338	251
	5	504	180	470	949	21925	3631	1494	450	534	3857	1555	12606	3888	5704	2146
	6	1074	96	256	594	5273	9597	795	261	327	2259	741	5920	1523	3597	2524
	7	121	1354	4033	1762	917	310	14941	810	1017	4120	4130	4010	1164	1491	234
	8	61	164	464	661	458	154	1418	1708	663	2840	933	1638	609	725	106
	9	62	179	401	437	412	146	1447	572	1387	4584	2411	2148	1067	709	121
	10	356	544	1412	2713	2156	802	4461	1968	3576	22263	5763	10615	6285	3909	629
	11	90	618	1276	938	804	228	4928	676	1965	5805	19431	6974	2380	1202	175
	12	197	234	610	757	2105	504	1983	439	781	5393	3940	18009	5663	2432	406
	13	183	213	464	872	2033	483	1386	420	664	5749	2148	12498	9945	2530	378
	14	1211	158	511	2770	3712	1561	1532	480	605	3946	1264	7598	2676	20297	1009
	15	268	52	144	327	2804	1918	462	148	188	1243	444	3369	836	1756	6028

KEY

- Less than 100 trips
- 100 - 499 trips
- 500 - 999 trips
- More than 1000 trips

- Intrazonal trips

Source: CCTA Model

Table 4-4: Daily 2040 Person Trips within West Contra Costa, CCTA Unadjusted Model

2040		Destination Zone														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Origin Zone	1	1471	48	148	719	1140	1299	449	150	208	1350	421	2345	755	3744	470
	2	13	2092	779	596	126	44	1171	86	107	477	504	590	118	205	28
	3	46	759	3058	925	383	145	3848	262	307	1361	1148	1451	376	595	90
	4	386	1031	1558	6087	1152	494	2999	618	613	4389	1636	3795	1486	4766	311
	5	785	235	562	1149	30173	5408	1870	526	634	4841	1972	14746	4742	8190	3160
	6	1586	127	284	666	7027	13405	949	279	368	2651	947	6196	1812	4613	3962
	7	159	1671	4843	2205	1279	507	18406	922	1236	5092	5362	5009	1404	1845	324
	8	71	180	476	716	561	232	1596	1718	733	3109	1081	1804	661	799	132
	9	79	235	466	521	548	231	1801	635	1660	5422	3035	2614	1244	862	163
	10	470	713	1684	3326	2957	1279	5656	2233	4366	27766	7450	13296	7717	4936	871
	11	123	882	1613	1248	1123	363	6575	796	2539	7279	25663	9068	2928	1574	246
	12	267	316	755	960	2858	767	2564	539	1012	7028	5187	24531	7641	3224	549
	13	235	287	532	1004	2491	715	1681	471	775	6884	2641	15067	11323	3055	498
	14	1437	187	577	3070	4862	2369	1852	529	701	4763	1589	8847	3175	23937	1333
	15	445	60	145	332	3408	2967	489	141	189	1312	502	3155	899	1983	6424

KEY

- Less than 100 trips
- 100 - 499 trips
- 500 - 999 trips
- More than 1000 trips

- Intrazonal trips

Source: CCTA Model

Table 4-5 and **Table 4-6** on the following pages include the number of trips originating within the Study Area and traveling to destinations external to the Study Area for both 2013 and 2040 forecast years. Most trips are originating from Richmond, San Pablo, Pinole, and Hercules and the three most frequently traveled destination zones external to the Study Area are Berkeley/Emeryville, Northeast San Francisco, and Oakland/Piedmont. Origin-destination trip patterns internal to the Study Area in the forecast year of 2040 are similar to the existing 2013 model trips.

Table 4-7 and **Table 4-8** include the number of trips originating in zones external to the Study Area and traveling to Study Area destinations for both 2013 and 2040 forecast years. These trips have origins in Berkeley/Emeryville, Solano County (Vallejo, Benicia), Marin County, Oakland/Piedmont, and Albany and are traveling most frequently to destinations in the western half of the Study Area, including Richmond, El Cerrito, San Pablo, Pinole, and Hercules. Origin-destination trip patterns internal to the Study Area in the forecast year of 2040 are similar to the existing 2013 model trips.

Table 4-5: Daily 2013 Person Trips outside of West Contra Costa, CCTA Unadjusted Model

2013		Destination Zone																					
		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Origin Zone	1	500	547	180	77	80	38	106	684	145	82	93	945	1007	104	201	32	353	77	96	165	266	140
	2	50	81	34	9	27	21	66	568	140	66	516	2760	575	64	123	16	44	17	79	93	58	30
	3	112	131	53	24	48	40	115	1078	252	123	696	3112	889	113	212	30	140	61	205	148	129	112
	4	336	379	156	65	111	77	220	1687	396	213	762	5769	1928	230	425	60	382	153	325	342	374	256
	5	1858	651	287	320	171	130	298	1962	396	276	321	3237	2335	349	629	97	2634	689	525	515	988	1008
	6	2067	623	274	293	156	88	214	1368	251	183	189	2093	2204	271	510	85	2212	358	237	404	710	568
	7	340	406	153	79	130	110	318	2982	720	343	1391	7560	2598	322	630	84	474	235	879	378	450	460
	8	138	95	43	26	40	32	93	791	163	94	234	1636	816	97	180	26	153	59	165	136	166	113
	9	140	102	41	34	39	29	72	637	154	83	203	1413	524	79	143	20	248	126	393	104	204	241
	10	650	478	198	155	168	137	329	2493	594	333	734	4989	2414	366	658	95	1165	554	1279	493	892	965
	11	343	408	155	106	126	106	287	2222	544	296	678	5047	2317	343	558	91	480	278	1982	395	938	840
	12	450	329	142	111	104	89	220	1606	356	217	369	2725	1732	288	444	78	630	276	1000	359	715	584
	13	452	304	131	114	93	77	174	1215	278	169	278	2053	1310	214	366	54	732	358	675	302	848	673
	14	963	782	305	162	169	105	265	1776	368	239	304	2890	2285	305	558	84	1068	259	344	440	479	404
	15	1912	471	209	269	114	58	133	809	154	111	113	1248	1199	160	293	47	4213	501	162	236	414	594

KEY

4.2		
4.3	4.3	Less than 100 trips
4.4	4.5	100 - 499 trips
4.6	4.7	500 - 999 trips
4.8	4.9	More than 1000 trips
4.10		

Intrazonal trips

Source: CCTA Model

Table 4-6: Daily 2040 Person Trips outside of West Contra Costa, CCTA Unadjusted Model

2040		Destination Zone																					
		16	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**
Origin Zone	**1**	575	751	247	63	102	42	120	920	156	105	107	1099	1257	133	313	60	424	82	112	212	250	122
	2	57	101	43	10	34	22	76	760	152	82	584	3158	731	76	183	24	49	16	92	117	66	29
	3	135	175	75	24	64	45	139	1484	289	159	833	3749	1203	156	345	62	158	58	268	195	134	110
	4	393	484	203	60	138	81	248	2225	421	262	861	6544	2419	300	656	107	416	131	365	433	359	212
	5	2510	1014	424	301	224	144	356	2730	440	366	404	4039	3170	507	1073	236	3438	664	681	734	1116	957
	6	3030	1005	419	294	223	108	271	2036	300	257	244	2742	3041	398	902	210	3197	467	322	621	1001	648
	7	453	617	266	79	193	135	418	4559	889	483	1787	9963	3824	545	1170	248	566	234	1169	570	464	457
	8	155	119	52	23	47	31	99	980	167	109	262	1823	985	130	274	53	165	49	175	167	158	87
	9	183	158	73	32	54	34	92	909	176	112	251	1752	761	175	284	78	277	118	503	160	218	228
	10	883	745	340	151	232	158	412	3575	682	450	932	6315	3406	713	1242	266	1330	522	1636	728	976	919
	11	484	713	297	103	191	135	388	3486	686	430	903	6818	3627	874	1230	426	566	272	2402	681	1096	738
	12	568	509	209	104	125	92	249	2098	382	263	462	3289	2195	510	749	237	694	243	1087	500	852	490
	13	573	458	206	99	119	83	202	1637	296	215	334	2448	1754	438	673	146	771	309	791	444	917	556
	14	1219	1093	425	161	220	117	313	2465	409	313	375	3534	2981	402	904	154	1407	285	446	578	497	411
	15	2343	629	271	214	138	61	147	1047	159	135	129	1431	1493	204	452	104	4886	479	195	313	474	562

KEY

- Less than 100 trips
- 100 - 499 trips
- 500 - 999 trips
- More than 1000 trips
- Intrazonal trips

Source: CCTA Model

Table 4-7: Daily 2013 Person Trips originating outside of West Contra Costa to West Contra Costa, CCTA Unadjusted Model

2013		Destination Zone														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Origin Zone	16	103	54	109	167	909	620	304	66	102	541	499	852	280	612	780
	17	132	80	127	176	272	163	307	46	63	324	383	467	164	423	173
	18	33	25	47	55	97	57	108	16	22	109	145	157	80	114	67
	19	49	51	124	147	512	264	298	54	87	443	444	853	224	398	310
	20	16	17	38	41	53	31	89	14	20	88	134	128	35	60	35
	21	17	27	66	65	67	35	144	25	27	138	150	182	53	83	34
	22	45	82	205	188	171	85	470	68	81	380	476	494	142	227	76
	23	94	272	809	537	389	208	1983	212	253	1072	1242	1137	370	571	171
	24	54	176	465	316	215	98	1127	121	153	646	810	766	194	311	83
	25	20	50	126	110	94	48	309	42	50	221	305	288	82	130	43
	26	29	565	1096	666	202	72	1824	208	206	946	827	1012	246	366	55
	27	135	1962	2627	2831	665	307	5483	602	675	2721	2802	2529	657	1058	242
	28	31	59	179	146	99	62	381	54	51	232	232	229	131	143	54
	29	20	32	92	99	65	39	178	33	27	133	145	198	97	92	35
	30	36	66	196	194	115	70	392	64	55	261	281	369	156	178	64
	31	8	16	44	48	31	17	83	16	14	68	81	120	33	47	15
	32	210	52	165	293	2486	1424	442	119	161	1042	507	2959	801	1310	3510
	33	60	49	128	165	631	293	316	66	107	531	570	803	249	455	471
	34	46	141	469	347	248	100	1481	138	308	985	2740	3015	416	346	104
	35	35	53	174	191	122	69	306	56	51	239	288	374	109	171	68
	36	36	16	86	116	72	56	138	24	24	104	146	133	55	102	67
	37	97	77	220	275	823	419	484	104	132	712	690	1688	352	661	705
	38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

KEY

- Less than 100 trips
- 100 - 499 trips
- 500 - 999 trips
- More than 1000 trips

- Intrazonal trips

Source: CCTA Model

Table 4-8: Daily 2040 Person Trips originating outside of West Contra Costa to West Contra Costa, CCTA Unadjusted Model

2040		Destination Zone														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Origin Zone	16	177	74	137	213	1228	879	382	81	116	705	661	1012	402	793	981
	17	158	99	148	204	361	228	364	53	68	396	480	549	201	509	215
	18	48	38	65	78	148	90	149	22	28	161	210	223	112	160	97
	19	66	44	99	125	529	303	261	45	72	412	450	638	241	364	326
	20	22	21	49	52	76	46	113	17	23	115	177	164	50	77	46
	21	18	27	63	62	77	44	149	23	27	143	177	194	55	85	37
	22	49	85	206	189	213	113	511	67	85	423	574	557	158	249	90
	23	121	347	1019	663	569	315	2642	256	329	1451	1795	1559	496	745	227
	24	59	180	483	330	264	130	1238	123	161	717	954	846	217	341	97
	25	24	55	138	121	121	65	355	44	55	259	376	340	96	149	51
	26	35	614	1192	706	259	107	2131	214	234	1096	1027	1135	283	414	69
	27	166	2066	2937	2990	879	436	6558	641	790	3251	3615	3004	798	1243	301
	28	36	87	258	179	144	86	612	69	77	345	362	359	132	185	63
	29	18	33	86	85	73	44	190	29	29	142	166	216	62	91	34
	30	33	79	211	188	147	90	491	65	68	320	370	462	124	199	67
	31	8	17	41	43	38	22	91	15	14	75	95	133	27	49	17
	32	249	49	152	263	2553	1808	428	103	145	987	530	2297	849	1189	3526
	33	83	54	142	182	795	383	359	69	107	617	678	886	299	503	532
	34	42	173	534	358	330	145	1968	150	406	1262	3875	3979	517	407	118
	35	28	52	135	134	133	77	297	42	50	246	323	385	93	159	62
	36	16	16	54	54	67	38	120	12	21	103	164	129	39	72	36
	37	96	67	176	221	788	459	434	85	114	655	734	1262	308	541	633
	38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

KEY

- Less than 100 trips
- 100 - 499 trips
- 500 - 999 trips
- More than 1000 trips

- Intrazonal trips

Source: CCTA Model

Areas within the project Study Area west of I-80 and east of the Union Pacific Railroad, following the San Pablo Avenue corridor, that show the greatest suitability for transit for both existing and future conditions also show the greatest trip densities. Areas identified in the TSI analysis with the highest suitability index outside of the Study Area include several cities to the south, such as Berkeley, Emeryville, and Oakland, as well as San Francisco, all of which are also destination areas accounting for the largest share of vehicle trips beginning in the Study Area during the AM peak period. An analysis of trips with both origins and destinations external to the Study Area also showed that the greatest magnitude of trips flowing through the Study Area are destined for similar areas in Oakland and northern Alameda County, followed by San Francisco. Though San Francisco has the highest transit suitability and the highest level of transit access, it does not have the quite the same level of demand as the Alameda County destinations.

The TSI analysis also illustrated some areas in the South Bay near San Jose as suitable for transit; however the O-D analysis showed few trips traveling between the Study Area and this part of the region. On the other hand, the O-D analysis showed a large share of vehicle trips traveling between the Study Area and cities just to the east in Contra Costa County; however the TSI analysis does not indicate these areas as very suitable for transit due to low densities and more dispersed trips origins and destinations as well as higher income levels and access to autos.

5 NEXT STEPS

The summary of trip origins and destinations combined with the analysis of socioeconomic factors within the Study Area and nine-county region provide a basis for determining potentially suitable market areas for future HCT investment. This two-step analysis will inform the development and evaluation of conceptual near-term, mid-term, and long-term HCT alternatives for West Contra Costa County.

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APPENDIX A

Geographic Delineations for 38 Travel Analysis Zones

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Table A-1: Geographic Delineations for 38 Travel Analysis Zones

Zone	TAZs included	Geographic Location
1	1087	West Contra Costa County Unincorporated Area
2	1042, 1043	El Cerrito
3	1041, 1047, 1048	El Cerrito
4	1044-1046, 1052, 1075, 1077	El Cerrito, San Pablo, Richmond
5	1080-1083	Pinole, Hercules
6	1084-1086	Pinole, Hercules
7	1040, 1049, 1050, 1051, 1058	El Cerrito, Richmond
8	1053, 1076	El Cerrito, Richmond
9	1056, 1057	Richmond
10	1054, 1055, 1064-1067	Richmond, San Pablo
11	1059-1061, 1063	Richmond
12	1062, 1068, 1069	Richmond
13	1070-1073	San Pablo, Richmond
14	1074, 1078-1079	Richmond, El Sobrante
15	1088-1090	Rodeo-Crockett
16	--	Central Contra Costa County – Martinez, Concord, Pleasant Hill, Walnut Creek
17	--	Lafayette, Orinda, Moraga
18	--	Eastern Contra Costa County – Pittsburg, Antioch, Oakley, Brentwood
19	--	Tri-Valley – Danville, San Ramon
20	--	Eastern Alameda County – Pleasanton, Dublin, Livermore
21	--	Southern Alameda County – Union City, Newark, Fremont
22	--	Central Alameda County – Hayward, San Leandro, Castro Valley
23	--	Oakland, Piedmont
24	--	Oakland
25	--	Alameda
26	--	Albany
27	--	Berkeley, Emeryville
28	--	Northeast San Francisco
29	--	Northwest San Francisco
30	--	Southeast San Francisco
31	--	Southwest San Francisco
32	--	Solano County – Vallejo, Benicia
33	--	Solano County
34	--	Marin County
35	--	San Mateo County
36	--	Santa Clara County
37	--	Napa and Sonoma Counties
38	--	Yolo and Sacramento Counties

Note: Corresponding TAZs are provided only for the Study Area of West Contra Costa County.