SOUTHERN CALIFORNIA ASSOCIATION OF GOVERNMENTS

Integrated Passenger and Freight Rail Forecast Study

Final Report - Task 8

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Executive Summary

Study Purpose

SCAG has completed the first regional integrated passenger and freight rail forecast for its six-county region. Since completing *On the Move, the Comprehensive Regional Goods Movement Plan and Implementation Strategy in 2013*, SCAG has recognized the need to forecast passenger rail, freight rail and goods movement on a regional level. Multi-billion dollar investments such as Metrolink's Southern California Optimized Rail Expansion (SCORE), Brightline West, and the California High-Speed Rail project, along with continued growth in freight rail and goods movement through the San Pedro Bay Ports Complex, call for taking a fresh look at future passenger and freight rail operations, capacity needs, and costs to identify opportunities that mutually benefit all public and private rail stakeholders in the SCAG region and help leverage rail-related funding opportunities.

This Integrated Passenger and Freight Rail Forecast Study evaluates future projected rail volumes through rail operations simulation, identifies additional infrastructure needs due to capacity constraints, and prepares a corridor-based strategic vision to implement them. The Study builds on concurrent capital improvement plans being undertaken by Metrolink, California High Speed Rail Authority, the Ports of Los Angeles and Long Beach also knowns as the San Pedro Bay Ports, the 2020 California State Rail Plan, BNSF Railway (BNSF), and Union Pacific Railroad Company (UPRR), and is not meant to replace or modify these plans as the Study relies upon these efforts collectively as inputs into the technical process.

To complete the Study, SCAG engaged stakeholders through the formation of a Technical Advisory Committee (TAC), consisting of freight and passenger rail operators, San Pedro Bay Ports and Port Hueneme, county transportation commissions (CTCs), CalSTA, Caltrans Headquarters and Districts, California High Speed Rail, the Los Angeles-San Diego-San Luis Obispo Rail Corridor Agency (LOSSAN Agency) and other rail stakeholders. There were four TAC meetings during the three-year course of this Study.

The Study was developed during the ongoing COVID-19 pandemic, which has severely affected economic activity and rail ridership in the SCAG region. Impacts to transit and passenger rail since the onset of COVID-19 in early 2020 has been particularly pronounced and longer lasting with recoveries varied across the region, whereas freight volumes have recovered, even setting new volume records for the Ports while freight rail operations have witnessed increasing volatility. While it is unknown what the longer-term impacts of the pandemic may turn out to be, the Study utilizes the current available assumptions about projected or planned rail shipments and passenger service levels.

Existing and Future Conditions

Rail Services and Operations

There are two Class I freight railroads serving the SCAG region[1]. These are the BNSF and UPRR. The major focus of freight rail transportation in the region are the ports, to and from which the Class I's haul trainloads of containerized and non-containerized cargo, with containerized cargo being the considerable

[1] As described by the U.S. Surface Transportation Board, a Class I railroad had operating revenues of at least $504.8 million in 2019.

majority. There is also traditional carload train traffic in the region as well for a variety of commodities and industries.

The SCAG region is served by the Metrolink commuter rail service, operated by the Southern California Regional Rail Authority (SCRRA), and *Pacific Surfliner* regional rail service, operated by the (LOSSAN Agency. Three Amtrak long distance trains also operate through the region. All three passenger services operate on segments of lines that are owned and dispatched by freight railroads BNSF and UPRR.

Infrastructure

The Metrolink passenger rail system consists of 538 route miles. These include rights-of-way (ROW) that are owned by BNSF and UPRR, as well as by the CTCs, including Los Angeles County Metropolitan Transportation Authority (LA Metro); Orange County Transportation Authority (OCTA); Riverside County Transportation Commission (RCTC); San Bernardino County Transportation Authority (SBCTA) and Ventura County Transportation Commission (VCTC). In addition, the Alameda Corridor Transportation Authority (ACTA) owns and operates the high-capacity Alameda Corridor between the San Pedro Bay Ports Complex and downtown Los Angeles.

Supporting mainline rail operations are a variety of rail facilities. Major freight facilities include intermodal yards at ports and at inland locations, traditional carload yards, and set-up auto handling facilities. Passenger facilities include major multimodal centers like Los Angeles Union Station (LAUS), plus a network of other multimodal and smaller local stations throughout the region and maintenance facilities in Los Angeles and San Bernardino.

Planned Rail Network Improvements

Both freight and passenger services are planning for major improvements. Most extensive are plans for both the Metrolink system and for high-speed rail (HSR). Metrolink's SCORE program calls for capital improvements to enhance the capacity of the regional rail system towards the Summer 2028 Olympic and Paralympic Games with a full build-out of SCORE by 2035. In 2022 Metrolink is expanding its network to the City of Redlands and a future expansion to San Jacinto and Hemet on the Perris Valley Line is being studied. The California High-Speed Rail will serve the SCAG region between Palmdale, Hollywood Burbank Airport, LAUS, and Anaheim. With plans for operating trains to and from Las Vegas, Brightline West is planning to extend this HSR service to both Palmdale and Rancho Cucamonga from the Victor Valley. Also, the Coachella Valley Rail passenger service is planned between LAUS and the Coachella Valley via Fullerton and Riverside. At the same time, freight carriers BNSF and UP will be investing in their systems, with the BNSF actively negotiating with SCRRA and LOSSAN regarding capacity expansion on its San Bernardino Subdivision, shared with Metrolink, *Pacific Surfliner* trains, and the Amtrak *Southwest Chief*.

Also, the ports will be expanding their container handling rail intermodal facilities in anticipation of increasing international container traffic.

Forecasts of Rail Activity

The ports provided the Study with its container train forecasts for 2025 and 2035. The ports' forecast included container trains to and from port-related and non-port-related intermodal facilities. The Study estimated future traditional carload trains based on current volumes and an annual growth assumption of around 2 percent, per a production-consumption model.

The Study assumed future Metrolink train volumes based on the SCORE program, which anticipates increases tied to specific milestones for future years. *Pacific Surfliner* trains will also likely increase, while Amtrak long-distance service levels are likely to remain unchanged.

Rail Network Demographics

As noted, COVID-19 has had a profound impact on economic activity and ridership. Per SCAG's 2020-2045 Regional Transportation Plan/Sustainable Communities Strategy, or Connect SoCal, the population and employment adjacent to the integrated passenger and freight rail network in the SCAG region is forecasted to increase significantly between 2016 and 2045. As of 2016, more than 25 percent of the population in the SCAG region lives within a half mile of Southern California's primary rail network. Even a higher percentage of jobs are located near rail lines, with more than one-third of jobs located within a half-mile of a rail line in 2016. By 2045, population and employment within a half-mile of the passenger/freight rail network is projected to increase by approximately one million each, an increase of 26 percent and 30 percent, respectively. In comparison, overall population growth in the SCAG region is expected to increase by 19 percent, while employment growth is projected at 20 percent.

With growth projected to occur disproportionately within a half-mile of Southern California's rail network, the forecasted increase of more than a million additional residents along with nearly a million jobs within this proximity calls for a freight and passenger rail system that can efficiently absorb an increase in traffic volume to meet regional mobility needs. The more readily residents have greater access to passenger rail service, the more the likelihood that they will consider multiple mobility options to use the service to access worksites and amenities throughout the region. Additionally, freight rail serves as a job generator throughout the region with freight-related jobs transcending a wide variety of workforce skill sets that are employed within many of the region's Port and rail facilities. With approximately one-third of all jobs being tied to freight, supporting workforce development throughout communities along these corridors is an important factor.

Rail Operations Simulation Findings

To determine the extent of line capacity improvements needed to handle future freight and passenger train volumes, the Study analyzed existing and future conditions through a rail operations simulation effort. That effort involved use of the Rail Traffic Controller (RTC) operations simulation program and five simulation cases. The RTC program simulates the operation of trains over a railroad network. Variations can be made in network track layouts, train consists, schedules, and operating rules and constraints, allowing the testing of such changes before they are implemented. RTC is used by North American Class I railroads, ports, and passenger rail operators to evaluate and plan their operations and capital expenditures. The five cases were:

- 2019 Base Case
- 2028 Case (Metrolink Milestone 1B Service Levels)
- 2035 Case (Metrolink Milestone 2 Service Levels)
- 2035 Alternate Case (Modified Metrolink Milestone 2 Service Levels)
- 2050 Case (Metrolink Milestone 3 Service Levels)

The Base Case reflected freight and passenger operations on main lines in the SCAG region in 2019, the base year in the Study and the standard against which future train performance in terms of minutes of delay over one week was assessed. The 2028, 2035, and 2050 cases assumed increasing freight and passenger train volumes (Metrolink and *Pacific Surfliner* trains) over time. California High Speed Rail service was assumed for the 2035 Alternate case and the 2050 case.

The simulation effort found that major capital investments providing greater line capacity (beyond those already planned to be implemented) were required in 2035 to accommodate both the maximum desired levels of passenger rail service and forecasted freight volumes, while maintaining train performance levels comparable with the Base Case. The investments included the SCORE improvements, California High

Speed Rail improvements, freight rail improvements, and additional improvements referred to as Beyond SCORE improvements. Even with higher passenger and freight volumes, the 2050 Case required no additional investments beyond those required for the 2035 case. As a result, the SCORE and Beyond SCORE investments needed by 2035 were selected as the Study's Strategic Corridor Vision. The Strategic Corridor Vision is meant to serve as an independent and objective assessment of the rail network, with the improvements to be vetted further across key stakeholders as to their phasing and inclusion within the 2024 Connect SoCal Update as well as for strategic development of a regional investment plan to be used to leverage federal and state funding opportunities.

Cost Estimates

Costs for the SCORE improvements projects, included in the 2018 Metrolink *Preliminary Study Report: SCORE Integrated Service and Capital Investments*, sum to a minimum of $8 billion in year of expenditure (YOE) dollars, the Beyond SCORE projects sum to approximately $5.7 billion in YOE dollars, and the Connect SoCal 2020 rail grade separation projects sum to approximately $5.9 billion in YOE dollars. Thus, the total required capital investment needed for the Strategic Corridor Vision amounts to approximately $19.6 billion in YOE dollars. The total excludes any separate facilities needed for the California HSR or Brightline West HSR projects. Operating and maintenance (O&M) costs for Metrolink, *Pacific Surfliner* and Amtrak long-distance services on the mainlines are expected to grow, with all identified planned increases in service, from $415.7 annually in the Base Case to $1.2 billion in 2035.

Shared-use Restrictions

Metrolink, *Pacific Surfliner*, and Amtrak long-distance trains run on ROWs owned by the Class I railroads and CTCs. The passenger services are subject to limits on both BNSF and UPRR rail lines. The limits are products of negotiation between the passenger services and their host freight railroads. Certain expansions of passenger service levels on BNSF and UP territories will require further negotiation, likely resulting in capacity investments meant to ensure fluid passenger and freight operations on the host railroads.

Traditionally, figuring out the capacity question and identifying and validating effective solutions to minimize and ultimately eliminate delays to both freight and passenger service has been left to operations simulation, as was done for this Study.

Strategic Corridor Vision

As noted above, the capacity enhancing investments required for fluid freight and passenger operations on main lines in the SCAG region in 2028 and 2035 were selected for the Strategic Corridor Vision. Additionally, the projects produce large scale economic benefits to the region (Long-Term Ridership and Productivity Impacts), with value added or Gross Regional Product (GRP) estimated to increase by $831 billion through 2050 and regional output estimated to increase by nearly $1.4 trillion through 2050, if the cooperation between parties – public and private – needed to realize the potential of the capacity enhancing projects is achieved. This achievement of the Strategic Corridor Vision is subject to funding availability, ridership demand and corresponding infrastructure needs, and implementation by the CTCs and freight and passenger railroads.

Next Steps

SCAG offers this analysis to its rail transportation stakeholders to inform the decisions they will be making regarding service expansion and capital improvements. This Study should be seen as the first step in a process of how freight and passenger rail operators can plan together for a robust regional rail system

propelling the economy and providing both efficient freight service and attractive mobility options for the SCAG region's residents.

SCAG will coordinate directly with TAC stakeholders to 1) utilize the Study's Strategic Corridor Vision as the foundational approach for the update to rail project improvements as part of the 2024 Connect SoCal Update and 2) concurrently position the region competitively for rail-related federal and state and other funding opportunities through the development of a regional investment plan.

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1. Introduction

1.1 Study Purpose

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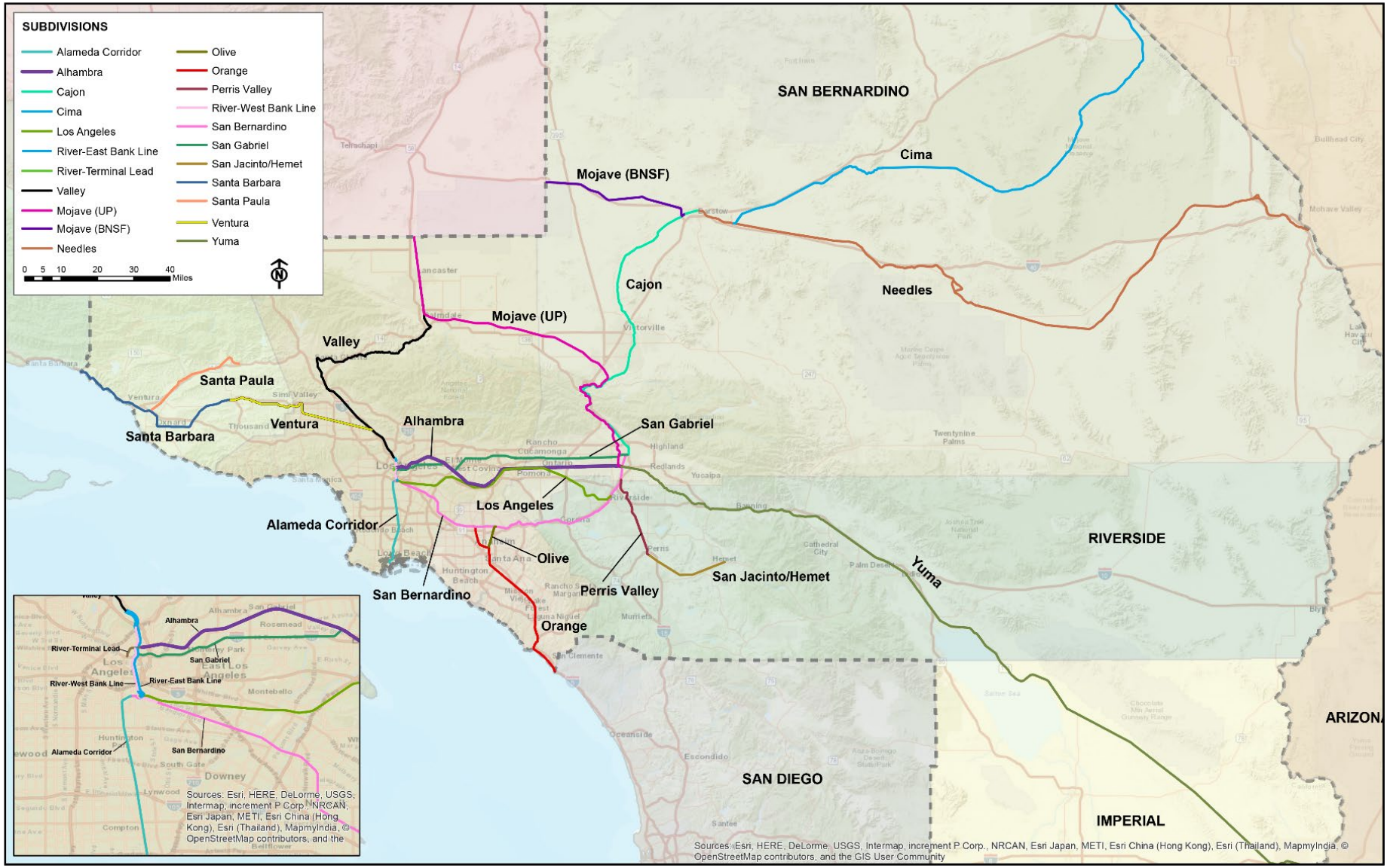
- Forecast future passenger and freight rail demand and levels through 2050, including interim years 2028 and 2035;
- Assess goods movement intermodal facility capacity;
- Assess future passenger and freight train movements and identify needed track capacity improvements by use of rail operations simulation software;
- Develop cost estimates of rail infrastructure improvements;
- Develop funding strategies; and identify strategic corridors to increase grant funding prospects.

Figure 1 shows the existing passenger and freight main line rail network of the SCAG region. Over the next 25 years, public and private rail owners have plans to implement a comprehensive package of capacity improvement programs throughout the region to accommodate projected increased growth in passenger and freight rail volumes. Additionally, the California High Speed Rail Authority (CHSRA) and Brightline West are planning to deliver high-speed rail projects to the region.

This Integrated Passenger and Freight Rail Forecast Study aims to evaluate future projected rail volumes through rail operations simulation, identify additional infrastructure needs due to capacity constraints, and prepare a corridor-based strategic vision to prepare towards implementing them. This study builds on concurrent capital improvement plans being undertaken by Metrolink, California High Speed Rail, Brightline West, the Ports of Los Angeles and Long Beach, or San Pedro Bay Ports, BNSF Railway (BNSF), and Union Pacific Railroad Company (UPRR) and is not meant to replace or modify these plans as the Study is relying upon these efforts collectively as inputs into the technical process.

The Study also engaged stakeholders through the formation of a Technical Advisory Committee (TAC), consisting of freight and passenger rail operators, the San Pedro Bay Ports and Port Hueneme, county transportation commission (CTCs), CalSTA, Caltrans and other rail stakeholders. There were four TAC meetings during the three-year course of this Study.

The Study was developed during the ongoing COVID-19 pandemic, which has severely affected economic activity and rail ridership in the SCAG region. Impacts to transit and passenger rail since the onset of COVID-19 in early 2020 has been particularly pronounced and longer lasting with recoveries varied across the region, whereas freight volumes have recovered, even setting new volume records for the Ports while freight rail operations have witnessed increasing volatility. While it is unknown what the longer-term impacts of the pandemic may turn out to be, the Study assumes that normalcy in rail shipments and rail ridership will return.



Source: AECOM, 2021

Figure 1 Regional Rail Map of SCAG Region

1.2 Stakeholder Outreach Approach and Summary

1.2.1 Stakeholder Engagement Approach

This Study engaged stakeholders through the formation of a Technical Advisory Committee (TAC), consisting of freight and passenger rail operators, the San Pedro Bay Ports and Port Hueneme, CTCs, CalSTA, Caltrans and other rail stakeholders. **Table 1** lists the TAC committee members that participated in the TAC meetings, the nature of the agency, and whether data pertinent to this Study was requested from these agencies.

Table 1 Technical Advisory Committee Member Agencies List

Agency	Public/Private	Data Needs Requested
Freight Rail Operators		
BNSF Railway	Private	Yes
Union Pacific Railroad (UP)	Private	Yes
Passenger Rail Operators		
Southern California Regional Rail Authority (SCRRA) (Metrolink)	Public	Yes
Amtrak (formally known as the National Rail Passenger Corp.)	Private/Public	Yes
Los Angeles-San Diego-San Luis Obispo (LOSSAN Agency) Rail Corridor Agency	Public	Yes
California High Speed Rail Authority (CHSRA)	Public	Yes
Ports/ACTA		
Port of Los Angeles (POLA)	Public	Yes
Port of Long Beach (POLB)	Public	Yes
Alameda Corridor Transportation Authority (ACTA)	Public	Yes
Port Hueneme	Public	Yes
County Transportation Agencies		
LA County Metropolitan Transportation Authority (Metro)	Public	No
Orange County Transportation Authority (OCTA)	Public	No
San Bernardino County Transportation Authority (SBCTA)	Public	No
Riverside County Transportation Commission (RCTC)	Public	No
Ventura County Transportation Commission (VCTC)	Public	No
Imperial County Transportation Commission (ICTC)	Public	No
San Gabriel Valley Council of Governments (SGVCOG)/Alameda Corridor-East (ACE)	Public	No
State Transportation Agencies		
California Department of Transportation (Caltrans)	Public	No
California State Transportation Agency (CalSTA)/Caltrans Division of Rail and Mass Transportation (DRMT)	Public	No

Source: AECOM, 2021

1.2.2 TAC Meeting Summary

The TAC was engaged in three key stages of the study through four meetings, as described below:

- **Stage 1: Existing and Future Conditions and Simulation Modelling Methodology**

  One TAC meeting was conducted in June 2020 to obtain concurrence from the TAC on Existing and Future Conditions, as well as the simulation modelling methodology. As a follow-up to this meeting, technical information on existing and future conditions, as well as the modelling approach and assumptions were sent to the TAC for review; in addition, data requests were also submitted to the TAC to solicit necessary input that would feed into the remaining tasks of this study.

- **Stage 2: Goods Movement Methodology and RTC Modelling Scenarios**

  Two TAC meetings were scheduled during this stage. Following the first TAC meeting during Stage 1, the second TAC meeting was held in April 2021 and focused on the Goods Movement Forecast Methodology and initial RTC Modelling Scenarios. The third TAC meeting in November 2021 reviewed the modelling results from the initial scenarios, obtained concurrence on the additional scenarios to model, and discussed the study approaches for Cost Estimating/Funding Strategy, Shared-use Restrictions and Strategic Corridors.

- **Stage 3: RTC Modelling Results, Cost Estimate/Funding Strategy Findings, Shared-Use Restrictions and Strategic Corridor Visions**

  The last TAC meeting was held in January 2022 to review the modelling results of all scenarios, and present results of cost estimates, funding strategies, shared-use restrictions, as well as solicit input on strategic corridors. All feedback from the TAC was incorporated into the Final Report.

2. Existing and Future Conditions

This section presents an inventory of the existing and future conditions for the socio-economic conditions adjacent to the integrated passenger and freight rail network in the SCAG region, discussions on planned improvements and an assessment of the advancement of Tier 4 and zero-emission technologies, as well as historical data, passenger rail and freight train forecasts, respectively. The section also covers historical rail traffic data in the SCAG region and well as the approaches utilized for forecasts of the freight and passenger train volumes needed for the operations simulation analysis described in Section 3.

2.1 Existing and Future Socio-economic Conditions

2.1.1 Existing Socio-economic Conditions

Demographic Analysis

The population density around rail subdivisions varies across the SCAG region, including the number of people, jobs, and facilities impacted by freight and passenger rail operations. Areas with higher population generally means greater demand for transportation. Impacts related to emissions, unsafe grade crossings, and excessive noise and vibration can be increased in areas with higher population and employment densities adjacent to rail routes.

Table 2 presents the population densities within one-half mile of the integrated passenger and freight rail network. The SCAG region has a population of 19.1 million spread over six counties[2]. Over 25 percent of the population (nearly five million) lives within one-half-mile of the 22 freight and passenger subdivisions. More than half of the regional population residing near rail lines lives in Los Angeles County. Several rail subdivisions terminate in the highly populated Downtown L.A. at Union Station. The Alhambra, San Gabriel, and Valley subdivisions are each bordered by populations of more than 400,000 in LA County. Nearly 20 percent of the SCAG population near rail is in San Bernardino County, primarily on the San Gabriel, Alhambra, and Cajon subdivisions.

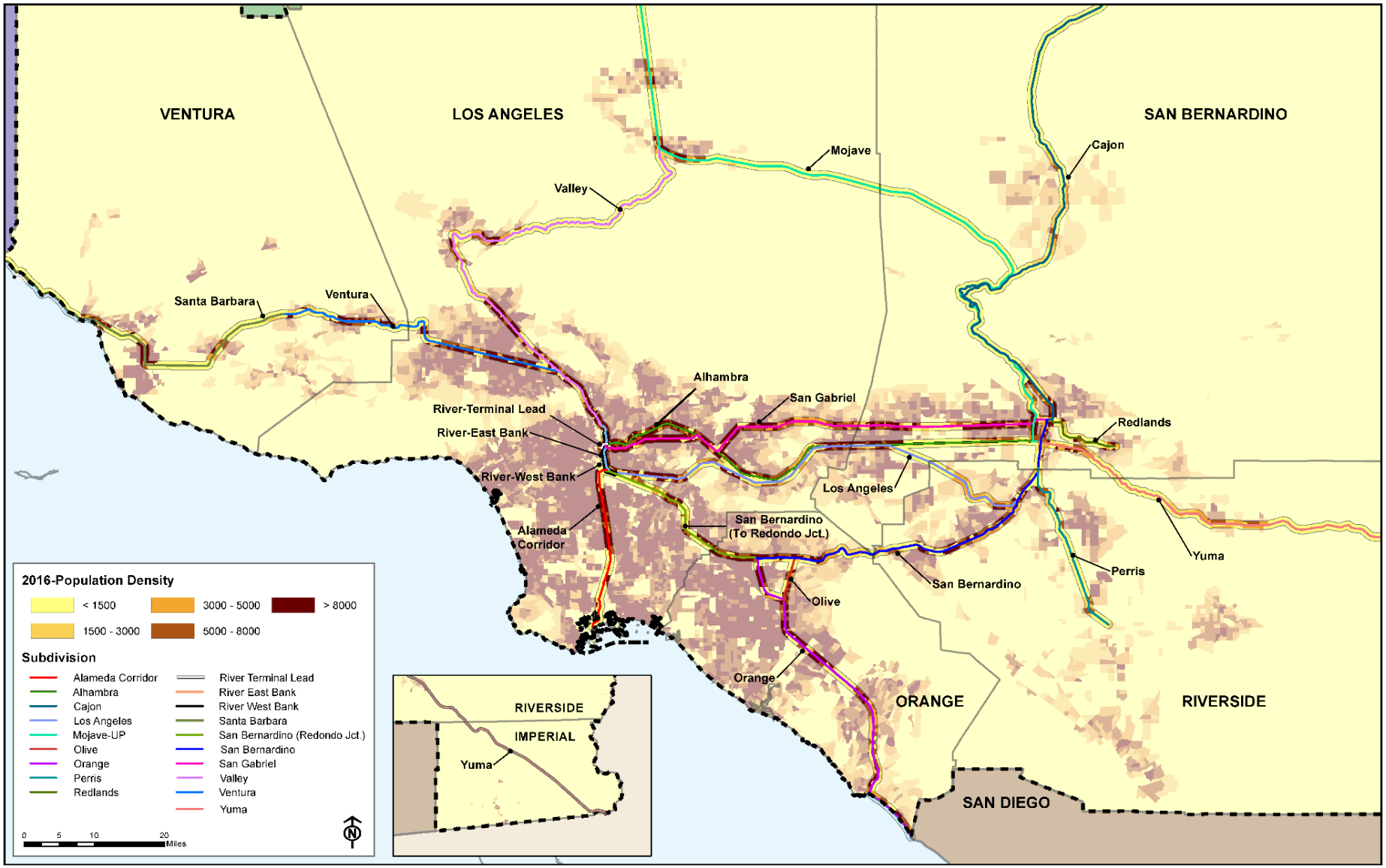
Population density (**Figure 2**) is concentrated around high-volume passenger train routes which fuels the opportunity for increasing passenger service. More than a half million people live within one-half mile of the Alhambra and San Gabriel Subdivisions. Population density is highest along the Riverside Subdivision, in downtown Los Angeles, and the San Gabriel Subdivision, which extends east out of downtown Los Angeles along moderately dense communities between Downtown Los Angeles and San Bernardino. The highest population densities surround the rail subdivisions that link downtown Los Angeles with the rest of the region, such as the Alhambra Subdivision (mostly freight), the San Bernardino Subdivision, and the freight-only Alameda Corridor. Many of these subdivisions also have the highest volume of train traffic.

[2] Based on SCAG 2020 RTP/SCS baseline data (2016 demographic data).

Table 2 Population and Population Density (2016)

	SCAG	Imperial		Los Angeles		Orange		Riverside		San Bernardino		Ventura	
		Total Pop.	Pop. per Sq. Mi	Total Pop.	Pop. per Sq. Mi	Total Pop.	Pop. per Sq. Mi	Total Pop.	Pop. per Sq. Mi	Total Pop.	Pop. per Sq. Mi	Total Pop.	Pop. per Sq. Mi
Alameda Corridor	221,000			221,000	9,151								
Alhambra	546,000			403,000	10,075					143,000	5,296		
Cajon	166,000									166,000	1,523		
Cima	2,000									2,000	13		
Los Angeles	450,000			227,000	5,867	2,987		96,000	6,000	77,000	6,760		
Mojave (UPRR)	198,000			100,000	1,851					98,000	1,574		
Mojave (BNSF)	9,000									9,000	213		
Needles	21,000									21,000	99		
Olive	55,000					55,000	8,449						
Orange	426,000					426,000	8,459						
Perris Valley	96,000							96,000	3,641				
River (LAUS)	32,000			32,000	22,857								
River East Bank	82,000			82,000	10,649								
River West Bank	60,000			60,000	8,889								
San Bernardino (San Bernardino to Fullerton Jct)	374,000					114,000	6,448	201,000	6,827	59,000	7,763		
San Bernardino (Fullerton to Redondo Jct)	192,000			103,000	4,921	89,000	14,355						
San Gabriel	689,000			457,000	11,540					232,000			
Santa Barbara	142,000											142,000	2,776
Valley	499,000			499,000	5,614								
Ventura	377,000			289,000	11,649							88,000	4,678
Yuma	279,000	4,000	37.17					216,000	1,932	59,000	4,574		
Redlands	80,000									63,000	5,464		
TOTAL BY COUNTY	**4,996,000**	**4,000**	**37**	**2,473,000**	**7,128**	**686,987**	**8,508**	**609,000**	**3,317**	**929,000**	**1,373**	**230,000**	**3,288**

**Analysis by subdivision is based on a half-mile buffer.*
Source: Final 2020 SCAG RTP/SCS



Source: AECOM, 2021

Figure 2 Population Density (2016)

Employment and Businesses

Table 3 presents the employment densities within one-half mile of the integrated passenger and freight rail network. Employment densities translates into greater opportunity for increasing passenger service. However, areas with denser employment can also be impacted by negative environmental, safety, and land use impacts.

Employment density (**Figure 3**) is highest surrounding the Riverside Subdivision around Los Angeles Union Station (LAUS), and along the Olive, Orange, and San Bernardino (Fullerton to Redondo) Subdivisions. These subdivisions carry passengers along the Inland-Empire-Orange County Lines and the 91 Line/ Perris Valley lines which have a significant volume of passenger trains.

There are approximately 3.2 million jobs located within a half mile of rail subdivisions in the SCAG region. This means that of the 8.7 million jobs in the SCAG region, nearly 37 percent are located near rail.[3] Most of that employment (54 percent) is in Los Angeles County. Orange and San Bernardino Counties each have 16 percent of the total jobs. Employment density is concentrated in central and southern LA County and northern Orange County. Employment density is high along many passenger routes. The Alameda Corridor, which is exclusively freight-oriented, and the Alhambra Subdivision, which is mostly freight-oriented, have high employment densities as well due to proximity to industrial and manufacturing businesses that benefit from close proximity to rail.

Income and Property Values

Table 4 shows the median commercial and residential median property values in LA County are $324,000 and $227,000, respectively. These property values are significantly lower than the average commercial and residential property values in LA County of $428,000 and $290,000, respectively. **Table 5** presents the median incomes within one-half mile of the rail network. Commuter and freight rail traffic creates negative environmental impacts such as noise, vibration, increased emissions and related health disparities. These environmental impacts typically result in reduced property values immediately adjacent to the rail network. As a result, median household incomes near rail facilities tend to be lower than average. While **Figure 4** shows land uses in the region, **Figure 5** shows that property values are lower around many of the key freight corridors, such as the Alameda Corridor, as compared to the rest of the region.

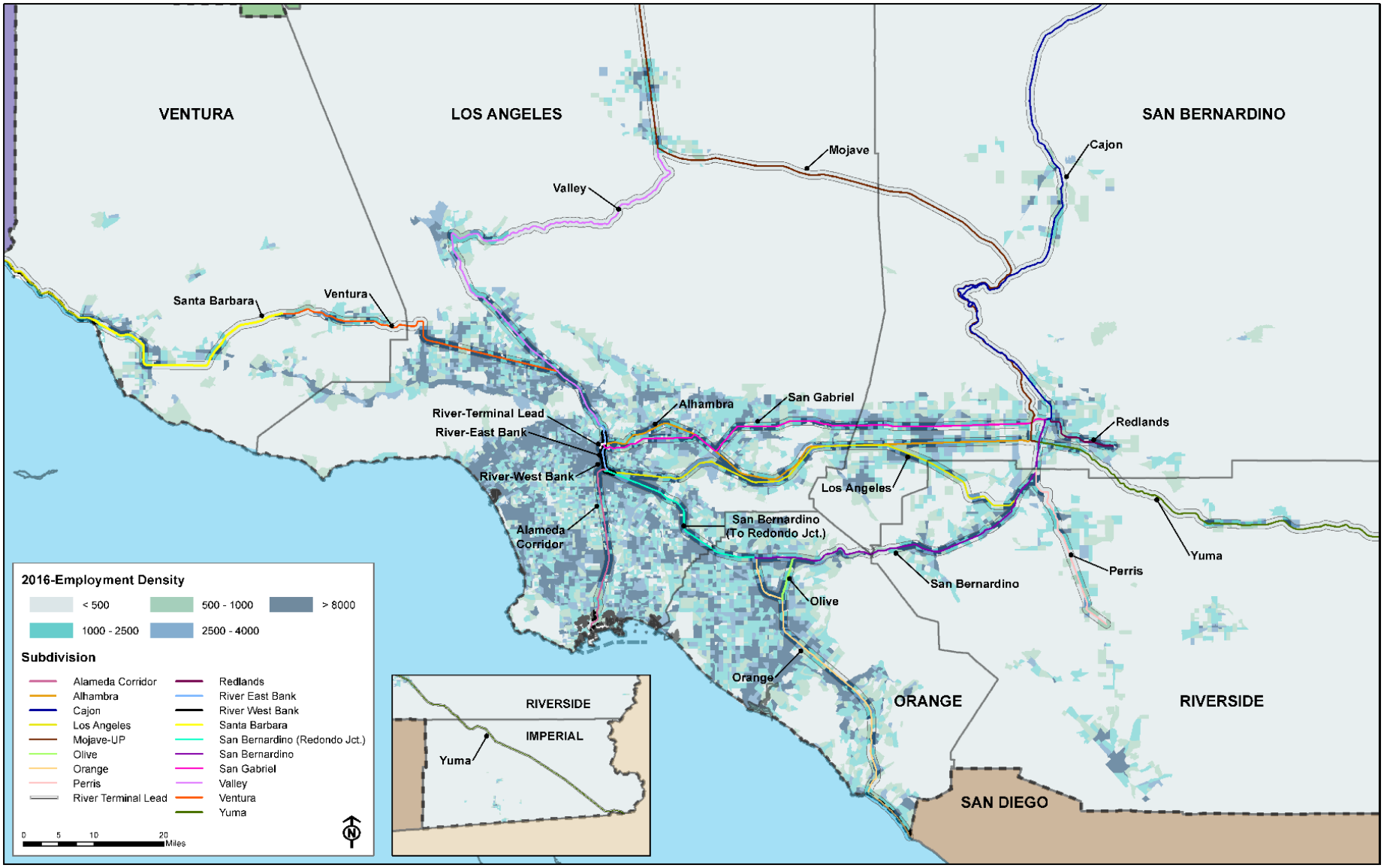
Figure 6 presents the median household incomes adjacent to the rail network. Much of the income variation by county can be explained by the broader variations in income among the SCAG member counties. Subdivisions in Orange County have relatively high median incomes compared to the other counties while the Yuma Subdivision, the only one in Imperial County, has the lowest median income at just $21,000. The Alameda Corridor (all freight) and Cima (all freight) and Needles (mostly freight) Subdivisions that are heavily freight are surrounded by lower income households that bear the brunt of goods movement impacts. Median incomes are particularly low surrounding the Alameda Corridor and the portions of rail subdivisions that extend from LAUS, as well as in the rural portions of Riverside and San Bernardino counties.

[3] Final Connect SoCal Demographics and Growth Forecast. SCAG. 2020. Retrieved from https://scag.ca.gov/sites/main/files/file-attachments/0903fconnectsocal_demographics-and-growth-forecast.pdf?1606001579.

Table 3 Employment and Employment Density (2016)

	SCAG	Imperial		Los Angeles		Orange		Riverside		San Bernardino		Ventura	
		Total Emp.	Emp. Per Sq. Mi	Total Emp.	Emp. Per Sq. Mi	Total Emp.	Emp. Per Sq. Mi	Total Emp.	Emp. Per Sq. Mi	Total Emp.	Emp. Per Sq. Mi	Total Emp.	Emp. Per Sq. Mi
Alameda Corridor	134,000			134,000	5,549								
Alhambra	364,000			246,000	6,150					118,000	4,370		
Cajon	46,000									46,000	422		
Cima	0										0		
Los Angeles	337,000			244,000	6,307			40,000	2,500	53,000	4,653		
Mojave (UPRR)	54,000			38,000	703					16,000	257		
Mojave (BNSF)	1,000									1,000	24		
Needles	8,000									8,000	38		
Olive	77,000					77,000	11,828						
Orange	311,000					311,000	6,176						
Perris Valley	61,000							61,000	2,313				
River (LAUS)	60,000			60,000	42,857								
River East Bank	69,000			69,000	8,961								
River West Bank	89,000			89,000	13,185								
San Bernardino (San Bernardino to Fullerton Jct)	248,000					96,000	5,430	133,000	4,518	19,000	2,500		
San Bernardino (Fullerton to Redondo Jct)	209,000			173,000	8,266	36,000	5,806						
San Gabriel	337,000			226,000	5,707					111,000	4,023		
Santa Barbara	96,000											96,000	1,877
Valley	258,000			258,000	2,902								
Ventura	236,000			192,000	7,739							44,000	2,339
Yuma	125,000	2,000	19					71,000	635	52,000	4,031		
Redlands	80,000									63,000	5,464		
TOTAL	**3,200,000**	**2,000**	**19**	**1,729,000**	**4,984**	**520,000**	**6,440**	**305,000**	**1,661**	**487,000**	**720**	**140,000**	**2,001**

**Analysis by subdivision is based on a half-mile buffer.*
Source: Draft 2020 SCAG RTP/SCS



Source: AECOM, 2021

Figure 3 Employment Density (2016)

Table 4 Property Values within a Half-mile of Rail Mainlines, Los Angeles County (2015)

	Median Residential Property Value	Median Commercial Property Value
Within half mile of rail	$226,687	$324,070
Beyond half mile of rail	$290,000	$428,000
All LA County	$281,000	$409,000

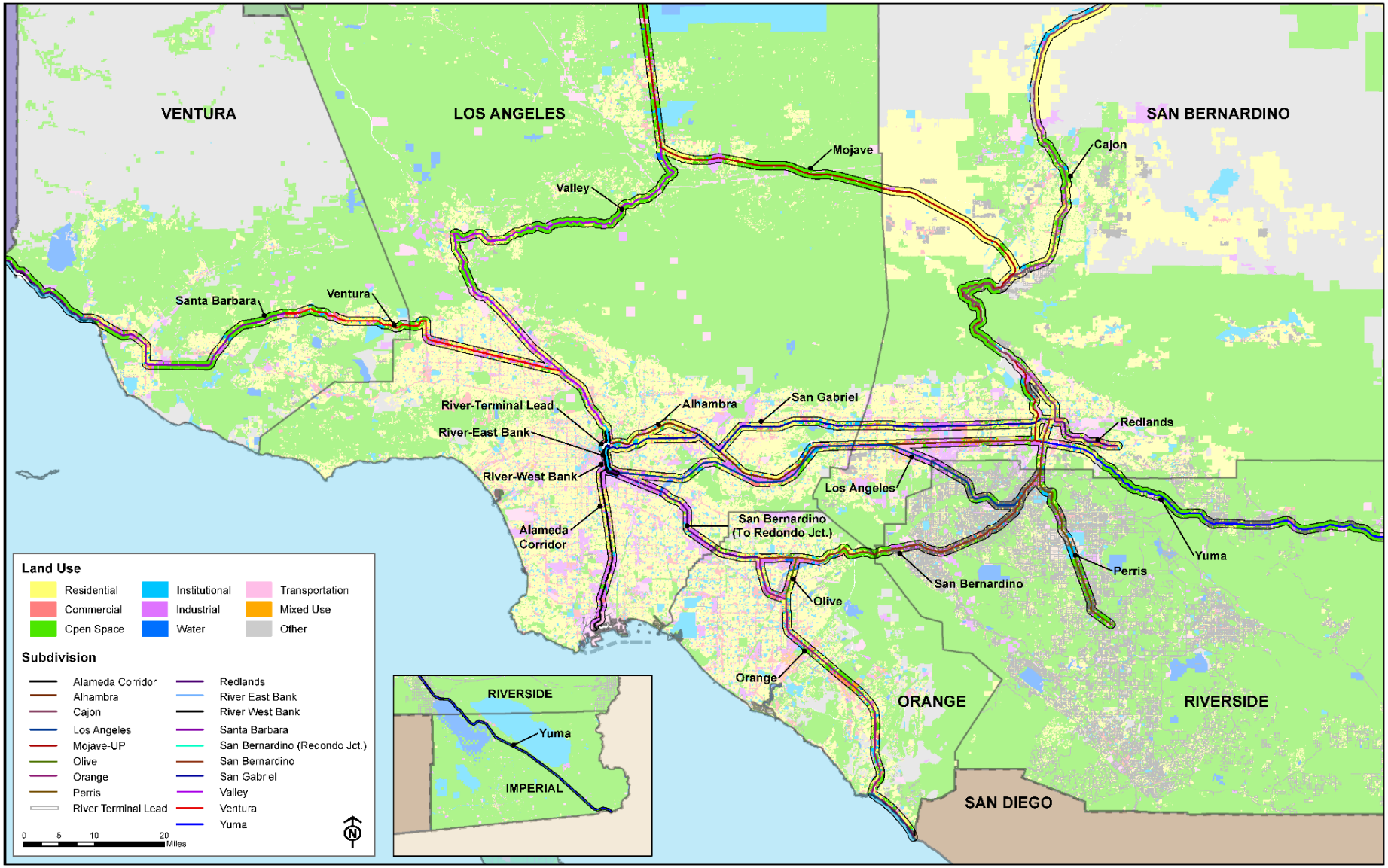
Source: LA County Data Portal. 2015 Assessor Parcels. https://egis3.lacounty.gov/dataportal/2016/04/06/assessor-parcels-2015-tax-roll/

**This analysis is based on LA County only rather than the entire SCAG region because of the availability of data.*

Table 5 Median Income by Subdivision (2016)

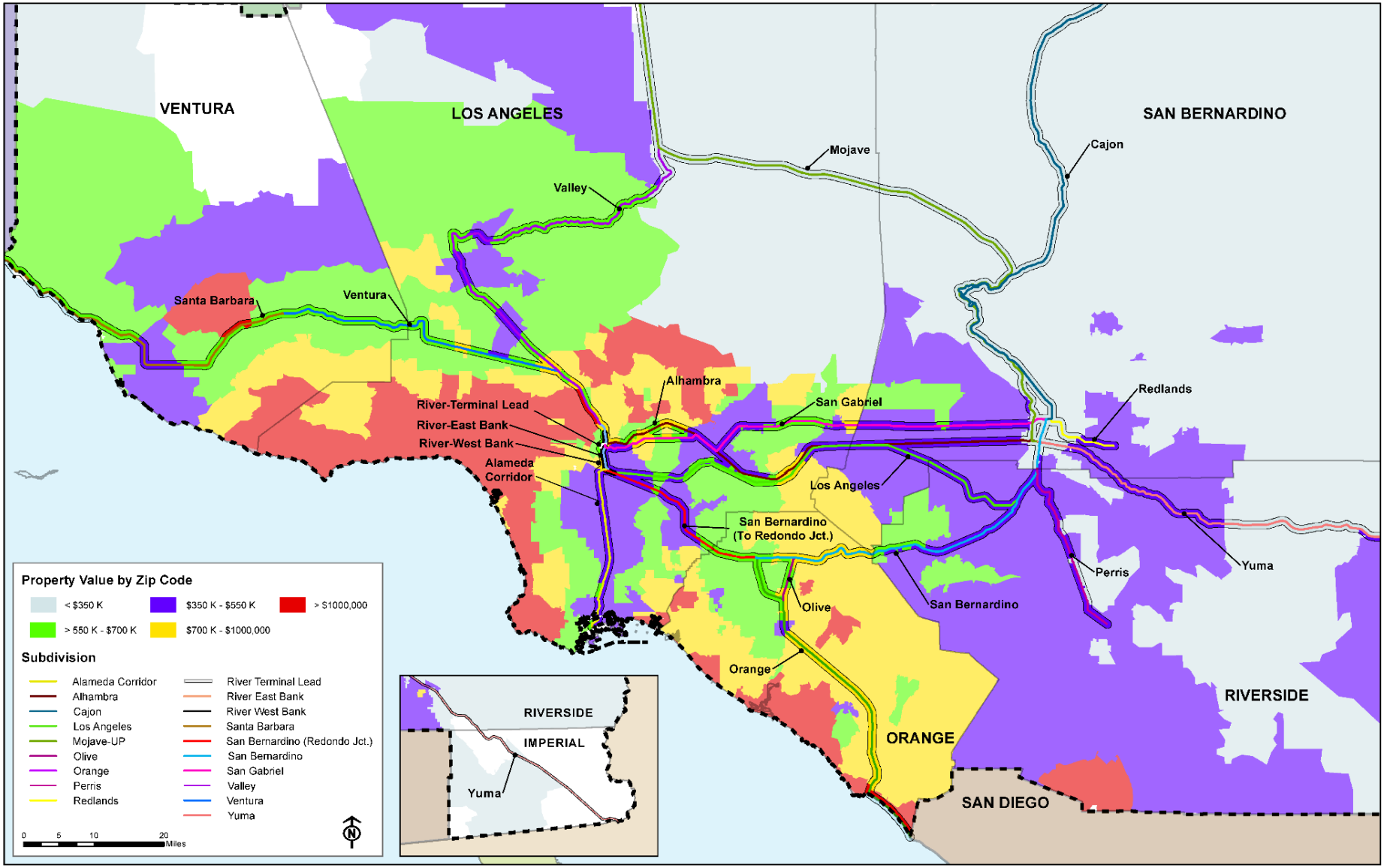
	Imperial	Los Angeles	Orange	Riverside	San Bernardino	Ventura
Alameda Corridor		$37,000				
Alhambra		$52,000			$44,000	
Cajon					$42,000	
Cima					$36,000	
Los Angeles		$53,000		$55,000	$44,000	
Mojave (UPRR)		$43,000			$51,000	
Mojave (BNSF)					$40,000	
Needles					$33,000	
Olive			$76,000			
Orange			$73,000			
Perris Valley				$45,000		
River (LAUS)		$38,000				
River East Bank		$42,000				
River West Bank		$37,000				
San Bernardino (San Bernardino to Fullerton Jct)			$84,000	$57,000	$47,000	
San Bernardino (Fullerton to Redondo Jct)		$55,000	$66,000			
San Gabriel		$51,000			$45,000	
Santa Barbara						$64,000
Valley		$57,000				
Ventura		$55,000				$82,000
Yuma	$21,000			$47,000	$55,000	
Redlands					$38,000	
County-wide Average	$43,000	$61,000	$82,000	$60,000	$56,000	$80,000

Source: Draft 2020 SCAG RTP/SCS, U.S. Census



Source: AECOM, 2021

Figure 4 Land Use (2016)



Source: Zillow 2020 Property Values. https://www.zillow.com/research/ztrax/.

Figure 5 Property Values (2020)

Source: AECOM, 2021

Figure 6 Median Income (2016)

2.1.2 Future Socio-economic Conditions

Demographic Analysis

The SCAG region is anticipated to grow by 3.6 million residents by 2045.[4] As shown in **Table 6**, the population within a half-mile of rail is expected to increase 26 percent and by a total of nearly 1.3 million residents, 36 percent of the total regional growth. Much of this growth will occur in LA County, with the population bordering the rail network expected to increase 22 percent from 2.5 million in 2016 to 3 million in 2045. This growth varies by county, between 16 and 175 percent, with the Yuma Subdivision in Imperial County seeing the largest percent growth and the Ventura County population expected to grow the least. **Figure 7** shows that the future population density, with much of the growth occurring adjacent to the rail network.

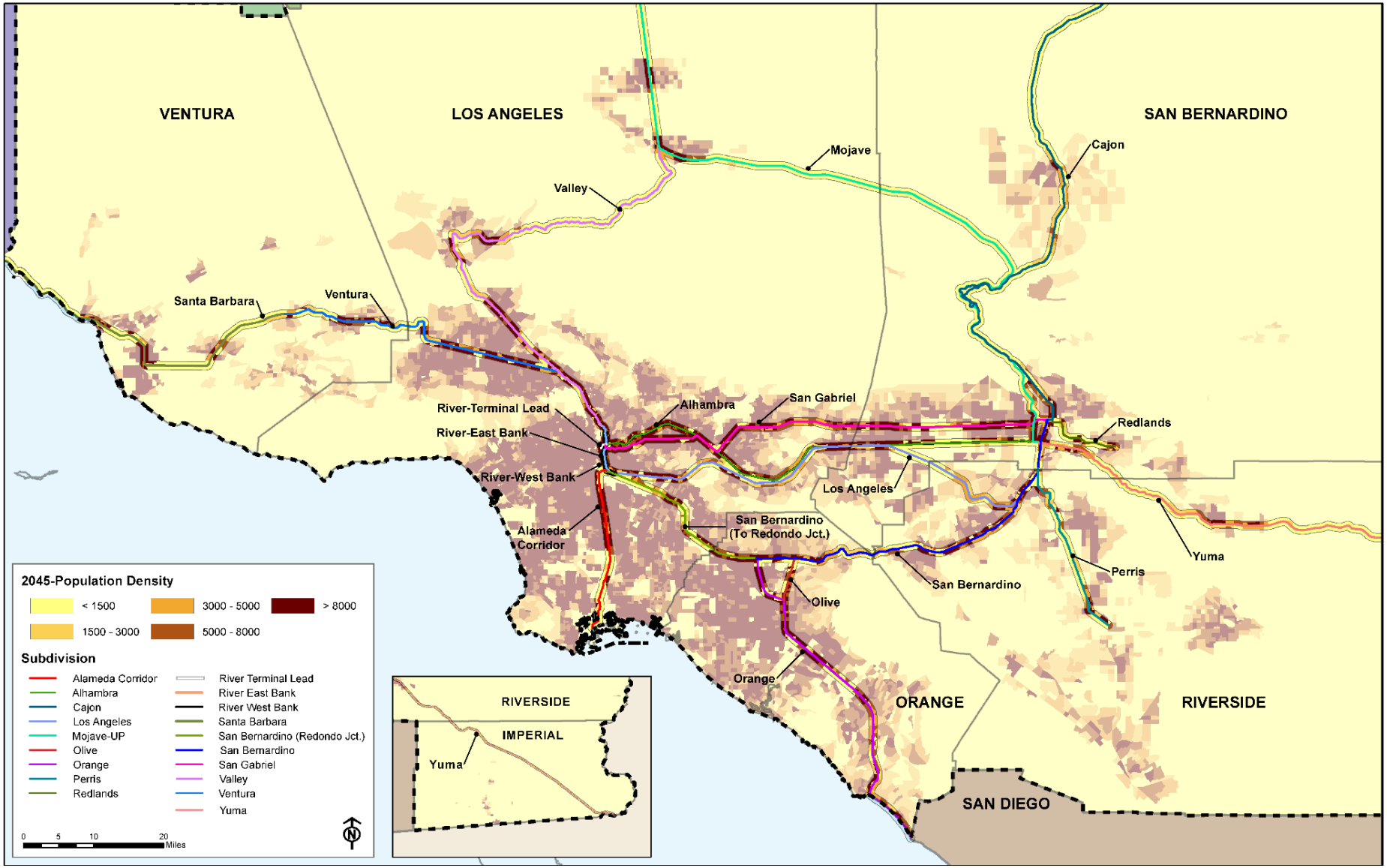
The highest growth is expected along the Riverside Subdivision near LAUS, which reflects the expected residential growth in the downtown Los Angeles region. Notably, the Perris Valley Subdivision and the Yuma Subdivision have amongst the highest anticipated growth, with an increase of 79 and 49 percent, respectively. Population growth is expected to occur along several of the existing freight lines with lower densities, including Cima and Needles Subdivision, highlighting the need to balance economic benefits and environmental impacts.

4 SCAG Connect SoCal “Who Are We Planning For?” Retrieved from https://scag.ca.gov/ready-2020

Table 6 Population and Population Density (2045)

	SCAG Pop.	Growth by Sub (2016-2045)	Imperial		Los Angeles		Orange		Riverside		San Bernardino		Ventura	
			Total Pop.	Pop. Per Sq. Mi	Total Pop.	Pop. Per Sq. Mi	Total Pop.	Pop. Per Sq. Mi	Total Pop.	Pop. Per Sq. Mi	Total Pop.	Pop. Per Sq. Mi	Total Pop.	Pop. Per Sq. Mi
Alameda Corridor	255,000	15%			255,000	10,559								
Alhambra	694,000	27%			478,000	11,950					216,000	8,000		
Cajon	204,000	23%									204,000	1,872		
Cima	3,000	50%									3,000	19		
Los Angeles	533,000	18%			328,000	8,478			107,000	6,688	98,000	8,604		
Mojave (UPRR)	276,000	39%			153,000	2,832					123,000	1,975		
Mojave (BNSF)	9,000	0%									9,000	213		
Needles	33,000	57%									33,000	156		
Olive	62,000	13%					62,000	9,524						
Orange	534,000	25%					534,000	10,604						
Perris Valley	172,000	77%							172,000	6,523				
River (LAUS)	54,000	69%			54,000	38,571								
River East Bank	126,000	27%			126,000	16,364								
River West Bank	109,000	82%			109,000	16,148								
San Bernardino (San Bernardino to Fullerton Jct)	457,000	22.5%					131,000	7,410	252,000	8,560	74,000	9,737		
San Bernardino (Fullerton to Redondo Jct)	219,000	14%			116,000	5,542	103,000	16,613						
San Gabriel	810,000	18%			509,000	12,854					301,000	10,910		
Santa Barbara	166,000	17%											166,000	3,245
Valley	613,000	23%			613,000	6,896								
Ventura	431,000	14.9%			331,000	13,341							100,000	5,316
Yuma	416,000	49%	11,000	102					331,000	2,961	74,000	5,736		
Redlands	80,000	27%									80,000	6,938		
TOTAL	6,256,000	25%	11,000	102	3,072,000	8,855	830,000	10,279	862,000	4,695	1,215,000	1,795	266,000	3,802
Growth by County (2016 - 2045)			**175%**	**175%**	**24%**	**24%**	**21%**	**21%**	**42%**	**42%**	**31%**	**31%**	**16%**	**16%**

**Analysis by subdivision is based on a half-mile buffer.*
Source: AECOM, 2021



Source: AECOM, 2021

Figure 7 Population Density (2045)

Employment

Future employment is an important consideration of economic impacts of rail and the conditions surrounding existing rail lines. Increasing employment densities allow for further mobility options, especially as proximity to rail services are closer. Employment projections are based on the SCAG Regional Growth Forecast developed for 2020 Connect SoCal. In raw numbers, LA County and San Bernardino County will have the highest growth in jobs while Riverside County is expected to see the greatest percent increase in employment (65 percent), as seen in **Table 7**. In 2045, more than 2 million jobs will be located within a half mile of rail subdivisions as compared to 1.7 million in 2016, a nearly 18 percent growth in employment. This compares to regionwide, employment growth of 19 percent over three decades. Figure 10 shows that the concentration of regional employment is similar to 2016, with more coverage falling into the highest density employment category.

The employment growth by subdivision mirrors the population growth trends discussed above with many of the lowest employment subdivisions increasing the most. Employment along the Mojave, Needles, and Perris Valley subdivisions are expected to see more than a doubling of employment. Employment along the Alameda Corridor and Olive Subdivisions is only expected to increase approximately 10 percent by 2045. Because more than two-thirds of the land use surrounding the Alameda Corridor is industrial, job growth may be a bit more limited, as there are land constraints for increasing employment capacity. The Olive Subdivision has very high employment density currently, potentially limiting the capacity for growth. Yet, this rate of growth may have implications for the Inland-Empire-Orange County Line that travels along the Olive Subdivision.

Income

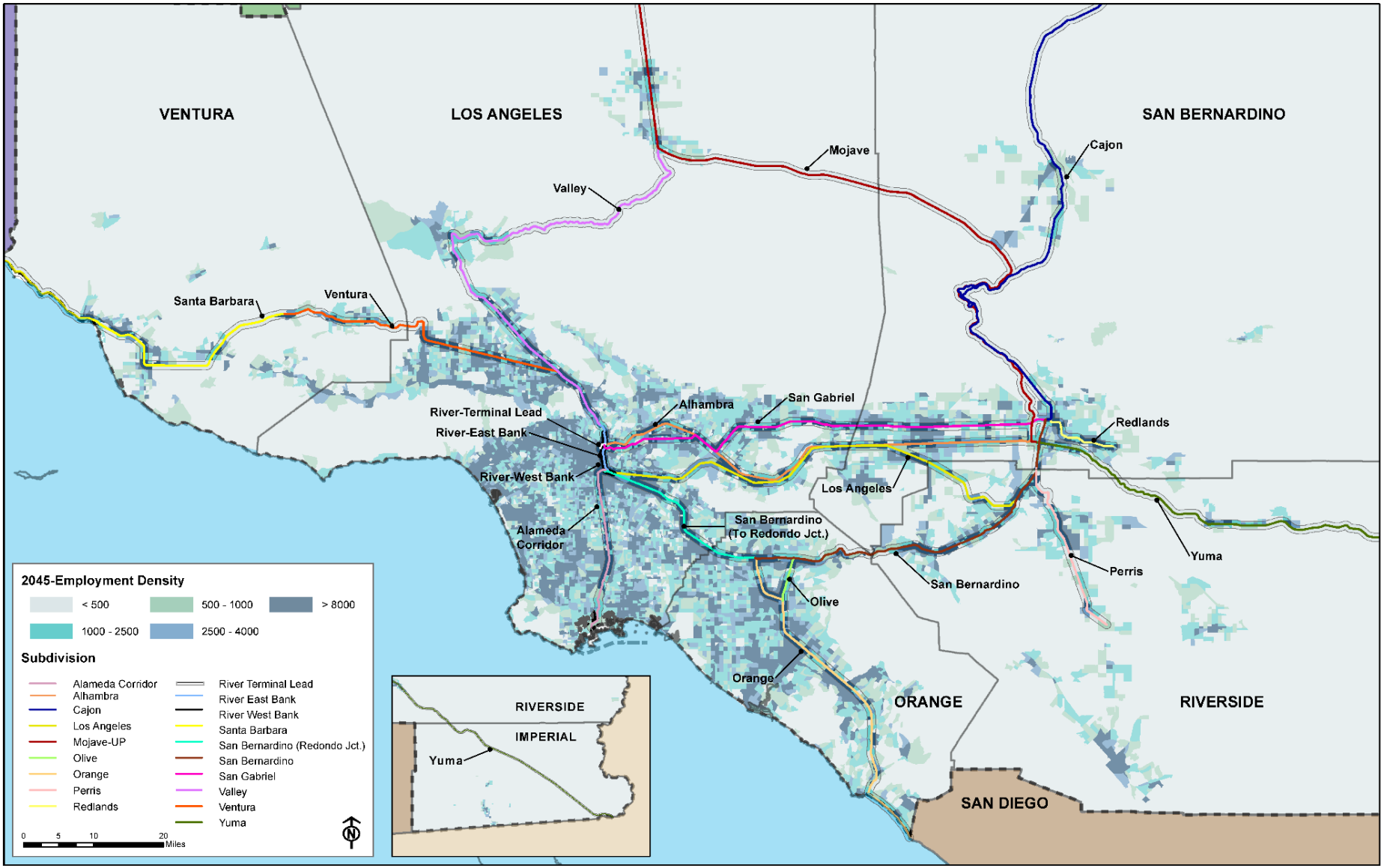
Median income growth is projected to vary considerably in the region and along the subdivisions, as shown in **Table 8**. Growth in median income is expected on almost all segments of the rail network in Riverside and San Bernardino Counties, while loss in median income near rail is expected on Orange County segments. Segments with the highest income growth, which range up to nine percent, include Perris Valley, Redlands, Alhambra, and Los Angeles Subdivisions. Significant income setbacks are anticipated along on the San Bernardino Subdivision in Orange County and the Yuma Subdivision in San Bernardino County.

Subdivisions with the highest adjacent populations and employment include the San Gabriel, Alhambra, Valley, Orange, Los Angeles, San Bernardino, Ventura, and Yuma. **Figure 8** shows employment density in the region in 2045, and **Figure 9** show median income in the region also in 2045.

Table 7 Employment and Employment Density (2045)

	SCAG	Growth by Sub (2016-2045)	Imperial		Los Angeles		Orange		Riverside		San Bernardino		Ventura	
			Total Emp.	Emp. per Sq. Mi	Total Emp.	Emp. per Sq. Mi	Total Emp.	Emp. per Sq. Mi	Total Emp.	Emp. per Sq. Mi	Total Emp.	Emp. per Sq. Mi	Total Emp.	Emp. per Sq. Mi
Alameda Corridor	149,000	15%			149,000	6,170								
Alhambra	442,000	27%			275,000	6,875					167,000	6,185		
Cajon	81,000	23%									81,000	743		
Cima	0											0		
Los Angeles	414,000	18%			263,000	6,798			57,000	3,563	94,000	8,253		
Mojave (UPRR)	83,000	39%			52,000	963					31,000	498	52	
Mojave (BNSF)	7,000	0%									7,000	166		
Needles	23,000	57%									23,000	109		
Olive	85,000	13%					85,000	13,057						
Orange	413,000	25%					413,000	8,201						
Perris Valley	129,000	77%							129,000	4,892				
River (LAUS)	79,000	69%			79,000	56,429								
River East Bank	111,000	27%			111,000	14,416								
River West Bank	134,000	82%			134,000	19,852								
San Bernardino (San Bernardino to Fullerton Jct)	359,000	22.5%					114,000	6,448	209,000	7,099	36,000	4,737		
San Bernardino (Fullerton to Redondo Jct)	238,000	14%			185,000	8,839	53,000	8,548						
San Gabriel	414,000	18%			259,000	6,540					155,000	5,618		
Santa Barbara	121,000	17%											121,000	2,366
Valley	315,000	23%			315,000	3,544								
Ventura	272,000	14.9%			219,000	8,827							53,000	2,818
Yuma	174,000	49%	2,000	19					109,000	975	63,000	4,884		
Redlands	116,000	27%									116,000	10,061		
TOTAL	4,159,000	25%	2,000	19	2,041,000	5,883	665,000	8,235	504,000	2,745	773,000	1,142	174,052	2,488
Growth by County (2016 - 2045)			**0%**	**0%**	**18%**	**18%**	**28%**	**28%**	**65%**	**65%**	**59%**	**59%**	**24%**	**24%**

*Analysis by subdivision is based on a half-mile buffer.
Source: AECOM, 2021



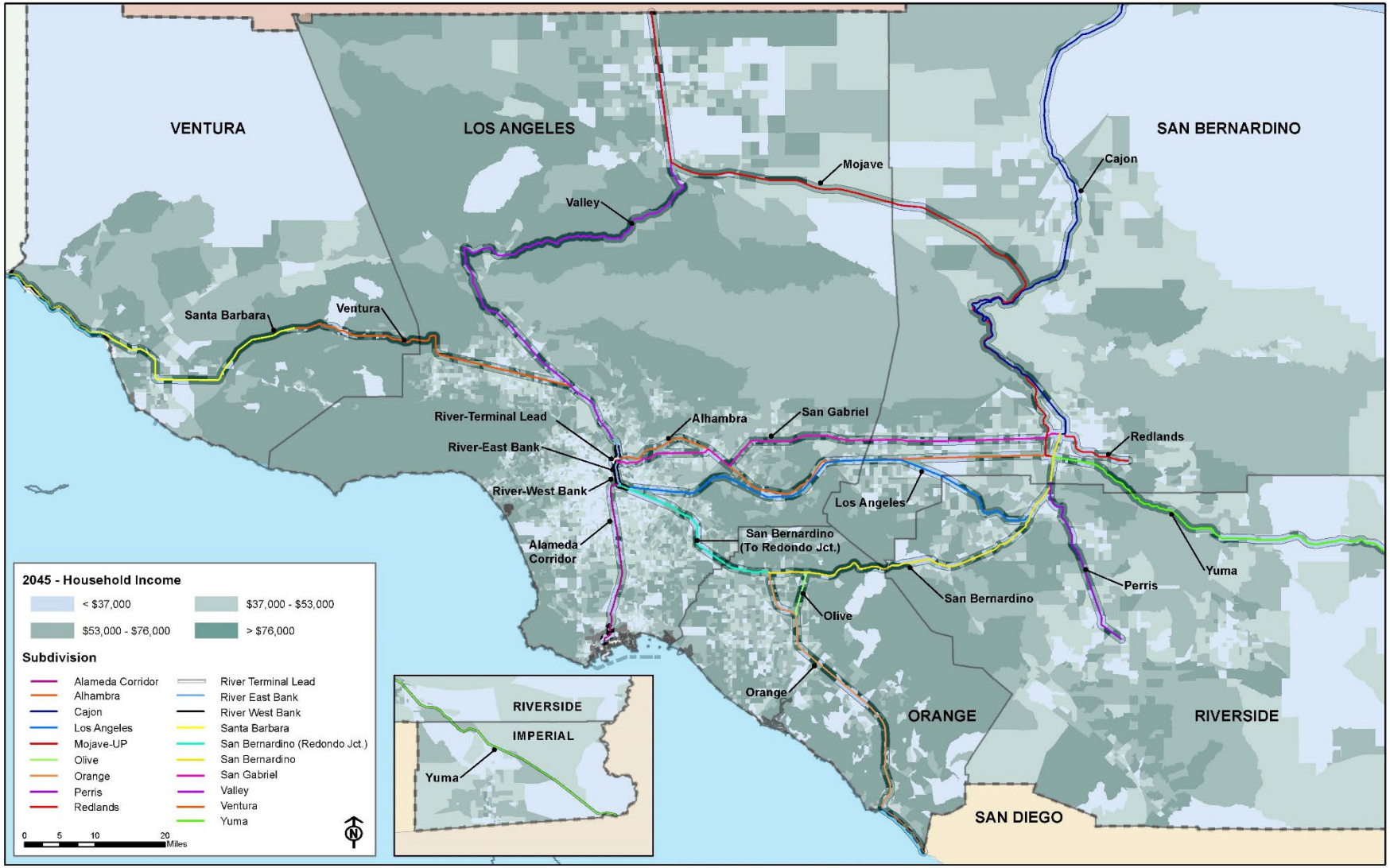
Source: AECOM, 2021

Figure 8 Employment Density (2045)

Table 8 Median Income (2045) and Percent Growth (2016 - 2045)

	Imperial		Los Angeles		Orange		Riverside		San Bernardino		Ventura	
	Med. Inc.	% Growth	Med. Inc.	% Growth	Med. Inc.	% Growth	Med. Inc.	% Growth	Med. Inc.	% Growth	Med. Inc.	% Growth
Alameda Corridor			$38,000	3%								
Alhambra			$52,000	0%					$46,000	5%		
Cajon									$41,000	-2%		
Cima									$36,000	0%		
Los Angeles			$52,000	-2%			$58,000	5%	$47,000	7%		
Mojave (UPRR)			$42,000	-2%					$52,000	2%		
Mojave (BNSF)									$41,000	3%		
Needles									$33,000	0%		
Olive					$74,000	-3%						
Orange					$71,000	-3%						
Perris Valley							$49,000	9%				
River (LAUS)			$38,000	0%								
River East Bank			$41,000	-2%								
River West Bank			$37,000	0%								
San Bernardino (San Bernardino to Fullerton Jct)					$80,000	-5%	$57,000	0%	$47,000	0%		
San Bernardino (Fullerton to Redondo Jct)			$57,000	4%	$64,000	-3%						
San Gabriel			$53,000	4%					$47,000	4%		
Santa Barbara											$66,000	3%
Valley			$57,000	0%								
Ventura			$56,000	2%							$82,000	0%
Yuma	$44,000	110%					$48,000	2%	$52,000	-5%		
Redlands									$40,000	5%		

Source: AECOM, 2021



Source: AECOM, 2021

Figure 9 Median Income (2045)

2.1.3 Socio-economic Conditions Summary

According to the 2020 Connect SoCal forecast, the population and employment adjacent to the integrated passenger and freight rail network in the SCAG region is forecasted to increase significantly between 2016 and 2045. As of 2016, more than 25 percent of the population in the SCAG region lives within a half-mile of Southern California's primary rail network. Even a higher percentage of jobs are located near rail lines, with more than one-third of jobs located within a half-mile of a rail line in 2016. By 2045, population and employment within half mile of the passenger/freight rail network is projected to increase by approximately one million each, an increase of 26 percent and 30 percent, respectively. In comparison, overall population growth in the SCAG region is expected to increase by 19 percent, while employment growth is projected at 20 percent (see **Table 9**).

Table 9 Population and Employment Growth (2016 - 2045)

	2016	2045	Growth
Population			
Within Half Mile of Rail Network	4,979,000	6,256,000	26%
Within SCAG Region	18,832,000	22,504,000	19%
Employment			
Within Half-Mile of Rail Network	3,196,000	4,159,000	30%
Within SCAG Region	8,389,000	10,049,000	20%

Source: AECOM, 2021

With growth projected to occur disproportionately within half mile of Southern California's rail network, the forecasted increase of more than a million additional residents along with nearly a million jobs within this proximity calls for a freight and passenger rail system that can efficiently absorb a significant increased traffic volume to meet regional mobility needs. The more readily residents have greater access to passenger rail service, the more the likelihood that they may consider multiple mobility options to use the service to access worksites and amenities throughout the region. Additionally, freight rail serves as a job generator throughout the region with freight-related jobs transcending a wide variety of workforce skill sets that are employed within many of the region's Port and rail facilities. With approximately one-third of all jobs being tied to freight, supporting workforce development throughout communities along these corridors is an important factor.

At the same time, there are negative impacts of living and/or working close to rail lines. By their very nature, rail operations and facilities create environmental impacts such as noise, vibration, increased emissions, and related health disparities. Noise and environmental pollution impact communities adjacent to rail lines to a higher degree than those located farther away. These impacts typically result in reduced property values immediately adjacent to the rail network, a trend that is clearly demonstrated along many of the key freight corridors as compared to the rest of the region. This makes these areas more affordable, but also places their residents at higher risk to these impacts.

The planning and design effort for implementing line capacity enhancement projects by the regional rail operators will need to take these factors into consideration. This will be especially the case over time as newer technologies may offer improved benefits with respect to noise and environmental pollution impacts, which will in turn will allow local jurisdictions to reassess planning and zoning approaches. In order for the region to remain economically competitive, it is vital for workforce development to remain at the forefront of

cutting-edge transitions as the industry shifts further towards more sustainable approaches to moving freight.

2.2 Existing Freight and Passenger Rail Networks and Operations

2.2.1 Existing Rail Operations and Infrastructure

Class I freight railroads BNSF Railway and Union Pacific Railroad provided freight services on several main lines in the SCAG region. These include, among others:

- **BNSF San Bernardino Subdivision**, between San Bernardino and Redondo Junction in downtown Los Angeles.
- **UP Alhambra Subdivision**, between West Colton and downtown Los Angeles.
- **UP Yuma Subdivision**, between West Colton and Indio.
- **UP Los Angeles Subdivision**, between West Riverside and downtown Los Angeles.
- **UP Santa Barbara Subdivision**, between Los Posas, Santa Barbara, and San Luis Obispo.

The region is also served by the Metrolink commuter rail system, operated by the Southern California Regional Rail Authority (SCRRA), on seven service lines:

- **Ventura County Line (VCL)**. This is the line between Burbank, Moorpark, Oxnard and Ventura. It is commonly known as the Coast Line. It is in public ownership from Burbank to Las Posas (just west of Moorpark). UP owns it from Las Posas to Oxnard, Ventura, Santa Barbara and SLO (i.e. the UP Santa Barbara Subdivision).
- **The Antelope Valley Line (AVL)**. This is also known as the Metrolink Valley Subdivision. It runs from CP Taylor (just outside downtown LA) to Burbank, Santa Clarita, Palmdale and Lancaster.
- **The San Bernardino Line (SBL).** This is the Metrolink San Gabriel Subdivision, which runs from just east of downtown at CP Pasadena Junction to El Monte, Claremont, Rancho Cucamonga, Rialto and San Bernardino.
- **Riverside Line (RIV).** This is the UP Los Angeles Subdivision.
- **Orange County Line (OCL).** This is a combination of track segments:
  - The River Subdivision from LAUS to Soto Street.
  - The BNSF San Bernardino Subdivision from Soto Street to Fullerton.
  - The Metrolink Orange Subdivision from Fullerton to Anaheim, Tustin, Laguna Niguel, San Juan Capistrano, San Clemente and the Orange County/San Diego County line.
- **The Inland Empire Orange County Line (IEOC).** This includes the BNSF San Bernardino Subdivision between San Bernardino, Riverside and Atwood, the Metrolink Olive Subdivision between Atwood and CP Maple, and the Metrolink Orange Subdivision been CP Maple and Laguna Niguel.
- **The 91 Line**. This includes:
  - The River Subdivision from LAUS to Soto Street (shared with the Metrolink Orange County Line).
  - The BNSF San Bernardino Subdivision from Soto Street to Fullerton and Highgrove.
  - **The Perris Valley Line (PVL).** This is a branch line running from just north of Riverside at Highgrove on the BNSF San Bernardino Line to Perris. It is an extension of the 91 Line. The original line extends to Hemet and San Jacinto.

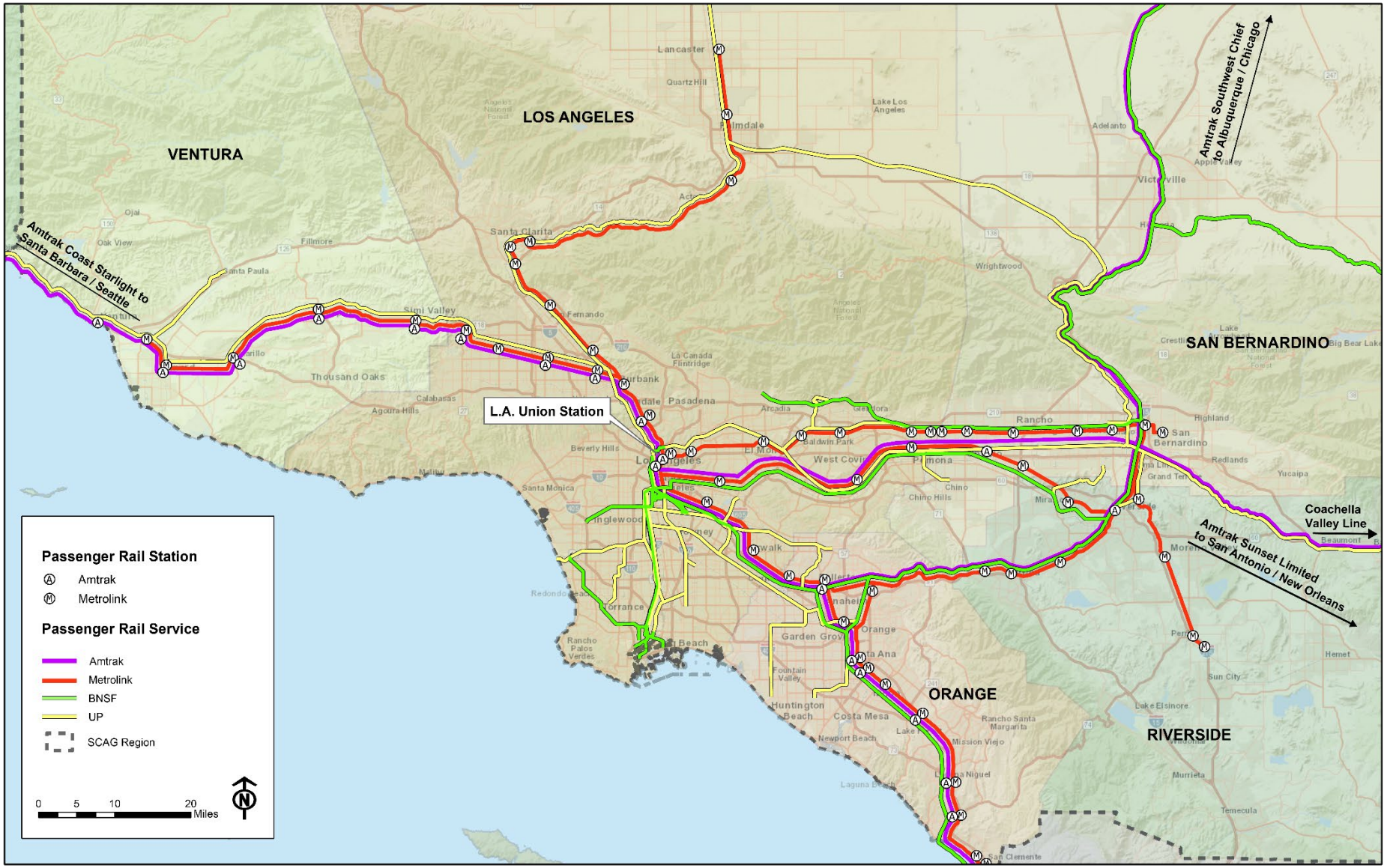
The *Pacific Surfliner* regional rail trains, operated by the Los Angeles-San Diego-San Luis Obispo Rail Corridor Agency (LOSSAN), runs between San Luis Obispo, Santa Barbara, LAUS, Anaheim, Laguna

Niguel, Oceanside and San Diego. These run on lines owned by BNSF and UP, as well as on lines owned by county transportation commissions.

Amtrak long-distance services (the daily *Southwest Chief*, the daily *Coast Starlight*, and the thrice weekly *Sunset Limited*) all terminate at LAUS. These passenger rail services operate in large part on lines that are owned and dispatched by freight railroads BNSF Railway (BNSF) and Union Pacific Railroad Company (UPRR) in the SCAG region.

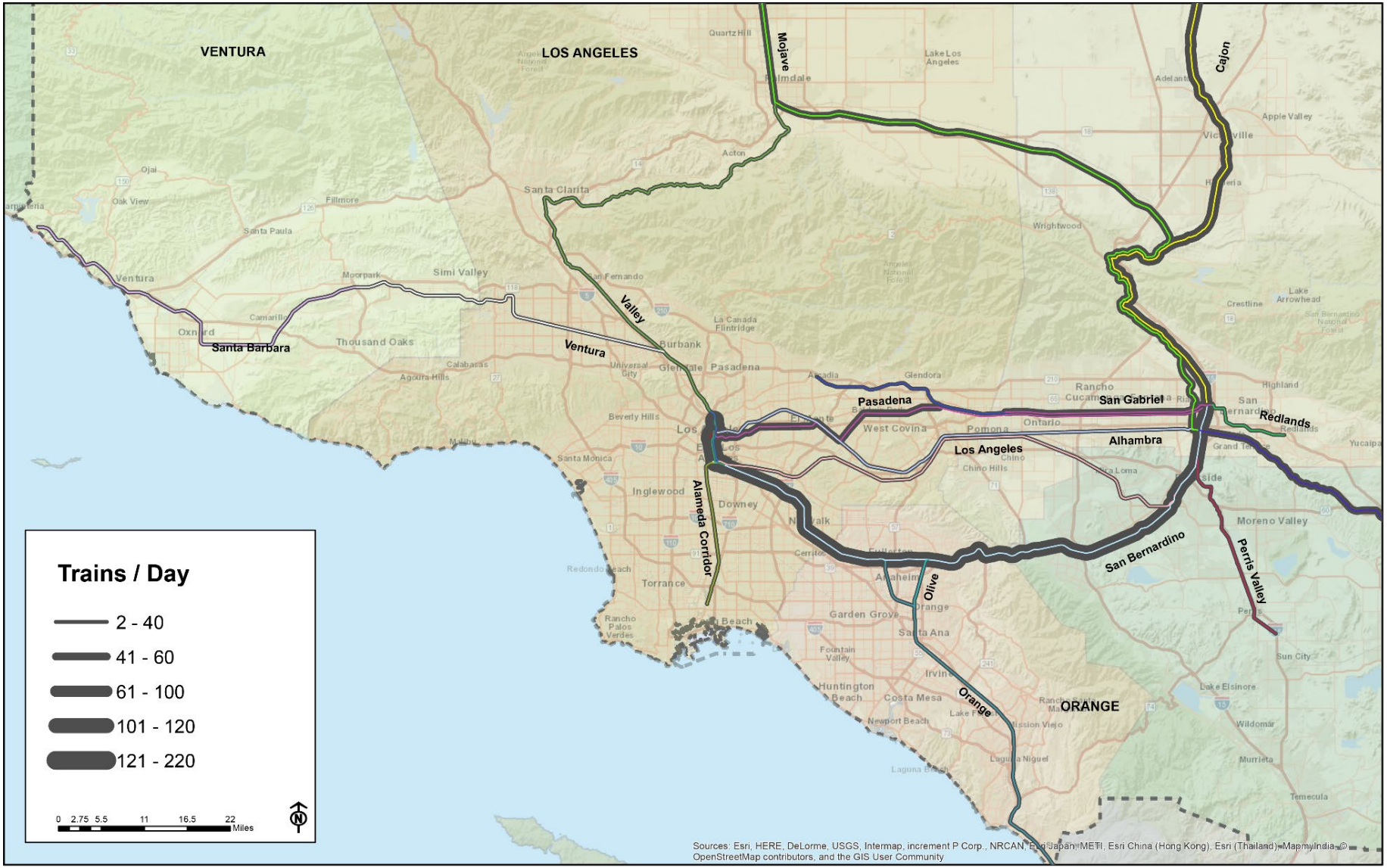
Figure 10 and **Figure 11** depict the existing passenger and freight rail operations and the level of operations of the main rail corridors (by trains per day).

The major main lines in the SCAG region consist of 194 route miles. These include lines that are owned by BNSF and UP, as well as by CTCs, including Los Angeles County Metropolitan Transportation Authority (LA Metro), Riverside County Transportation Commission (RCTC); San Bernardino County Transportation Authority (SBCTA) and Ventura County Transportation Commission (VCTC). The Alameda Corridor Transportation Authority (ACTA) owns and operates the high-capacity Alameda Corridor between the San Pedro Bay Port Complex and downtown Los Angeles.



Source: California State Rail Plan, 2018; AECOM, 2021

Figure 10 Existing Passenger and Freight Rail Operations Map



Source: California State Rail Plan, 2018; AECOM, 2021

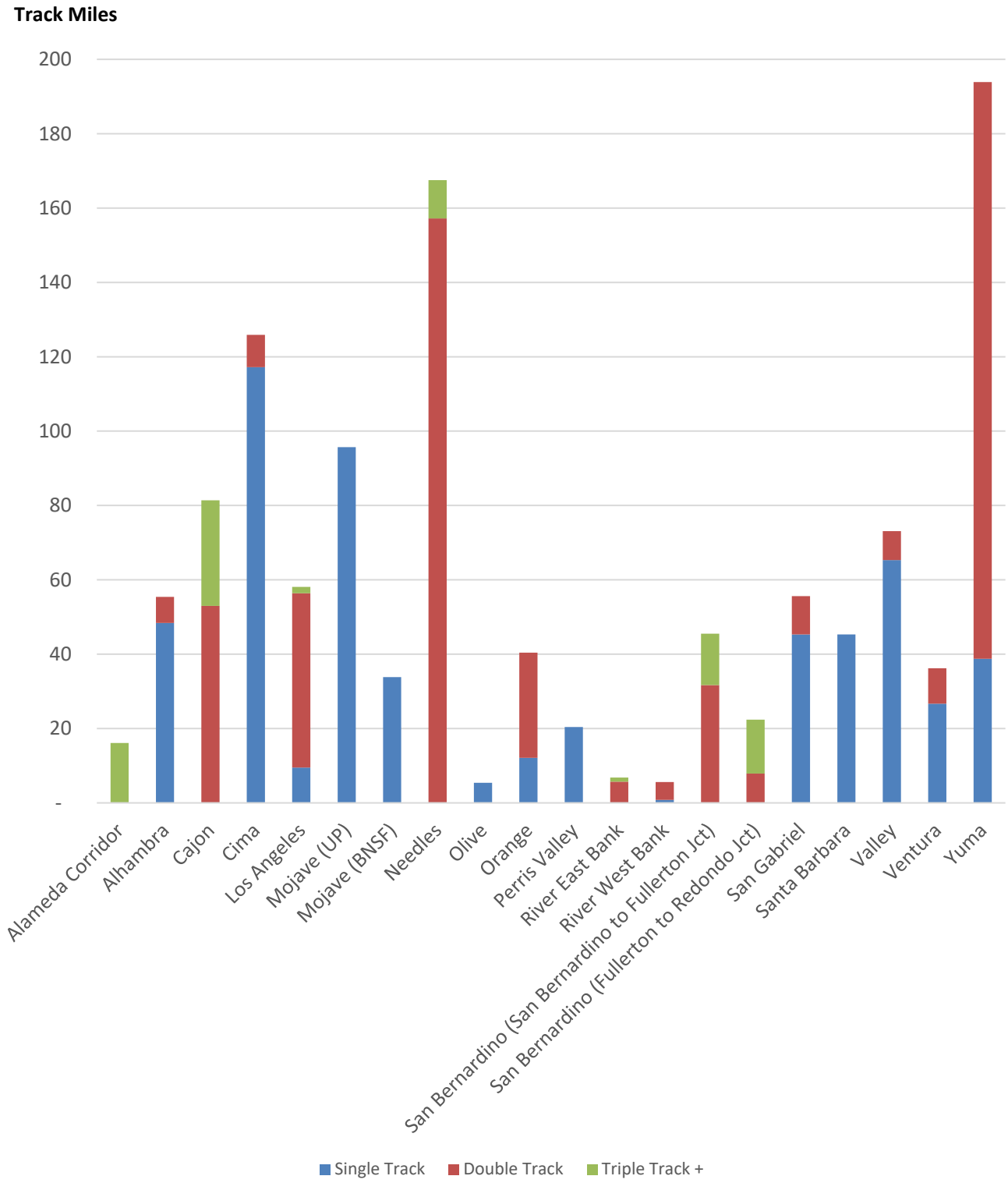
Figure 11 Existing Passenger and Freight Rail Volumes (Trains per Day)

Table 10 and **Figure 12** summarize the inventory and current utilization of capacity (if a line is at 100% of capacity, it is being fully utilized) of the integrated passenger and freight rail subdivisions.

Table 10 Existing Passenger and Freight Rail Network Summary

Subdivision	Type of Service	Rail Operators	Inventory				
			Single	Double	Triple	Route-Miles	Capacity
Alameda Corridor	Freight	UP, BNSF	-	-	16	16	42%
Alhambra	Freight/ Passenger	UP, Amtrak	48	7	-	55	43-61%
Cajon	Freight/ Passenger	BNSF, UP, Amtrak	-	53	28	81	55-97%
Cima	Freight	UP	117	9	-	126	26%
Los Angeles	Freight/ Passenger	UP, BNSF, Metrolink	10	47	2	58	56%
Mojave (UP)	Freight	UP	96	-	-	96	30-104%
Mojave (BNSF)	Freight	BNSF, UP	34	-	-	34	65%
Needles	Freight/ Passenger	BNSF, UP, Amtrak	-	157	10	168	79-90%
Olive	Passenger/ Freight	Metrolink, BNSF	5	-	-	5	72%
Orange	Passenger/ Freight	Metrolink, BNSF, UP, Amtrak	12	28	-	40	42-48%
Perris Valley	Passenger/ Freight	Metrolink, BNSF, UP	20	-	-	20	48%
River (LAUS)	Passenger/ Freight	Metrolink, BNSF, UP, Amtrak	Varies	Varies	Varies	1	31-38%
River East Bank	Passenger/ Freight	Metrolink, UP, Amtrak	-	6	1	7	31-38%
River West Bank	Passenger/ Freight	Metrolink, BNSF, Amtrak	1	5	-	6	76-119%
San Bernardino (San Bernardino to Fullerton Jct)	Freight /Passenger	BNSF, Metrolink, Amtrak	-	32	14	46	90-92%
San Bernardino (Fullerton to Redondo Jct)	Freight /Passenger	BNSF, Metrolink, Amtrak	-	8	15	22	53-88%
San Gabriel	Passenger/ Freight	Metrolink, UP, Metrolink, BNSF	45	10	-	56	87-100%
Santa Barbara	Freight/ Passenger	UP, Metrolink, Amtrak	45	-	-	45	74%
Valley	Passenger/ Freight	Metrolink, UP, Amtrak	65	8	-	73	114-121%
Ventura	Passenger/ Freight	Metrolink, UP, Amtrak	27	10	-	36	74-76%
Yuma	Freight	UP, Amtrak	39	155	-	194	43-45%

Source: AECOM



Source: AECOM, 2021

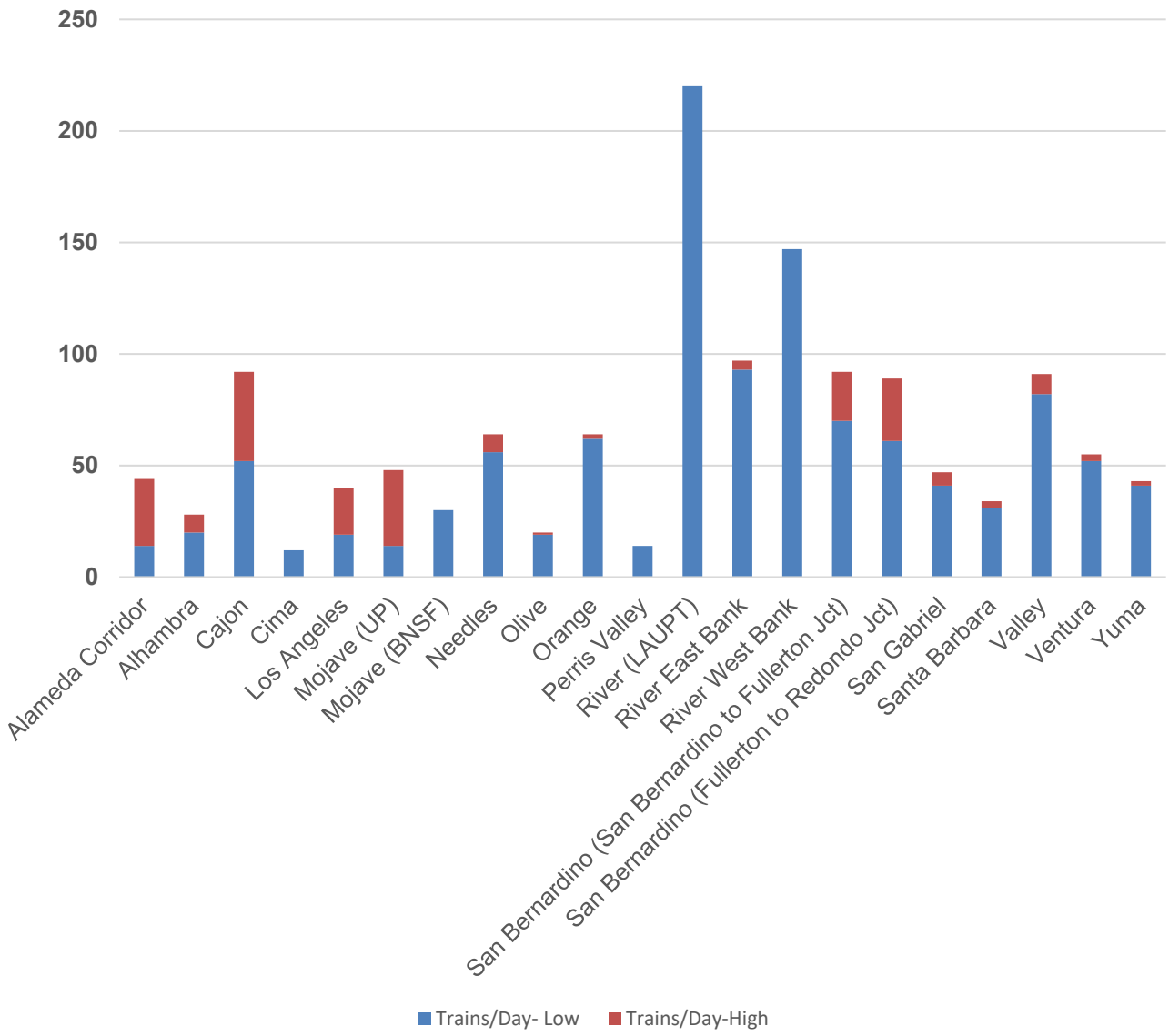
Figure 12 Existing Track Characteristics by Subdivision

Table 11 and **Figure 13** summarizes the daily number of trains that access each rail subdivision as well as which freight and passenger operators use those subdivisions:

Table 11 Existing Passenger and Freight Rail Operations Summary

Subdivision	Owner	Operations						
		BNSF	UP	Metro-link	Amtrak	Freight Trains/ Day	Passenger Trains/ Day	Total Trains/ Day
Alameda Corridor	ACTA	✓	✓			14-44		14-44
Alhambra	UP				✓	19-27	1	20-28
Cajon	BNSF		✓		✓	50 – 90	2	52-92
Cima	UP					12		12
Los Angeles	UP	✓		✓		7 – 28	12	19-40
Mojave (UP)	UP					14 – 48		14-48
Mojave (BNSF)	BNSF		✓			30		30
Needles	BNSF		✓		✓	54-62	2	56-64
Olive	OCTA	✓		✓		3-4	16	19-20
Orange	OCTA	✓		✓	✓	6-8	56	62-64
Perris Valley	RCTC	✓		✓		2	12	14
River (LAUS)	Metro	✓	✓	✓	✓	0	220	220
River East Bank	Metro		✓		✓	4 – 8	89	93-97
River West Bank	Metro	✓		✓	✓	0	147	147
San Bernardino (San Bernardino to Fullerton Jct.)	BNSF			✓	✓	32-54	38	70-92
San Bernardino (Fullerton to Redondo Jct.)	BNSF			✓	✓	7-35	54	61-89
San Gabriel	Metro/ SBCTA	✓	✓	✓		2-8	39	41-47
Santa Barbara	UP		✓	✓	✓	1-4	30	31-34
Valley	Metro		✓	✓	✓	3-12	79	82-91
Ventura	Metro/ VCTC		✓	✓	✓	3-6	49	52-55
Yuma	UP		✓		✓	40-42	1	41-43

Source: California State Rail Plan estimated total daily freight trains; Metrolink 2015 Map Book; Metrolink 2018 Map Book; AECOM, 2021
Note: Checkmarks indicate that the railroad operates trains on the subdivision via trackage rights.



Source: AECOM, 2021

Figure 13 Existing Trains per Day by Subdivision

Supporting main line rail operations are a variety of rail facilities. Major freight facilities include:

- Intermodal yards, serving both international and domestic container traffic. The yards are located on-dock (at ports), near dock, and in inland locations, such as near downtown Los Angeles (UP East Yard and Los Angeles Transportation Center, and BNSF Hobart Yard) and in the Inland Empire (BNSF San Bernardino Intermodal Facility).
- Traditional carload classification yards, where long-distance trains are assembled into shorter local trains for carloads delivery in the region. An example is the UP's West Colton Yard.
- Set-up auto facilities, where motor vehicles are moved on and off long-distance trains. These include the BNSF auto facility in San Bernardino and the UP Mira Loma auto facility in Jurupa Valley.

Passenger train facilities include major multimodal facilities such as Los Angeles Union Station, served by Metrolink commuter trains, LOSSAN *Pacific Surfliner* regional trains, and Amtrak long-distance trains, as

well as by other regional multimodal and smaller local stations. The passenger services have maintenance and support facilities in Los Angeles and San Bernardino.

2.2.2 Supplemental Freight Train Counts

Freight train movements were collected during the summer of 2021 at five SCAG area locations to better understand freight train traffic along main lines and at major rail facilities. Summaries of findings at each location appear below. Domestic versus international categorizing, was distinguished solely by equipment relationships. For example, international containers range from 20-foot to 48-foot dimensions generally, while domestic intermodal containers are strictly 53-foot, as well as transferred by trailers on flat cars (TOFCs).

Loma Linda, UP Yuma Subdivision

Data collection occurred for eight days, from July 23 to July 30. Data was collected at Beaumont Avenue. An average of 28 trains per day was recorded, of which 52 percent were westbound and 48 percent eastbound. Train types were intermodal at 59 percent, non-intermodal or carload trains at 35 percent, and auto carrier trains at 6 percent. Of the intermodal trains 79 percent were domestic, and 21 percent were international.

Palmdale, UP Mojave Subdivision and Metrolink Valley Subdivision

Data collection occurred for seven days, from July 25 to July 31. There were two locations: one at Serra Highway to capture trains on the Antelope Valley Line, and the other at 10th Street East to capture trains on the UP Mojave Subdivision, aka the Colton Cutoff. Data collected at Serra Highway captured an average of one train per day, exclusively intermodal domestic. On the Colton Cutoff there was an average of seven trains per day, of which 13 percent were intermodal trains and 88 percent non-intermodal carload trains (difference from 100 percent of total trains is due to rounding).

Jurupa Valley, UP Mira Loma Set-up Auto Facility and UP Los Angeles Subdivision

Data collection occurred for eight days, from July 23 to July 30. There were two locations: one at Etiwanda Avenue to capture trains going in and out of the UP Mira Loma auto facility; and the other just south of Limonite Avenue along the UP Los Angeles Subdivision. Data collected at Etiwanda Avenue captured an average of eight trains per day, all auto carrier trains. Data collected south of Limonite Avenue captured an average of 17 trains per day, consisting of 64 percent intermodal, 23 percent non-intermodal carload trains, and 13 percent auto carrier trains. Of the intermodal trains 77 percent were domestic, and 23 percent were international.

Colton, UP West Colton Yard, UP Alhambra and Mojave Subdivisions

Data collection occurred for seven days, from August 8 to August 16. There were five locations. These were, from west to east:

- Serra Avenue, capturing trains going east and west on the UP Alhambra Subdivision and into and out of Colton Yard (west end);
- South Pepper Avenue, capturing trains going east and west on the UP Yuma Subdivision and into and out of Colton Yard (east end);
- Just east of South Pepper Avenue and south of I-10, capturing trains on the north-south UP Mojave Subdivision;
- West Valley Boulevard, capture trains moving between the Yuma Subdivision and the BNSF San Bernardino Sub in the northwest quadrant of Colton Crossing; and,

- Southeast quadrant of Colton Crossing, capturing trains moving between the Yuma Subdivision and the BNSF San Bernardino Subdivision.

At Serra Avenue, the west end of Colton Yard, an average of 14 trains per day were recorded, of which 86 percent were non-intermodal carload trains, 13 percent intermodal trains, and one percent auto carrier trains. At South Pepper Avenue, the east end of the yard, there was an average of 24 trains per day were recorded, of which 64 percent were non-intermodal carload trains, 34 percent intermodal trains, and 2 percent auto carrier trains; these included trains going to and from the UP Mojave Subdivision east of South Pepper Avenue and the BNSF San Bernardino Subdivision in the northwest quadrant of Colton Crossing. It was presumed that the vast majority of carload trains recorded at Serra Avenue and South Pepper Avenue operated in and out of Colton Yard, while intermodal and auto carrier trains bypassed the yard.

In the southeast quadrant of Colton Crossing, UP trains going between the BNSF San Bernardino Subdivision and the UP Yuma Sub averaged 14 trains per day, consisting of 63 percent intermodal trains, 20 percent non-intermodal carload trains, and 17 percent auto carrier trains. The intermodal trains were 87 percent domestic and 13 percent international.

San Bernardino, BNSF Intermodal and Set-up Auto Facilities and San Bernardino and Cajon Subdivisions

Data collection occurred here for seven days, from August 15 to August 21. There were four filming locations. These were, from north to south:

- West 5th Street, capturing trains operating in and out of the BNSF intermodal facility in San Bernardino;
- North Rancho Avenue, capturing movements in and out of a hopper facility just west of North Rancho Avenue and to and from the SCRRA San Gabriel Subdivision;
- West Rialto Avenue, capturing trains operating in and out of the BNSF auto facility.
- West Valley Boulevard (Colton), capturing trains on the BNSF San Bernardino Subdivision south of San Bernardino.

Recordings showed the following average daily train movements:

- 2 auto carrier trains in and out of the BNSF auto facility south of West Rialto Avenue;
- 5 trains in and out of the hopper facility and to and from the San Gabriel Subdivision at North Rancho Avenue;
- 24 trains in and out of the San Bernardino intermodal facility, as noted at West 5th Street;
- 60 trains to and from Cajon Pass, as noted at West 5th Street, with most of trains being intermodal trains;
- 44 trains to and from Los Angeles, as noted at West Valley Boulevard, with most trains being intermodal trains.

2.3 Planned Improvements for Freight and Passenger Rail

2.3.1 Planned Facilities and Equipment

Metrolink's SCORE Program

Metrolink's Southern California Optimized Rail Expansion (SCORE) Program invests in capital improvements to enhance the capacity of the regional rail system towards the Summer 2028 Olympic and Paralympic Games. The foundational elements of the program include track additions, crossing and signal

improvements, and an expanded and lower emission fleet. These investments will transform Southern California regional rail by supporting more reliable and frequent service throughout the entire day.

SCORE's vision for the future of the Southern California rail system is to enhance mobility options and connect affordable housing and job centers, add tracks, provide consistent train service in both directions, add rehabilitate maintenance centers to keep trains running, protect dedicated tracks for freight service, and upgrade rail grade crossings. The program is expected to have significant economic benefits including 1.36 million jobs created over the 32- year forecast period. To accomplish this vision and deliver on the economic benefits, SCORE relies on a partnership between Metrolink, the LOSSAN Agency, California High-Speed Rail Authority, and BNSF.

The projects identified as part of the SCORE program is divided into three phases. Phase One ("Early Completion") projects would be completed by 2023, and Phase Two ("Mid-Term") would be completed by 2028. Phase 1 and 2 projects include line capacity enhancements, line reliability enhancements, maintenance facilities, grade separation projects, and the concurrent Link Union Station (Link US) project. Phase Three does not have any identified projects but aims to address any future needs beyond 2028.

- **Phase 1: Early Completion (by 2023)**

  At least every 30-minute directional peak service on Ventura County and San Bernardino Lines, increased service on Orange County, the 91-Perris Valley Line, and possibly Inland Empire / Orange County Line (IEOC). The enhanced option also includes an off-peak service level of two trains per hour per direction on Ventura County, San Bernardino, and Orange County lines.

- **Phase 2: Mid-Term (2028)**

  Commuter rail service with headways of 30-minutes bidirectional, all day for all seven lines.

- **Phase 3: Long-Term Plans (Post 2028)**

  Commuter rail service with headways of 30-minutes bidirectional, all day, for Metrolink for all lines. Service every 15-minutes on core segments of Ventura County, Orange County, and Antelope Valley lines. Improvement plans would also accommodate hourly service for LOSSAN *Pacific Surfliners* as well as blended service with CA HSR.

The rail simulation conducted in this Study found that many projects intended to be completed as part of SCORE Phases 1 and 2 could be completed by 2035 and still enable desired service levels.

Table 12 lists all of the SCORE projects along with the years which the rail simulation requires these projects for trains to operate fluidly on the model network. The years identified for the projects in the SCORE program is also noted.

Source: AECOM, 2021

Figure 14 Future SCORE Program Map

Table 12 SCORE Program Projects[5]

Project #	Project Name	Subdivision	SCORE Plan		Revised Per Model		Notes
			Track Length (miles)	Year in Service	Track Length (miles)	Year in Service	
Line Capacity Enhancements (Phase 1)							
1	Marengo Siding Extension:	San Gabriel	0.75	2028	0.75	2028	Extension of existing siding
2	El Monte Station Ped Improvements and Siding Extension	San Gabriel	0.6	2028	0.6	2028	Extension of existing siding
3	Double Track CP Central to East of Upland Station	San Gabriel	2.5	2028	2.5	2035	Existing 1 track, future 2 tracks. Shared freight/passenger
4	Rancho Siding Extension from MP 39.2 to CP Archibald	San Gabriel	0.9	2028	0.9	2028	Extension of existing siding
5	CP Lilac to Rialto Station Double Track	San Gabriel	0.5	2028	0.5	2035	Existing 1 track, future 2 tracks. Shared freight/passenger
6	Signal Respacing at Marengo to Hondo	San Gabriel	-	2028	-	2035	
7	Signal Respacing at Bassett to Vista	San Gabriel	-	2028	-	2035	
8	Signal Respacing at Kaiser to Vernon	San Gabriel	-	2028	-	2035	
9	Signal Respacing from Central to Nolan	San Gabriel	-	2028	-	2035	
10	Signal Respacing from Colonia to Burbank	Ventura	-	2028	-	2035	
11	Simi Valley Double Track and Platform:	Ventura	2.2	2028	2.2	2028	Existing 1 track, future 2 tracks. Shared freight/passenger
12	Chatsworth Station and Signal Improvements	Ventura	-	2028	-	2035	
13	Acton Double Track	Valley	2	2028	2	2035	Existing 1 track, future 2 tracks. Shared freight/passenger
14	Vista Canyon Station and Siding, including station design	Valley	1	2028	1	2028	Allowance of 1 mile - new siding
15	Santa Clarita Double Track from CP Lang to CP Canyon	Valley	6.5	2028	0.8	2028	Existing 1 track, future 2 tracks. Shared freight/passenger
16	Balboa Siding Extension and Speed Improvements	Valley	1.2	2028	1.7	2028	Extension of existing siding
17	Brighton to Roxford Double Track	Valley	11	2028	3.6	2028	Existing 1 track, future 2 tracks. Shared freight/passenger
18	Burbank Junction Speed Improvements	Valley		2028	-	2035	
19	Signal Respacing from Lancaster to McGinley	Valley		2028	-	2035	

[5] Projects 31 and 34 have received funding from CHSRA, and projects 30 and 32 may also receive funding from CHSRA.

Project #	Project Name	Subdivision	SCORE Plan		Revised Per Model		Notes
			Track Length (miles)	Year in Service	Track Length (miles)	Year in Service	
20	Signals in Orange County (Atwood—Orange)	Orange		2028	-	2035	
21	Reconfigure Irvine Station and add 3rd Track	Orange	0.8	2028	0.8	2035	Existing 2 tracks, future 3 tracks. Shared freight/passenger
22	Signal Respacing: La Palma to College	Orange		2028	-	2035	
23	Signal Respacing: Maple to Solow	Orange		2028	-	2035	
24	Signals in OC (Avery—Songs)	Orange		2028	-	2035	
25	Orange/Olive Junction and Wye	Orange		2028	-	2035	
26	CP Songs to San Mateo Creek	Orange		2028	-	2035	
27	CMF Tail Track North End Connector	Valley	0.13	2028	0.13	2035	
28	Signal Improvements Burbank to LA	Valley		2028	-	2035	
29	LA—SB Dedicated Passenger Corridor: Hobart through Commerce	San Bernardino	20	2028	20	2035	Project included in BNSF Improvements. Existing 3 tracks, future 4 tracks. Shared freight/passenger.
30	LA—SB Dedicated Passenger Corridor: Hobart Yard Relocation	San Bernardino		2028	-	2035	Project included in BNSF Improvements.
31	Rosecrans/Marquardt Grade Separation	San Bernardino		2028	-	2035	Project included in BNSF Improvements.
32	LA—SB Dedicated Passenger Corridor: Fullerton Jct. Reconfiguration	San Bernardino		2028	-	2035	Project included in BNSF Improvements. Various track additions to reconfigure Junction.
33	Riverside Downtown Track and Platform Improvements	Perris Valley Line		2028	-	2035	
LINK Union Station (Phase A)							
34	Link US Phase A	River West Bank	1	2028	1	2028	Two run-through tracks.
Line Reliability Enhancements							
35	Lone Hill Avenue to CP White Double Track	San Gabriel	3.85	2028	3.85	2035	
36	Rialto Station to CP Rancho Double Track	San Gabriel	2.4	2028	2.4	2035	
37	Raymer to Bernson Double Track	Ventura	6.4	2028	6.4	2035	
38	Moreno Valley/March Field Station and Track Upgrades	Perris Valley	-	2028	-	2035	
Maintenance Facilities (Phase 1)							
39	Irvine Maintenance Facility—Phase 1	Orange	0.1	2028	0.1	2035	

Project #	Project Name	Subdivision	SCORE Plan		Revised Per Model		Notes
			Track Length (miles)	Year in Service	Track Length (miles)	Year in Service	
40	Eastern Maintenance Facility Buildout	San Bernardino	-	2028	-	2035	
41	Santa Clarita Area Maintenance Facility Environmental, Design, and Property	Valley	2.7	2028	2.7	2035	
42	Lancaster Outlying Point Storage Tracks, and Design for Maintenance Facility	Valley	0.8	2028	0.8	2035	
43	Moorpark Area Maintenance Facility Environmental, Design, and Property	Ventura	1	2028	1	2035	
44	East Ventura Area Maintenance Facility Environmental, Design, and Property	Santa Barbara	-	2028	-	2035	
45	South Perris Light Maintenance Facility Environmental, Design, and Property	Perris Valley	2.7	2028	2.7	2035	
Grade Separation Projects (Phase 1)							
46	Doran Street and Broadway/Brazil Grade Separation	Valley	-	2028	-	2035	
47	Etiwanda Ave Grade Separation	San Gabriel	-	2028	-	2035	
Complementary System Enhancement Projects							
48	I-10 Express Bypass Study	San Bernardino	-	2028	-	2035	
49	Perris Valley Line Service Improvement and Capacity Study	Perris Valley	-	2028	-	2035	
50	Ventura County Line Service Improvement and Capacity Study	Santa Barbara	-	2028	-	2035	
51	Riverside Line Service Improvement and Capacity Study	UP Los Angeles	-	2028	-	2035	
52	Ontario Airport Connection	UP Los Angeles	-	2028	-	2035	
Line Capacity Enhancements (Phase 2)							
53	Moorpark to Simi Valley Double Track, and replace Arroyo Simi Bridges	Ventura	3.7	2035	3.7	2035	
54	New Siding between Tunnels 27 and 28	Ventura	0.6	2035	0.6	2035	
55	Palmdale to Lancaster Double Track:	Valley	8.6	2035	8.6	2035	
56	Double Track CP Ravenna to Russ	Valley	5.6	2035	5.6	2035	
57	Double Track between CP Saugus and CP Hood	Valley	2.2	2035	2.2	2035	
58	Orange—Olive Junction Improvements and Wye	Orange	-	2035	-	2035	
59	Third Track between Tustin area and Laguna Niguel Area	Orange	13	2035	13	2035	

Project #	Project Name	Subdivision	SCORE Plan		Revised Per Model		Notes
			Track Length (miles)	Year in Service	Track Length (miles)	Year in Service	
60	Double Track CP Songs to San Mateo Creek Lagoon	Orange	1.3	2035	1.3	2035	
61	Perris Valley Line—Second Main Track	Perris Valley	6.2	2035	6.2	2035	
62	3rd Main Fullerton to San Bernardino: Prado Dam to San Bernardino	San Bernardino	46	2035	46	2035	Project included in BNSF Improvements. Existing 2 tracks, future 3 tracks. Shared freight/passenger.
62	LA—SB Dedicated Passenger Corridor: 3rd Main Track on the BNSF SB route	San Bernardino	10	2035	10	2035	Project included in BNSF Improvements. Existing 2 tracks, future 3 tracks. Shared freight/passenger.
LINK Union Station (Phase B)							
63	Link US Phase B	River West Bank	0.5	2035	0.5	2035	10 Run-thru tracks
Maintenance Facilities (Phase 2)							
64	Santa Clarita area Maintenance Facility Buildout	Valley	-	2035	-	2035	
65	Lancaster Outlying Point Storage Tracks, and Maint. Facility	Valley	-	2035	-	2035	
66	Moorpark Area Maintenance Facility Buildout	Ventura	-	2035	-	2035	
67	South Perris Light Maintenance Facility Buildout	Perris Valley	-	2035	-	2035	
Grade Separation Projects (Phase 2)							
68	Pioneer Blvd Grade Separation	San Bernardino	-	2035	-	2035	
69	Norwalk Blvd/Los Nietos Road Grade Separations	San Bernardino	-	2035	-	2035	
Unmapped							
70	Siding between Tunnels 27 & 28 (MP 443.8-443.24)	Ventura	0.56	2035	0.56	2035	
71	Double Track Palmdale to Lancaster (MP 76.2-67.6)	Valley	8.6	2035	8.6	2035	
72	Double Track Ravenna to Russ (MP 52.45-47.0)	Valley	5.45	2035	5.45	2035	
73	Design for 4th main track on west end Pico Rivera to Santa Fe Springs	San Bernardino	4.5	2035	4.5	2035	Project included in BNSF Improvements.

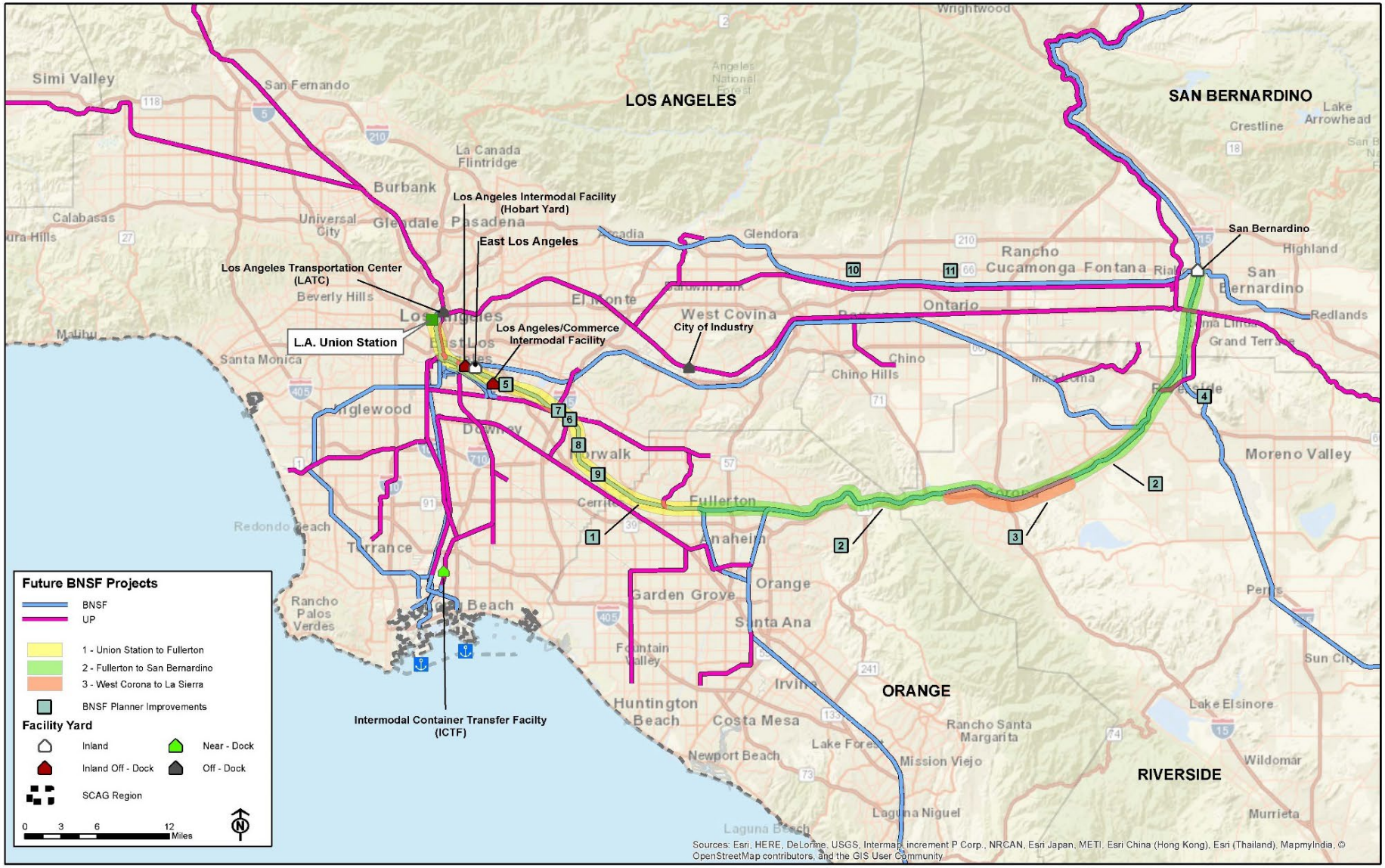
Project #	Project Name	Subdivision	SCORE Plan		Revised Per Model		Notes
			Track Length (miles)	Year in Service	Track Length (miles)	Year in Service	
							Existing 3 tracks, future 4 tracks. Shared freight/passenger.
74	Systemwide Rolling Stock/Fleet	All	-	2035	-	2035	
75	4th Main on East End: Santa Fe Springs to Basta	San Bernardino	12	2035	12	2035	Project included in BNSF Improvements. Existing 3 tracks, future 4 tracks. Shared freight/passenger.
76	LAUS Signal Upgrades:	N/A	-	2035	-	2035	
77	Level Boarding Platform Study, Location TBD		-	2035	-	2035	
78	Systemwide Electrification Study and Rail Fleet Upgrades		-	2035	-	2035	
79	Systemwide Higher Reliability/Capacity Train Control		-	2035	-	2035	
Additional SCORE Projects Required Per Modeling							
80	Project X.1: Extension, second main track, Laguna Niguel (CP Avery) to CP Trabuco		NA	NA	1.8	2035	
81	Project X.2: Extension, second main track, Santa Clarita to CP Honby - SCORE		NA	NA	4.4	2035	
Total Metrolink Added Track per SCORE			199		193		Route-Miles

Source: AECOM, 2021

BNSF Improvements

In October 2017 BNSF Railway identified the following projects as required mitigation for hosting expanded Metrolink and LOSSAN service as well as HSR on its San Bernardino Subdivision. The projects were enumerated in a letter to Brian Kelly, then Secretary of the California State Transportation Agency (CalSTA).

- Four (generally) dual-use passenger/freight main tracks between Control Point Soto, west of Los Angeles Union Station, and Fullerton in a right-of-way that currently accommodates a three-track mainline railroad. The four-track configuration will allow for the segregation of passenger and freight trains in this segment and facilitate more fluid operations.
- Three main tracks between Fullerton and San Bernardino in a right-of-way that currently accommodates primarily a two- and three-track mainline railroad. This project will enhance the capacity of the mainline for more fluid freight and passenger operations.
- A fourth main track (passing track) between the La Sierra passenger station and the West Corona passenger station. This project will enhance the capacity of the main line for more fluid freight and passenger operations.
- Yard, staging and support tracks to replace-in-kind at other locations tracks which will be lost if the SCORE plan is to be accommodated. This project will ensure that the capability of BNSF to provide its existing level of freight service is maintained.
- Terminal capacity and connectivity to replace similar capabilities and capacities at BNSF's Hobart and Commerce intermodal facilities. This project will ensure that the capability of BNSF to provide its existing level of freight service is maintained.
- Staging tracks for BNSF freight trains in the Barstow area to facilitate planned project-related construction windows. This project will ensure that the capability of BNSF to provide its existing level of freight service is maintained during construction of improvements on the San Bernardino Subdivision.
- Signal spacing reduced to 1.25 miles. This project will enhance the capacity of the San Bernardino Subdivision to handle higher freight and passenger train volumes.
- Crossovers placed at a minimum of every six miles, but no more than every eight miles. This project will enhance the capacity of the San Bernardino Subdivision to handle higher freight and passenger train volumes.
- The separation of all rail/highway at-grade crossings between L.A. Union Station and Fullerton. There are five at-grade crossings at: Pioneer Boulevard, Norwalk Boulevard, Los Nietos Road, Lakeland Road, and Rosecrans/Marquardt Avenue; all crossings are in Santa Fe Springs. This project will minimize the potential for delay to freight and passenger trains by eliminating the potential for highway-rail accidents and incidents at these crossings.
- Intermodal capacity and related lead tracks east of Riverside. This project will ensure that the capability of BNSF to provide its existing level of freight service is maintained. **Figure 15** and **Table 13** summarize the planned improvements for BNSF.



Source: AECOM, 2021

Figure 15 Future BNSF Projects

Table 13 BNSF Improvements Program Projects

Project #	Project Name	Subdivision	Adding Track to Existing ROW		Year in Service
			Triple or More Tracking (Adding 1 track to double track)	Sidings	
Line Capacity Enhancements					
1	Soto to Fullerton Depot- Add 1 Main Track for a total of 4 Main Line Tracks	San Bernardino	20.4		2030/2040
2	Fullerton Depot to San Bernardino- Add 1 Main Track for a total of 3 Main Line Tracks and replacement of existing sidings	San Bernardino	46		2030/2040
3	Passing Siding between West Corona to La Sierra	San Bernardino		9.1	2030/2040
4	Intermodal capacity and related lead tracks east of Riverside	San Bernardino			2030/2040
Maintenance Facilities					
5	Hobart/Commerce Intermodal Facility: 1.Capital expansion –production tracks, wide-span cranes, stacking cranes 2.Operational improvements through optimization –route trucks through facility based on real-time congestion 3.Customer behavior –smooth volume over day/week	San Bernardino			2030/2040
Grade Separation Projects					
6	Norwalk Blvd. / Los Nietos Rd.	San Bernardino			2030/2040
7	Pioneer Blvd. / Rivera Rd.	San Bernardino			2030/2040
8	Lakeland Rd.	San Bernardino			2030/2040
9	Rosecrans Av./Marquardt Av.	San Bernardino			2030/2040
Total BNSF Improvements (Route-Miles)			**66**	**9**	**76 Route-Miles**

Source: AECOM, 2021

Union Pacific Railroad Improvements

UP provided no specific information on improvements either planned or proposed regarding its existing system in the SCAG region. UP did provide feedback as part of the initial data development and participated throughout the TAC process.

California High-Speed Rail Authority

CHSRA is constructing a high-speed rail system that will provide service between Anaheim via Los Angeles, San Francisco, Sacramento, and San Diego. The California high speed rail system is a central element of the 2018 *California State Rail Plan* and is planned to provide service between Anaheim via Los Angeles and San Francisco within the horizon year of this Study.

The high-speed rail (HSR) project consists of dedicated, fully grade separated track accommodating speeds of up to 220 miles per hour for the segment between San Jose and Hollywood Burbank Airport. The San Jose to San Francisco corridor shares tracks with Caltrain, the Capitol Corridor, ACE and Amtrak. Within the SCAG region, the Hollywood Burbank Airport to downtown Los Angeles Union Station corridor will share the LOSSAN Corridor with new dedicated electrified tracks and the L.A. to Anaheim corridor will share existing tracks with conventional passenger services. (A future fourth main track dedicated to freight service will be built between L.A. Redondo Junction and Fullerton Junction).

The HSR project will be delivered in two phases. Phase 1 includes service from Anaheim via Los Angeles to San Francisco. Phase 2 includes service from Los Angeles to San Diego and Merced to Sacramento. CHSRA's 2020 Business Plan reports that the Central Valley segment of Phase 1 between Bakersfield and Merced in northern California is under construction and expected to be completed by the end of the decade. The remaining portions of Phase 1 connecting to Anaheim via Los Angeles and San Francisco are slated to be completed by 2033.[6] Phase 2 of the project is not expected to be completed before 2045. Phase 1 of the California High-Speed Rail project includes the following segments within the SCAG Region:

- Palmdale to Burbank Section – Includes a dedicated right-of-way with electrified tracks.
- Hollywood Burbank Airport to LAUS – Includes two new tracks which are dedicated between Hollywood Burbank Airport station to CP Allen (just north of Glendale station) and then shared from CP Allen to LAUS.
- LAUS to Anaheim – Includes blended service, sharing tracks with Metrolink trains and the Pacific Surfliner along the River West, San Bernardino, and Orange Subdivisions.

Figure 16 presents the HSR Map within the SCAG region. The numbers refer to segments of the high-speed rail project coinciding with subdivisions in the SCAG region.

6 https://www.hsr.ca.gov/about/business_plans/2020/

Source: AECOM, 2021

Figure 16 Future California High-Speed Rail and Brightline West Map

Brightline West

Another high-speed rail service, Brightline West, has plans to serve the Los Angeles and Inland Empire regions with operations to and from Las Vegas. From Las Vegas, Brightline West trains will run via the median of the I-15 Freeway to the Victor Valley, then to Palmdale along the High-Desert Corridor and through the Cajon Pass to Rancho Cucamonga. Construction between the Victor Valley and Las Vegas is scheduled to begin in late 2022 or 2023, and the extensions to the Antelope Valley and Rancho Cucamonga are in the planning stages.

Port Improvements

For Port improvements, the study relied upon the work developed through the Ports of Los Angeles and Long Beach Rail Study – December 2020. Combined, the ports comprise the largest port complex in the Western Hemisphere with about 40 percent of all imports to the United States and 25 percent of all exports from the United States, moving through port facilities. The ports Rail Study (RS) provided an update on the ports rail network improvements that are expected to be needed over the next 25 years to accommodate projected on-dock container rail volumes, as well as noncontainerized volumes. Table 14 provides the ports on-dock rail facility capacity (lifts/year) for the 2025 scenario, and a 2045 base scenario and 2045 expanded scenario.

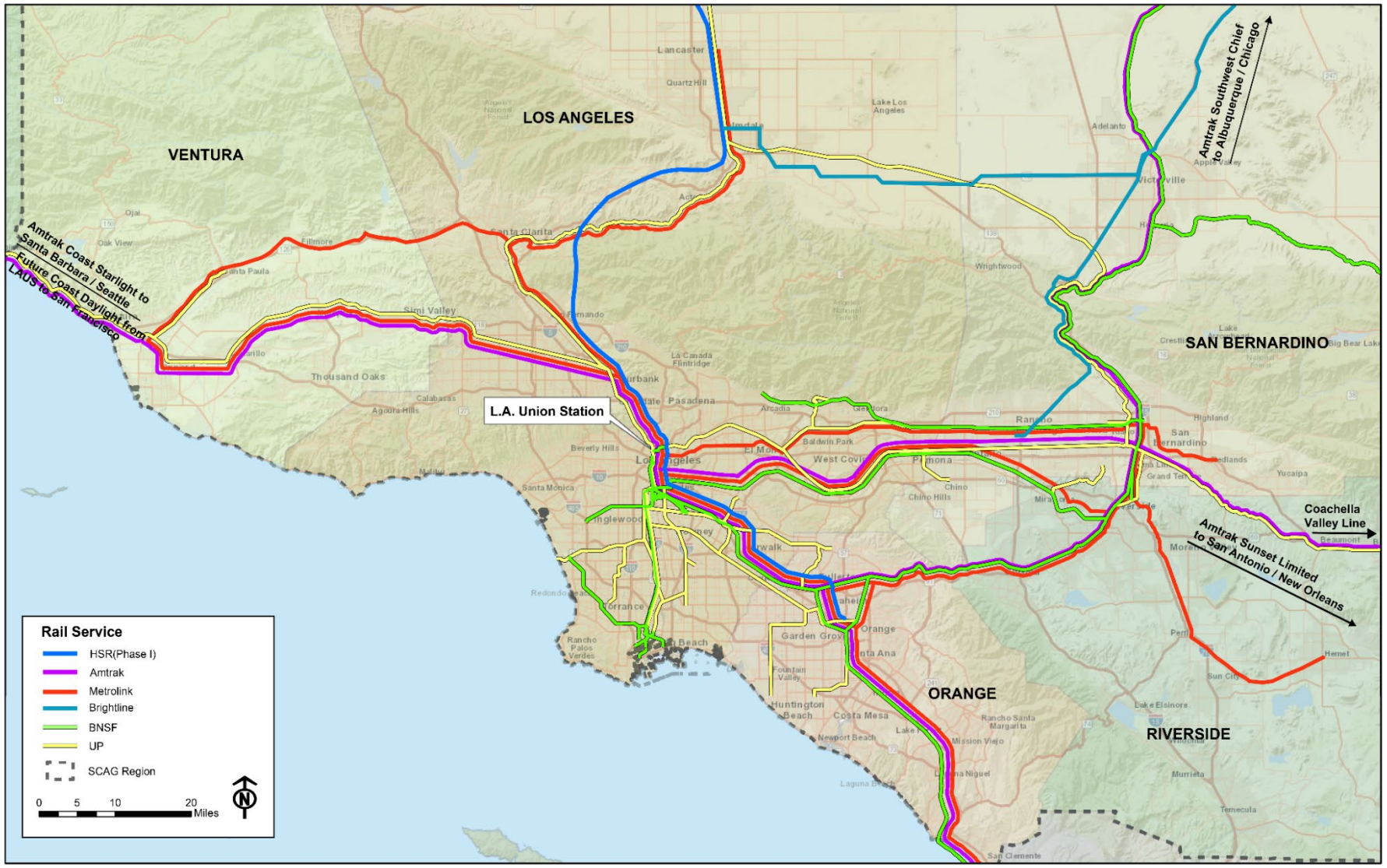
The existing on-dock facilities, although having room for future expansion, will still be inadequate over time. If the container forecasts come to fruition, the demand and supply for on-dock facilities' capacity would reach equilibrium around between approximately 2030 and 2035, with the exception of one railyard in the Port of Long Beach. The ports continue to advance planning and implementation of expansion projects for their existing sites to maximize capacity.

Table 14 San Pedro Bay Ports On-dock Rail Facility Capacity 2045 Forecast

	Existing 2019	2025	2045 (Base Scenario)	2045 (Expanded Scenario)
	Actual (Lifts/Year)	Capacity (Lifts/Year)	Capacity (Lifts/Year)	Capacity (Lifts/Year)
Ports Total	2,265,000	4,679,000	5,624,500	6,599,000

2.3.2 Integrated Passenger and Freight Rail Network Improvements

The future passenger and freight rail operations are depicted in **Figure 17.**



Source: AECOM, 2021

Figure 17 Future Passenger and Freight Rail Operations Map

Table 15 show the planned improvements for the rail network in the SCAG region. The summary assumes that CHSRA trains will be able to use a double-track passenger facility between Fullerton Junction and Redondo Junction, along with Metrolink commuter trains and Pacific Surfliner and Amtrak long-distance intercity trains.

Table 14 Planned Rail Network Improvements (in miles)

Subdivision	Owner	New ROW		Adding Track to Existing ROW				Length
		Double	Three +	Double Tracking (Adding 1 Track)	Triple or More Tracking (Adding 2+)	HSR Tracks	Sidings	
Orange	OCTA			1.30	13.80		-	15.10
River (LAUS)	Metro		1.50			2.00	-	3.50
River West Bank	Metro					3.60	-	3.60
San Bernardino (San Bernardino to Fullerton Jct.)	BNSF				46.00		-	46.00
San Bernardino (Fullerton to Redondo Jct.)	BNSF				20.40		9.10	29.50
San Gabriel	Metro/SBCTA			8.75			2.25	11.00
Valley	Metro			58.85		15.10	1.80	75.75
Ventura	Metro/VCTC			10.10			1.16	11.26
Central (HSR Only)	CHSRA	34.10					-	34.10
Total Planned Improvements		**34.10**	**1.50**	**79.00**	**80.20**	**20,70**	**14.31**	**229.81**

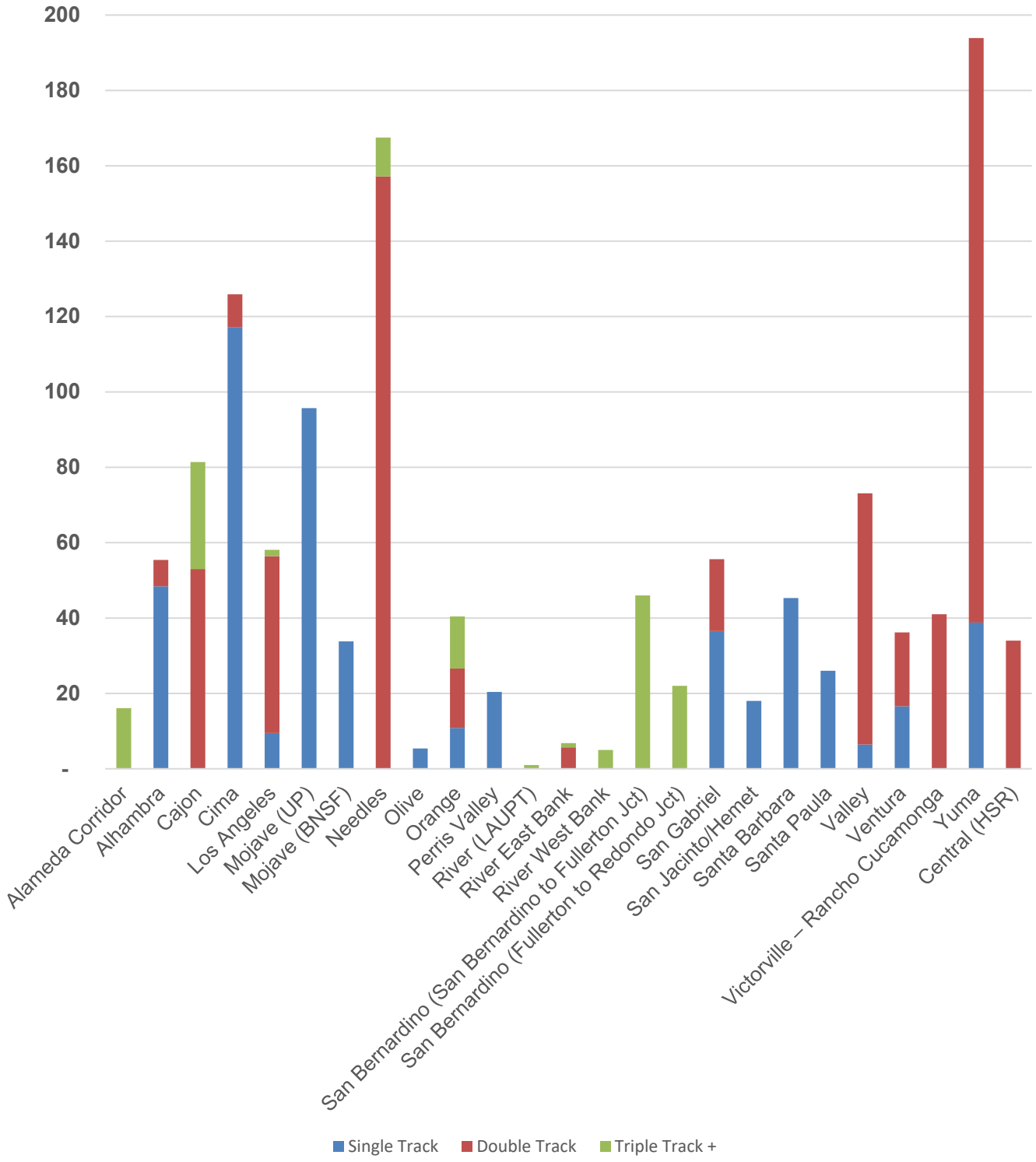
Source: AECOM, 2021

Table 16 presents the future rail main line network trackage information by subdivision and rail operator in the SCAG region. Generally speaking, adding more main line track increases the capacity of a rail line to handle more trains.

Table 15 Future Rail Network by Line

Subdivision	Type of Service	Rail Operators	Inventory (miles)			
			Single	Double	Triple+	Total
Alameda Corridor	Freight	ACTA, UP, BNSF	-	-	16	16
Alhambra	Freight/Passenger	UP, Amtrak	48	7	-	55
Cajon	Freight/Passenger	BNSF, UP, Amtrak	-	53	28	81
Cima	Freight	UP	117	9	-	126
Los Angeles	Freight/Passenger	UP, Metrolink	10	47	2	58
Mojave (UP)	Freight	UP	96	-	-	96
Mojave (BNSF)	Freight	BNSF, UP	34	-	-	34
Needles	Freight/Passenger	BNSF, UP, Amtrak	-	157	10	168
Olive	Freight/Passenger	Metrolink, BNSF	5	-	-	5
Orange	Freight/Passenger	Metrolink, BNSF,UP, Amtrak	11	16	14	40
Perris Valley	Freight/Passenger	Metrolink, BNSF	20	9	-	29
River (LAUS)	Passenger/HSR	Metrolink, Amtrak, CHSRA	-	-	1	1
River East Bank	Freight/Passenger	Metrolink, UPRR, Amtrak	-	6	1	7
River West Bank	Freight/Passenger/ HSR	Metrolink, Amtrak, CHSRA			5	5
San Bernardino (San Bernardino to Fullerton Jct.)	Freight/Passenger	BNSF, Metrolink, Amtrak	-	-	46	46
San Bernardino (Fullerton to Redondo Jct.)	Freight/Passenger/ HSR	BNSF, Metrolink, Amtrak, CHSRA	-	-	22	22
San Gabriel	Freight/Passenger	Metrolink, UP, Metrolink, BNSF	37	19	-	56
San Jacinto/Hemet	Passenger	Metrolink	18	-	-	18
Santa Barbara	Freight/Passenger	UP, Metrolink, Amtrak	45	-	-	45
Santa Paula	Freight/Passenger	UP, Fillmore Western Railway	26	-	-	26
Valley	Freight/Passenger/ HSR	Metrolink, UP, Amtrak	6	67	-	73
Ventura	Freight/Passenger	Metrolink, UP, Amtrak	17	20	-	36
Victorville – Rancho Cucamonga	Passenger	Brightline	-	41	-	41
Yuma	Freight	UP, Amtrak	39	155	-	194
Central (HSR)	HSR	CHSRA		34		34
Total			**529**	**630**	**145**	**1,304**

Source: AECOM, 2021



Source: AECOM, 2021

Figure 8 Future Freight and Passenger Inventory

2.4 Advancement of Tier 4 and Zero-emission Technologies Assessment

In this section, we provide a brief overview of the passenger and freight rolling stock that is deployed in the SCAG region, along with a discussion of the U.S. Environmental Protection Agency (USEPA) locomotive emissions regulations, as well as the potential for Tier 4 conversion in the SCAG region.

2.4.1 EPA Locomotive and Marine Diesel Emissions Regulations

The regulatory classifications of diesel locomotive engines includes the following tiers:

- Tier 0 applies to line-haul and switch locomotives originally built between 1973 and 2001
- Tier 1 applies to locomotives originally built between 2002 and 2004
- Tier 2 applies to locomotives originally built between 2005-2012
- Tier 3 applies to new and certain remanufactured locomotives built between 2012-2014
- Tier 4 applies to new and certain remanufactured locomotives built beginning in 2015

Tier 4 represents USEPA's current emissions threshold. Beginning in 2015, all new locomotives were required to meet this standard. The emissions inventories conducted as part of the 2008 regulatory impact analysis promised massive reductions from previous standards: a 90 percent reduction in PM and an 80 percent reduction in NOx for engines meeting the 2015 standards compared to those meeting the prior standards.[7,8] These standards do not impact greenhouse gas (GHG) emissions, but rather are meant to mitigate longstanding air quality impacts and associated negative effects on health caused by the combustion of diesel fuel.

Locomotive transport is already more fuel efficient per ton-mile than on-road modes despite consuming 7 percent of all diesel fuel and moving 40 percent of all freight ton-miles in the U.S. These standards help ensure that the social costs of burning fossil fuels are minimized until low or zero-carbon energy sources are implemented for rail propulsion.[9]

2.4.2 Current Rolling Stock Composition

2.4.2.1 Passenger

Passenger operations in the SCAG region are presently conducted by Metrolink and Amtrak. Metrolink's fleet includes 69 locomotives, 175 passenger cars, and 95 cab cars (non-powered passenger rolling stock that can control operation of a train) that transported Metrolink passengers 432 million passenger miles in 2019.[10] Of the 69 locomotives currently in use, 13 meet EPA Tier 0, 1 meets EPA Tier 1, 15 meet EPA Tier 2, and 40 are Tier 4 compliant.

[7] "Regulatory Announcement: EPA Finalizes More Stringent Emissions Standards for Locomotives and Marine Compression-Ignition Engines" (US Environmental Protection Agency Office of Transportation and Air Quality, March 2008), https://nepis.epa.gov/Exe/ZyPDF.cgi/P100094D.PDF?Dockey=P100094D.PDF. Page 4.
[8] "Regulatory Impact Analysis: Control of Emissions of Air Pollution from Locomotive Engines and Marine Compression Ignition Engines Less than 30 Liters Per Cylinder." Page 3-101.
[9] C. James Kruse, Jeffrey Warner, and Leslie Olson, "A Modal Comparison of Domestic Freight Transportation Effects on the General Public: 2001-2014" (National Waterways Foundation, January 2017), http://nationalwaterwaysfoundation.org/documents/Final%20TTI%20Report%202001-2014%20Approved.pdf; "Regulatory Impact Analysis: Control of Emissions of Air Pollution from Locomotive Engines and Marine Compression Ignition Engines Less than 30 Liters Per Cylinder."
[10] Fact Sheets & Numbers. Prepared by Metrolink. Available from https://Metrolinktrains.com/about/agency/facts—numbers/.

On the LOSSAN corridor, Amtrak currently utilizes 82 passenger cars, along with 14 Siemens Chargers that are Tier 4 compliant, along with 2 locomotives that are Tier 0.[11] In addition, Amtrak's long-distance trains that serve the SCAG region exclusively utilize Tier 0 locomotives, principally GE P-42 DC.

2.4.2.2 Freight

BNSF and UPRR have national fleets so there is limited information available on freight rail equipment specific to the Southern California region. As of 2019, BNSF controlled approximately 70,000 freight cars and 8,000 locomotives systemwide[12], while UPRR controlled approximately 7,700 locomotives, 57,000 freight cars, 54,000 containers, and 48,000 chassis, respectively. As a result of agreements established between CARB, the SCAQMD, and the railroads, BNSF and UPRR are assigning low emissions locomotives to perform operations within the region.[13] As of 2017, UPRR had a fleet of about 180 of qualifying locomotives that are primarily used in the Los Angeles Basin. The third major freight operator in the SCAG region, PHL, utilizes a fleet of approximately 25 diesel electric locomotives that are a mix of EPA Tier 2, 3, and 4 compliant.

2.4.3 State of the Practice: Zero Emissions Technologies for Diesel Locomotive Engines

There are two main compliance strategies for locomotive operators: retrofits through maintenance and remanufacturing (known as after-treatments), and new rolling stock. Several manufacturers have developed Tier 4-compliant diesel-electric locomotives for both switcher and line-haul operators.[14] However, lengthy locomotive service lives means that if about 1,200 locomotives turn over each year, it might take 25 years before the entire fleet complies with Tier 4 standards. As a result, after-treatment technologies have proliferated to mirror efficiencies in new builds.[15] Some examples of strategies, include:

- **Idle reduction strategies.** Including horsepower, the strategies ensure that locomotives need not idle their engines to remain powered during hotelling or railyard operations, thereby saving large amount of fuel. Line-haul freight locomotives, for example, idle for nearly 40 percent of their operating time.[16] While this may reduce fuel consumption, upstream energy supply needs to originate from clean sources for idle reduction strategies to truly reduce air emissions and energy consumption. Idle reduction kits are already deployed on many locomotives and in railyards, including in California.[17]
- **More efficient internal combustion systems.** Exhaust gas recirculation, diesel oxidation catalysts, selective catalytic reduction, and diesel particulate filters all work to remove NOx and PM from engine exhaust using chemical and physical processes. These systems are already deployed and

[11] DB Consulting, **Amtrak's Five-Year Equipment Asset Line Plan – Base (FY2019) and Strategic Plan (FY2020–2024**).
[12] BNSF Form 10-K Annual Filing. 2019. Accessed from https://www.sec.gov/Archives/edgar/data/934612/000093461220000004/llc12311910k.htm

[13] UP Form 10-K Annual Filing. 2019. Accessed from https://www.sec.gov/ix?doc=/Archives/edgar/data/100885/000010088520000065/unp-20191231x10k.htm

[14] Andrew Corselli, "Wabtec Delivers 1,000th Tier 4 Locomotive," Railway Age, April 25, 2019, https://www.railwayage.com/mechanical/locomotives/wabtec-delivers-1000th-tier-4-locomotive/; Jeff Stagl, "Locomotive Builders Continue to Craft Tier 4 Models to Help Railroads Further Their Environmental Pursuits," Progressive Railroading, January 2016, https://www.progressiverailroading.com/mechanical/article/Locomotive-builders-continue-to-craft-Tier-4-models-to-help-railroads-further-their-environmental-pursuits--46915.
[15] University of Illinois at Urbana-Champaign Rail Transportation and Engineering Center, "Transitioning to a Zero or Near-Zero Emission Line-Haul Freight Rail System in California: Operational and Economic Considerations" (California Air Resources Board, Spring 2016).
[16] California Air Resources Board, "Technology Assessment: Freight Locomotives," November 2016.
[17] California Air Resources Board.

can be installed stock, or in some cases retrofitted to existing locomotives; retrofits are constrained by the existing space and on-board electrical system load capacities.[18]

Fully electrified locomotive systems exist around the world, including for heavy-haul freight operations and long-haul passenger trains. Some systems use purely electric power from overhead catenaries, while others use diesel-electric combinations to propel trains where catenaries are unavailable. Fully electrified trains in the U.S. include Amtrak's Acela in the Northeast Corridor, and dual-model systems are deployed by both Amtrak and New Jersey Transit. Outside the United States, countries deploying these systems include Australia, India, Germany, and Sweden.[19]

All of the major railroads operating in Southern California – passenger carriers Amtrak and Metrolink, and freight carriers BNSF, UPRR, and PHL have embarked on efforts to substantially reduce emissions from their operations in the region. However, though the electric operation of trains using overhead catenary is a proven solution to achieving zero GHG emissions, the capital cost hurdles to doing so are high. Additionally, freight railroads have raised concerns based on operational feasibility. Thus, the focus is on technologies that are less capital intensive and leverage off of development being performed for other modes. Among the alternative energy sources that exhibit the most potential to achieve meaningful technical and economic feasibility are batteries and hydrogen fuel cells. Trials have been launched with both technologies on freight and passenger rail rolling stock in the US and overseas. Some examples are as follows:

- In 2021, locomotive manufacturer Wabtec, together BNSF and the California Air Resources Board trialed a battery storage line-haul locomotive. Though the technical concept could be proven, deployment awaits substantially larger battery capacity that is cost-effective.[20]
- Also in 2021, CP, in collaboration with Ballard, a leading producer of hydrogen fuel cells, announced the development of a main line locomotive using this technology.[21]
- In late 2020, Progress Rail announced the deployment of its new Joule battery-powered locomotive on PHL, with testing scheduled to commence during the second half of 2021.[22]
- The San Bernardino County Transportation Authority (SBCTA) contracted with Stadler, a railcar manufacturer headquartered in Switzerland, to utilize hybrid fuel cell and battery technology in a multiple-unit regional passenger train. Presently being tested in Europe, the first trains for the US market are scheduled for delivery to SBCTA in 2024. If successful, Caltrans anticipates deploying similar trains in other regions of the state.[23]

Development of alternative technologies to diesel engines in the rail sector has lagged that of the highway sector. This is due to the much smaller market for railroad locomotives than for highway trucks, the inherent energy efficiency advantages of rail over highway, the far longer longevity of the rolling stock (locomotives typically are in active use for 40 or more years), and far higher energy requirements of a mainline locomotive versus a diesel highway tractor. This raises technical challenges that will need to be addressed before widespread adoption can occur, a burden that the rail supply industry may not be able to absorb on its own. Both BNSF and UPRR (along with many of the other large Class I railroads), along with PHL, have

[18] University of Illinois at Urbana-Champaign Rail Transportation and Engineering Center, "Transitioning to a Zero or Near-Zero Emission Line-Haul Freight Rail System in California: Operational and Economic Considerations."
[19] Cambridge Systematics, "Task 8.3: Analysis of Freight Rail Electrification in the SCAG Region" (Southern California Association of Governments, April 2012).
[20] https://www.railwayage.com/mechanical/locomotives/bnsf-wabtec-bel-pilot-the-results-are-in/
[21] https://www.globalrailwayreview.com/news/119246/cp-fuel-cell-modules-hydrogen-locomotive-program/
[22] https://www.railwayage.com/mechanical/locomotives/phl-to-test-progress-rail-emd-joule/?RAchannel=mechanical
[23] https://www.gosbcta.com/project/diesel-multiple-unit-to-zero-emission-multiple-unit-pilot/

committed to migrating away from conventional diesel-electric locomotives for future fleet acquisitions, but the timing for this migration has not been set.[24]

2.4.4 Potential for Tier 4 Conversion in the SCAG Region

The following is a summary of the findings for considering policies to make rail operations in the SCAG region comply with Tier 4 regulations.

- **The social benefits of Tier 4 conversion outweigh the costs by substantial margins.** Based on the USEPA's regulatory impact analysis (RIA) of the Tier 4 rulemaking (including marine engines), the benefit-cost ratio in 2030 will be about 13.6 – a substantial margin.[25] Separating out railroads on the basis of current energy consumption,[26] railroads would contribute about 60 percent of those benefits, including reducing thousands of premature deaths and workdays lost.
- **Tier 4 compliance largely depends on trade-offs of cost and maintenance schedules.** Locomotive manufacturers already produce new and remanufactured diesel-electric locomotives that meet Tier 4 standards through high-efficiency engines and retrofits. Metrolink is presently on a path to phase out its locomotive fleet that does not comply with Tier 4 standards and is further embarking on a pilot program to evaluate zero emissions rolling stock. However, the costs for migrating to a zero emissions fleet are likely to be substantial, and the rate at which implementation occurs will be dependent on technical advancement and available funding. More generally, Tier-4 locomotives and remanufacture kits are expensive. The RIA estimates that Tier 4 diesel-electric remanufacture costs could be as high as $68,000 per kit as compared to $22,000 for Tier 0.[27] Actual costs will vary, but most passenger and freight operators have been reluctant to conduct retrofits of existing locomotives thus far, maintaining existing equipment "as is" and taking a wait and see attitude.
- **Electrification is technically mature, but dual mode is more cost-effective.** As discussed above, railroads around the world have fully electrified passenger and freight railroads, including long- and heavy-haul operations. In the presence of a power grid supplied by clean electricity, emissions can reach zero; this result would still meet Tier 4 locomotive regulations even if upstream power includes some dirtier sources, since the regulations target the smokestack. In the long-term, operations that can be converted to electricity – whether battery or catenary – should be.

There are tradeoffs to converting to fully electrified transport in the near-term when comprehensive change over time cannot be guaranteed. In particular, electrification creates an artificial boundary where the infrastructure ends, such as at ports in which non-electric trains may not be able to operate. As a result, trainsets will need to be recomposed at these boundaries or pulled over the last journey segments using diesel switcher locomotives, which will result in lost time and logistical concerns on already crowded track.[28]

Until these long-term concerns are addressed through infrastructure planning and capital programming, dual-mode locomotives make the most sense. These locomotives can alternate between electric power from overhead catenaries and diesel power provided either by tenders or onboard engines, thus allowing them to proceed across the infrastructure boundary as necessary without incurring the changeover costs. Dual-mode locomotives also resolve questions for the moment regarding inter-regional freight travel, where providing electric infrastructure in remote parts of the U.S. may be impractical.

[24] Railway Age, Zero-Emission Locomotives on U.S. Railways? (February 12, 2021). https://www.railwayage.com/mechanical/zero-emission-locomotives-on-u-s-railways/?RAchannel=home and https://www.trains.com/trn/union-pacific-sees-battery-electric-locomotives-as-the-future/
[25] "Regulatory Impact Analysis: Control of Emissions of Air Pollution from Locomotive Engines and Marine Compression Ignition Engines Less than 30 Liters Per Cylinder," ES-10.
[26] Stacy Davis and Robert Boundy, "Transportation Energy Data Book: Edition 38" (Oak Ridge, TN: Oak Ridge National Laboratory, 2020), Table 2.7, https://TEDB.ORNL.GOV.
[27] "Regulatory Impact Analysis: Control of Emissions of Air Pollution from Locomotive Engines and Marine Compression Ignition Engines Less than 30 Liters Per Cylinder," 7–60.
[28] Cambridge Systematics, "Task 8.3: Analysis of Freight Rail Electrification in the SCAG Region," 4–9.

2.5 Historical Rail Traffic Data

In this section, an overview is provided on historical rail traffic, utilizing the Surface Transportation Board's (STB) waybill data. This information is helpful in providing historical trends, and key cargo flows to and from national markets.

2.5.1 Summary of Recent Year STB Waybill Data

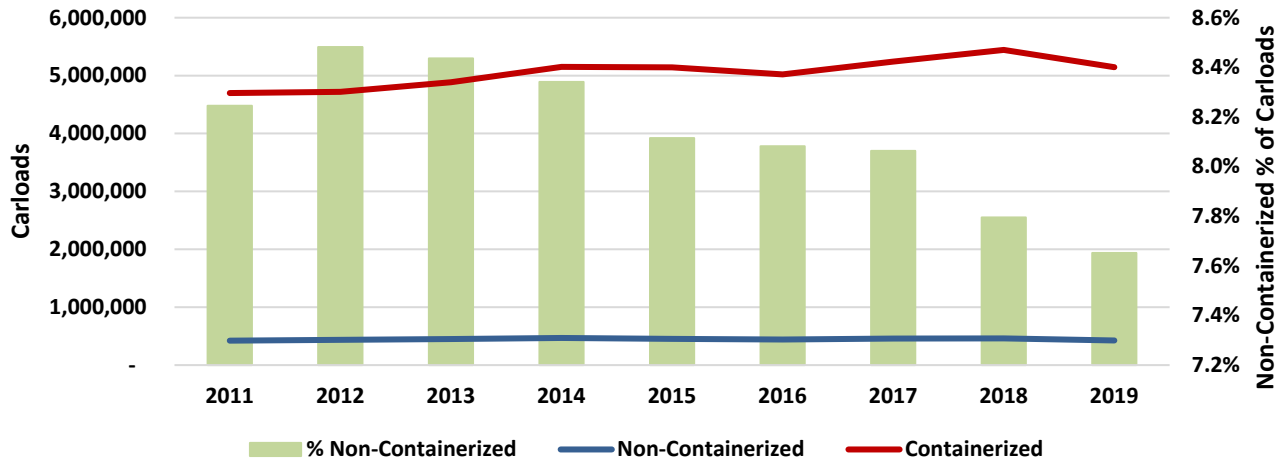
The forecasting process is built from a time series Waybill database of rail activity in California. The database provides information at both a county-to-county origin-destination level and a directional level. Implicitly within this data and the derived forecast, the following directional flows are captured:

- **Inbound Flows:** Flows originating outside the Southern California region and terminating within.
- **Outbound Flows:** Flows originating within the SCAG region and terminating outside.
- **Internal Flows:** Flows whose point of origination and termination reside within the SCAG region.
- **Through Flows:** Flows where neither the point of origination nor termination reside within the SCAG region but are expected to route through the region based on the network layout.

The following are high-level summaries of the Waybill data with proprietary competitive information redacted.

Regarding the types of commodities being moved in relation to the region, **Figure 19** shows that the volume of activity overall is growing in terms of the number of carloads, though the rate of containerized carloads is growing at a faster pace than the non-containerized ones, causing a slight reduction in the overall balance of "bulk" carload activity in region.

Figure 9 Historical Waybill Containerized Versus Non-Containerized Carloads
SCAG Region In/Out/Internal Flows

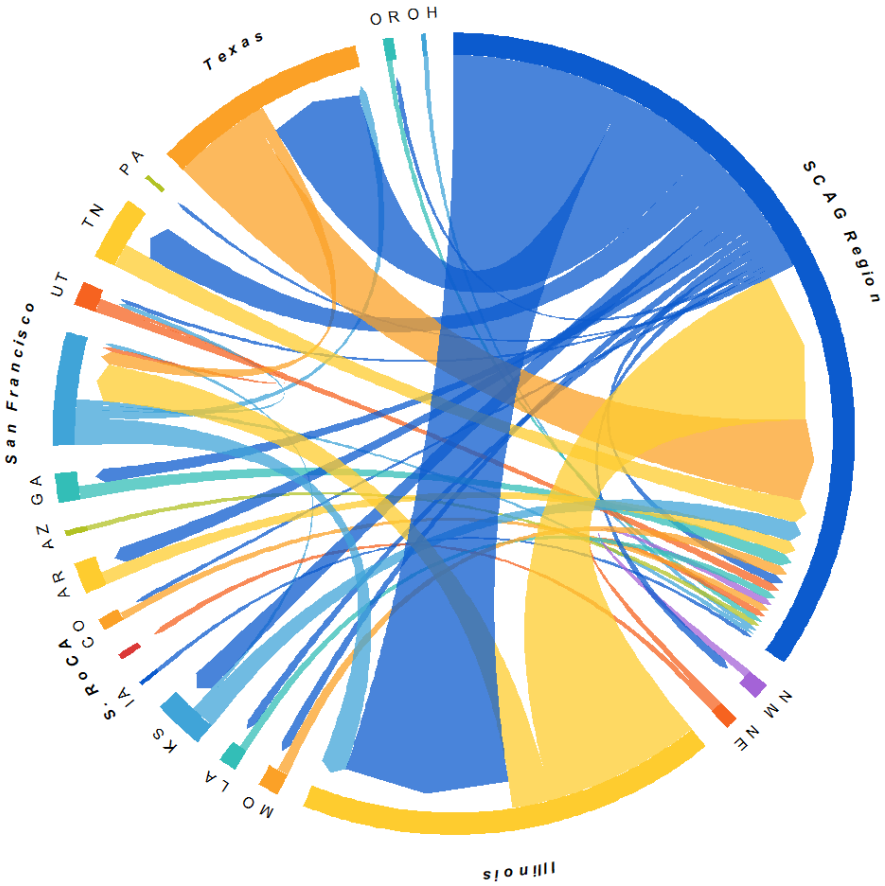


Source: AECOM, 2021

When discussing markets that are involved in generating traffic within the SCAG region, the circular flow diagram in **Figure 20** highlights the patterns of trade involving the largest shippers and receivers. The thickness of the flow lines represents the current year's number of carloads moving, with only trade partners moving more than 25,000 carloads being shown in the plot. The direction of the arrows on the flow lines indicates the path of freight movement taking place (arrows from the SCAG region to regions such as Texas represent outbound flows and vice versa). Note that within this complex pattern of freight movements, there is a handful of major markets worth highlighting, including traffic going back and forth between Illinois and Texas. These locations represent major container markets. A non-trivial volume of goods is unloaded at the

Ports of Los Angeles / Long Beach (Port of Unlading), left sealed in their containers, and shipped directly to inland port districts such as Joliet or Illinois International Port District (IIPD) where they are registered with customs (Port of Entry). Note in the following flow diagram that the non-metro regions were split between northern rest of California (N. RoCA - not shown due to small volume of traffic) and southern rest of California (S. RoCA) to make contiguous, logical, forecast regions while still remaining true to their Federal Highway Administration's (FHWA) Freight Analysis Framework (FAF) zone origins.

Figure 20 Pattern of Top SCAG Region Associated Carload Activity



Source: AECOM, 2021

When referencing geographies within the state of California, we broke our regions as described in the forecasting model we derived loosely based on FAF zones (with the exception of taking Imperial County out of the 'rest of' FAF zone and adding it back into the Los Angeles FAF Zone (which we can then refer to as the SCAG region). The other change was to take the remaining 'rest of' FAF zone and split it into contiguous northern and southern 'Rest of California' regions (references as N. RoCA, and S. RoCA respectively). The following figure depicts the California geographies explicitly:

Figure 21 Breakout of California Regions

Source: AECOM, 2021

2.6 Passenger Train Forecast

Metrolink is currently planning major service expansions in future years. These include going to half-hour bi-directional headways on all lines during most of the day Mondays through Fridays in the near term, and later to quarter-hour headways on the busiest parts of the Ventura, Antelope Valley and Orange Lines. Trains will also increase on weekends. Schedules for weekday Metrolink in future years are included in Metrolink's 2021 *Cost-Benefit and Operations Analysis* (CBOA) and are assumed for the operations simulation assessment discussed in Section 3. The CBOA also includes future *Pacific Surfliner* schedules. Amtrak long-distance trains – the Coast Starlight, the Sunset Limited and the Southwest Chief – will likely operate more or less on their current schedules and frequencies in the future.

2.7 Freight Train Forecasts

The Study required forecast of freight trains to be included in the RTC simulations for the 2019 Base Case and the subsequent 2028, 2035 and 2050 cases discussed in Section 3. There are two main categories of freight considered in these cases. One is containerized cargo, that is, cargo that is shipped by rail in intermodal containers. Containerized cargo has two main subcategories: international containers and domestic containers. International containers are those that traverse between the U.S. and various areas of the world, primarily in Asia. Domestic container shipments are containers going from a U.S. origin to a U.S. destination, e.g., Los Angeles to Chicago. Domestic container shipments can still involve international containers as in certain cases, international containers are transloaded into domestic containers to achieve economies of scale for shippers. A typical example of transloading includes two 40-foot international containers being taken to a warehouse with the goods being transferred out and reloaded into one 53-foot domestic container. The current estimate is that approximately 35% of international containers are transloaded, whereas the remaining domestic container shipments are purely domestic. The other category of freight includes all other non-containerized cargo.

2.7.1 Container Train Forecast

The Study used actual 2019 intermodal train movements in the SCAG Region for the Base Case simulation. For use in this Study, the ports provided its forecast of intermodal container trains going to and from the SCAG region. The port's model forecasts included trains carrying international and domestic containers. The port intermodal train forecasts were for 2025 and 2035.

The port forecasts served as the basis for train counts for the outer-year simulation cases, with a modification that container trains were assumed to grow longer, reflecting a practice that BNSF and UPRR are doing today to minimize train starts and save operating costs. Intermodal growth to 2028 at 2 percent per year compounded was re-calculated from the number of increased trains to the trailing footage of the increase. The average trailing footage for each type of intermodal train, by carrier (BNSF and UP) and direction, in the Base Case was multiplied by the percentage those train counts represented of all intermodal trains in the Base Case. The result was then used to determine the trailing footage to be added to each carrier's intermodal trains in the 2028 case. The growth footage was then divided between new trains and existing trains made longer. In particular, double stack trains for BNSF and UP in both directions, were preferentially lengthened since both BNSF and UP are already operating such trains at trailing lengths between 11,400 and 15,000 feet. The same process was followed for the 2035 and 2050 simulation cases.

2.7.2 Traditional Carload Train Forecasts

Added to the traffic forecasted by the ports, are non-port, non-intermodal traffic which represented traffic either moving through the RTC network (through flows), or traditional carload activity. These network flows were then forecasted into the future by relating the freight commodities moving between markets (described in the STB waybill data), to the industries responsible for producing and consuming them at both ends of the rail move and looking at how their economies were forecasted to grow and change over time (using Moody's Analytics Forecasts).

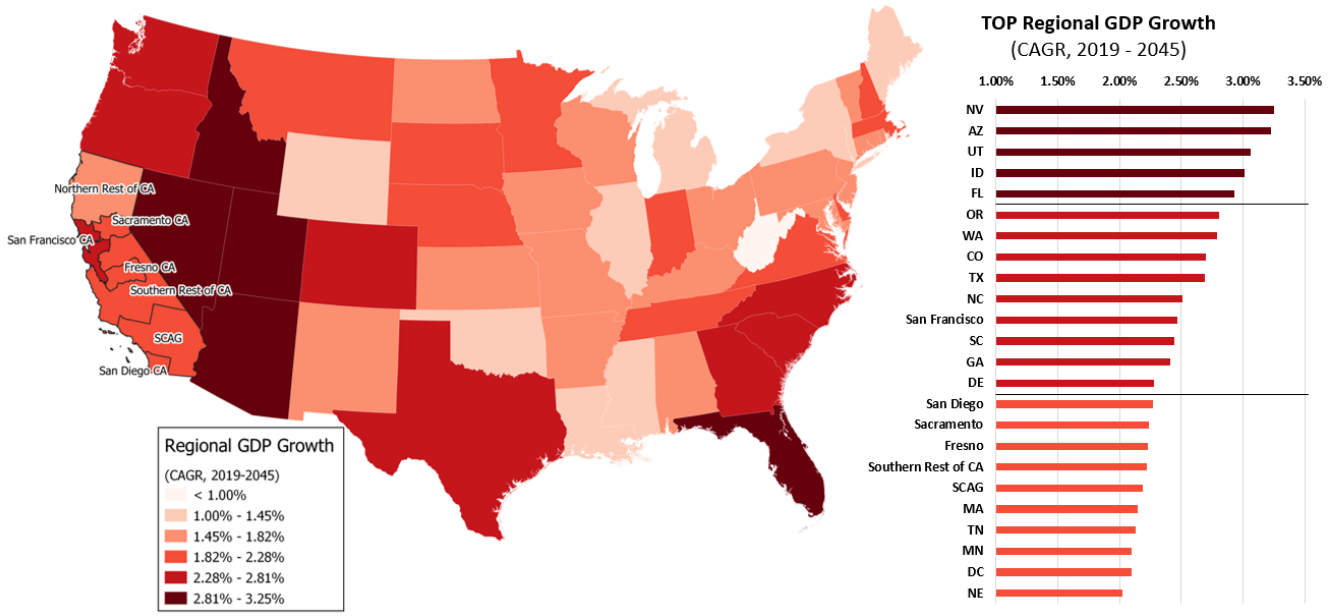
Table 17 highlights the growth in overall Gross Domestic Product (GDP) expected for the seven regions of California, statewide growth, as well as national overall averages. Note that these were the latest Moody's forecasts as of mid-March 2021, so they are inclusive of longer-term expectations of global macro effects related to the ongoing pandemic and are therefore highly relevant given the timing of this project.

Table 16 Regional GDP Growth

Region	**Ratio** GDP Growth (2045 / 2019)	**Compound Annual Growth Rate** (CAGR, 2019 – 2045)
Sacramento	1.78	2.24%
San Diego	1.79	2.27%
San Francisco	1.89	2.47%
Fresno	1.77	2.23%
Northern RoCA	1.49	1.54%
Southern RoCA	1.77	2.22%
SCAG	*1.75*	*2.19%*
California	**1.8**	**2.28%**
United States	**1.72**	**2.12%**

Source: EBP Analysis of Moody's Data

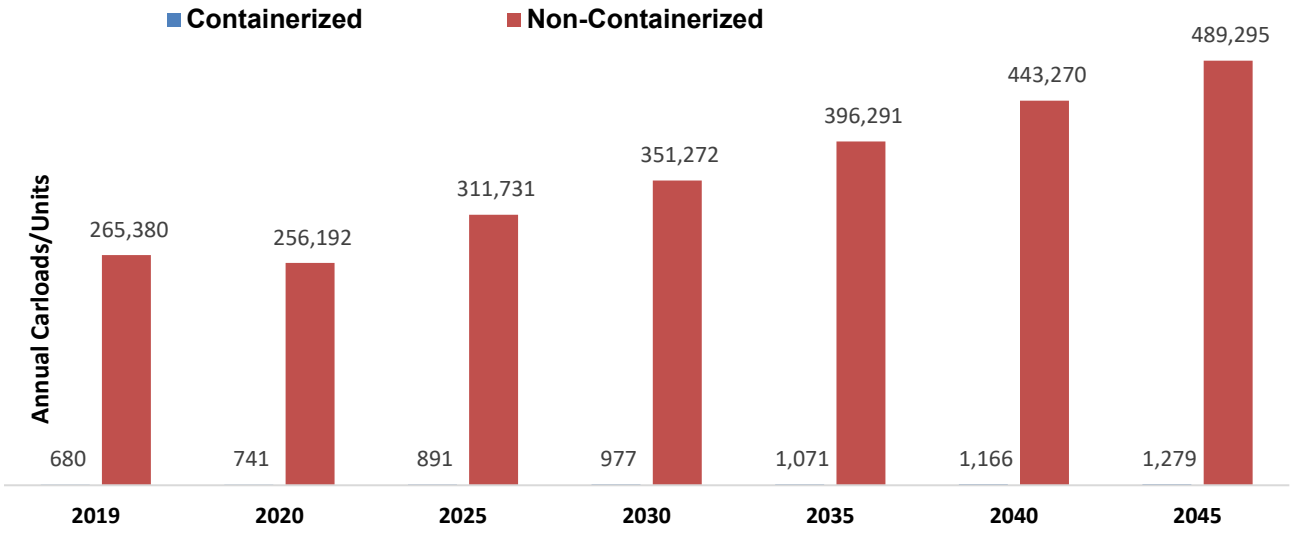
As a note on the geographic detail of the freight – economy model, the U.S. rail activity is broken up into state geographies for non-California regions (**Figure 22**). For California-specific regions, the SCAG region is defined and then broken out of the rest of California based on FAF regions, though further subdivision was done for the region defined as Rest of California (RoCA). This region was broken down into northern RoCA and southern RoCA regions to make them contiguous and allow for variation in freight activity.



Source: EBP Analysis of Moody's Data

Figure 22 National Level Economic Growth

By applying the regional industry forecasts to the freight economy model, a forecast of the carload activities is generated (shown in **Figure 23**). Note that we are only showing the volume of activity that is not being captured by the port forecasts (QTTB model) here.



Source: EBP Analysis

Figure 23 Forecast of SCAG Freight Activity (Originating or Terminating in Region)

The figure above shows that the non-port non-intermodal traffic originating or terminating within the region is overwhelmingly describing non-containerized traffic. Note that the non-QTTB traffic being captured here is largely inbound and passthrough carloads as shown in the above figure. **Figure 15** includes the forecasted volumes of through traffic to the above figure and highlights their relative volume. Contrary to forecasted volumes in SCAG regional traffic, through flows passing through the RTC network (not originating or terminating within the SCAG/model region) are more closely split between containerized and non-containerized.

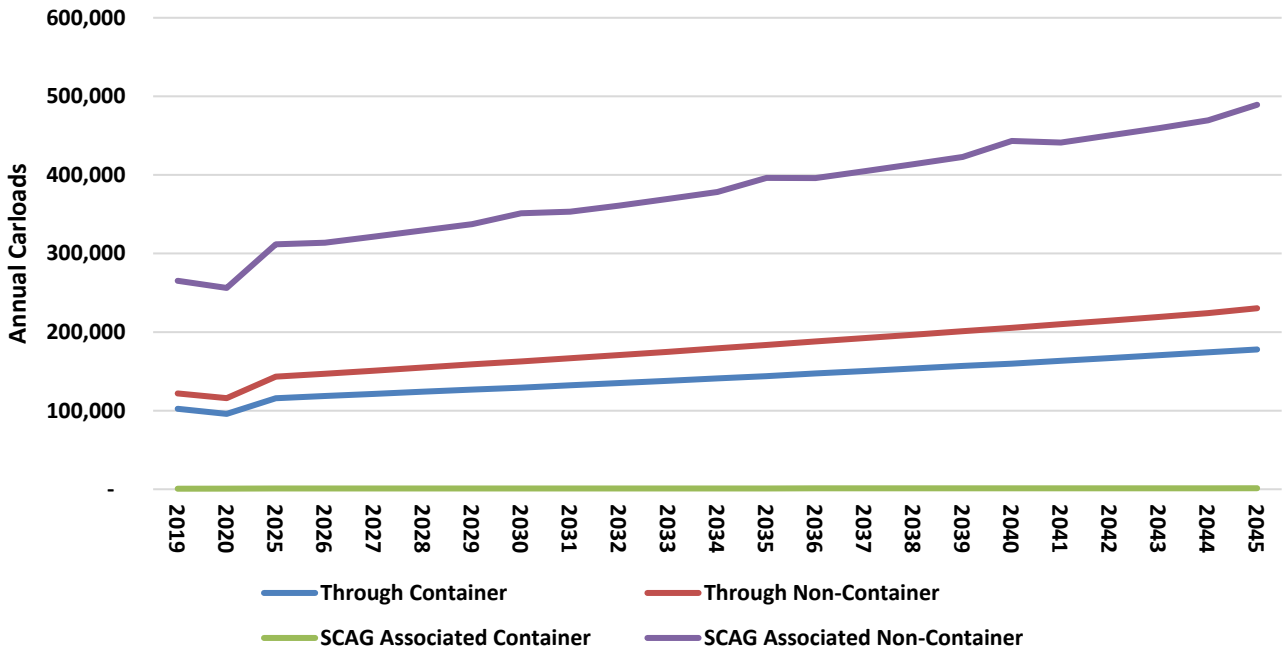


Figure 24 Forecast of Carload Traffic

In aggregate **Table 18** the forecasted activity by direction shows a continued growth of around 1.4% to 2.6% per year for rail freight goods by direction, with an aggregate compound growth rate of 2.36% per year across all directions.

Table 17 Summary of Growth

Direction of Carload Movement	Comparison of Compound Annual Growth Rate	
	2011 – 2018 (Historical SCAG Region)	**2019 – 2045 (Forecasted, Non-QTTB)**
Inbound	1.8%	2.6%
Internal	2.4%	2.1%
Outbound	2.3%	1.4%
Through	1.4%	2.3%
Total	**1.9%**	**2.4%**

Source: EBP Analysis

For local freight trains operating within the Southern California Basin, the forecast increase in carloads by location was added to the respective local freight trains serving those areas. These local freight trains all have marginal capacity sufficient to absorb the expected increase in carload demand: additional train starts are not expected to be required, and recent past history has shown that the number and frequency of purely local carload gathering, and distribution trains has declined. The remaining local freight trains can be expected in some cases to get longer, but the overall count of such trains in the simulation cases has been kept relatively constant.

Long-haul carload freight trains (i.e., those arriving from and destined to points outside the SCAG region such as the Pacific Northwest, the Rocky Mountain and Midwest states, and the Gulf Coast) were estimated to increase in number according to the annualized index for carload traffic for the respective calendar year.

Carload trains arriving in and departing from the San Pedro Bay port complex were initially entered into the simulation train file for the Base Case from actual movement data. To the extent that port forecasts showed static demand for a given type of carload traffic (typically individual carloads of boxcar, flatcar, and gondola cargo), those car counts and the trains handling such cars, were kept constant in future year simulation cases. Unit trains of carload traffic, on the other hand – which typically includes bulk export cargo such as potash, bulk import cargo such as slab steel, vehicles, chemicals in tank and /or covered hopper cars, and to some extent scrap metal, was increased according to the port carload forecast. For the most part, this growth was modeled as accommodated in longer, heavier trains, and only as a last resort, in additional train starts.

3. Rail Operations Simulation

This section provides the Rail Traffic Controller (RTC) operations simulation methodology, process, and results.

3.1 Rail Traffic Controller Overview

RTC is a computer program created by Berkeley Simulation Software, LLC, which simulates the operation of trains over a railroad network. Variations can be made in network track layouts, train consists, schedules, and operating rules and constraints, allowing the testing of such changes before they are implemented. RTC is used by North American Class I (large) railroads to evaluate and plan their operations and capital expenditures. The Class I freight carriers whose trackage and trains are to be modeled in this study (BNSF and UP) use the model, are familiar with the methodology, and accept the model's results when it is used to their standards. SCRRA and Amtrak also use RTC for their simulation studies.

3.2 Dispatching Simulation Approach

3.2.1 RTC Files

The simulation model consists primarily of two kinds of files:

- **Network files:** These include track, signals, grades, curves, bridges, road crossings, and railroad junctions or interlockings. These files can contain details to the extent as needed to ensure accuracy of analysis. The network files also allow the simulation to reflect the specific time that segments of track must be withdrawn from service for Maintenance-of-Way activity. Such work is done within a so-called "window", which specifies the beginning and ending clock times within which the work will be done. The work is then protected by a Track Permit which allows the Maintenance crew to control the track, restricting train movements as required.
- **Train files:** These include all information related to individual trains (including identity, type, weight, length, locomotives, time and day of operation, relative priority, origin and destination, route, railroad carrier and intermediate work). In all simulation cases run for this study, each train instance and operating day are treated individually (to best reflect the real-world operations). Some freight trains operate on completely random schedules, according to traffic demands; or according to availability of resources (like locomotives and crews). RTC also captures this variation in rail operations.

3.2.2 RTC Dispatching Logic

The model fully reflects how the conflicts between trains are resolved as in the real-world operational situations, with the full knowledge of all trains on the territory, as well as the look-ahead capability available to a powerful computer program. Unless a train is badly delayed, or the crew is nearing the federally mandated 12 hours-of-continuous-service limits, both actual railroad dispatchers and the simulation program "dispatcher" will generally give preference to passenger trains over expedited freight trains, to expedited freight trains over lower priority manifest freight trains, and to through manifest trains over local freight trains or yard engines. These priorities are determined by the freight railroads and are incorporated into the meet-pass logic used to resolve train conflicts. Intermodal trains with commercial cargo moving under service contracts with committed transit and arrival times will take precedence over other trains -- sometimes even over passenger trains if the expedited freight train is running late, or the crew is short on remaining legal work time under the federal Hours of Service law.

RTC and human dispatchers make their rail dispatching decisions based on many factors involved in train performance:

- Priority
- Type of train
- Time available for the train and engine crew to work
- Train length and weight
- Locomotive power
- Scheduled work

When there are conflicts among the dispatching factors, the model, like its human counterparts, discards normal priorities and seeks alternate solutions that will keep the railroad as fluid as possible under the circumstances. Sometimes, the model fails. Repeated failures demonstrate that the planned operations are not possible or not sustainable. This result indicates the rail demand being placed on the available plant and the practical capacity of that plant are incompatible.

The model will generally minimize the total cost of delay to the trains involved in a conflict. The model dispatcher will do this for all trains involved in any conflict or series of conflicts. Sometimes, up to 30 trains may be involved in a related series of conflicts. These conflicts frequently arise around congested terminals or on high-density line segments. Every decision to advance one train and delay another has its own set of subsequent effects. RTC sorts and permeates the possibilities and settles on the solution that seems to work best. However, the model is imperfect and can result in flaws or deficiencies, resulting in poor solutions or falsely rejected reasonable solutions. Therefore, the RTC user will review the RTC model to iteratively change the initial RTC decision for a better or more realistic solution.

RTC allows for revising its decisions until the delay cost is minimized, whereas a human dispatcher cannot do the same. However, the difference does not invalidate the model. Rather, it means that the RTC solutions may be more optimistic than real life. In practice, RTC base cases typically calibrate to within a small percentage of actual movement records. That process of validating the model is an important part of ensuring that model outputs in planning cases are reliable.

3.2.3 RTC Performance Measures

RTC is designed to measure railroad performance based on time-related metrics. Some measures are absolute numbers, and some are normalized ratios of performance.

- **Train count** – This is the number of trains over a period (per day or per week) measured in the model. This number is always less than the number of trains in the case: trains that do not complete their entire run within the measured week are excluded from the statistics, lest they distort the results. All trains in the case are dispatched; not all are measured.
- **Average speed** – This is the average operating speed, in miles per hour, of the measured trains operating across the entire network, or across a specific part of the network (such as a railroad subdivision or district).
- **Delay Ratio** – This is the ratio of congestion-related delay to “ideal” or “unimpeded” running time. Unimpeded time equals the time it would take to operate all the trains, including any *en route* work they need to do or requirements they would have to meet (like federally mandated brake system tests), without any congestion-related delay. So, the numerator is delay; it varies. The higher the number, the worse things are. The denominator does not change within a case – it is the irreducible minimum amount of time that it would take to run the railroad. The ratio is one measure of “normalized” delay: it allows for a comparison of performance between simulation cases, or between segments of the railroad network, where the train counts are not the same. The lower the delay ratio, the better the expected, sustainable train performance will be.

- **Delay Hours/Day** – This is the absolute number of train-hours per calendar day lost to congestion related delay. Since a “train-hour” can take a value, it is a useful measure: reduce the delay hours, reduce the costs. A freight-train hour, however, is just that: one train, either sitting still or running, for one hour. In reality, not all trains are equal, and the value of one hour lost by a train with 100 loaded cars of time-sensitive freight is quite different from the value of one hour lost by a local switching 20 cars a shift. Still, absolute values are needed, also. Generally, those solutions that eliminate the largest number of delay hours per day turn out to be the most cost-effective at generating private benefits.
- **Delay Minutes/100 Train-miles** – This is an alternate, railroad industry measure of normalized delay. It functions much like the delay ratio (the numerator is actually the same, except reduced to minutes instead of hours); but the denominator is the distance trains travel over time, rather than just the time itself. These ratios will often be extremely high in terminals, because switch engines seldom go very far. By the same token, a significant reduction in delay minutes per 100 train miles will suggest a significant improvement in asset and labor productivity.

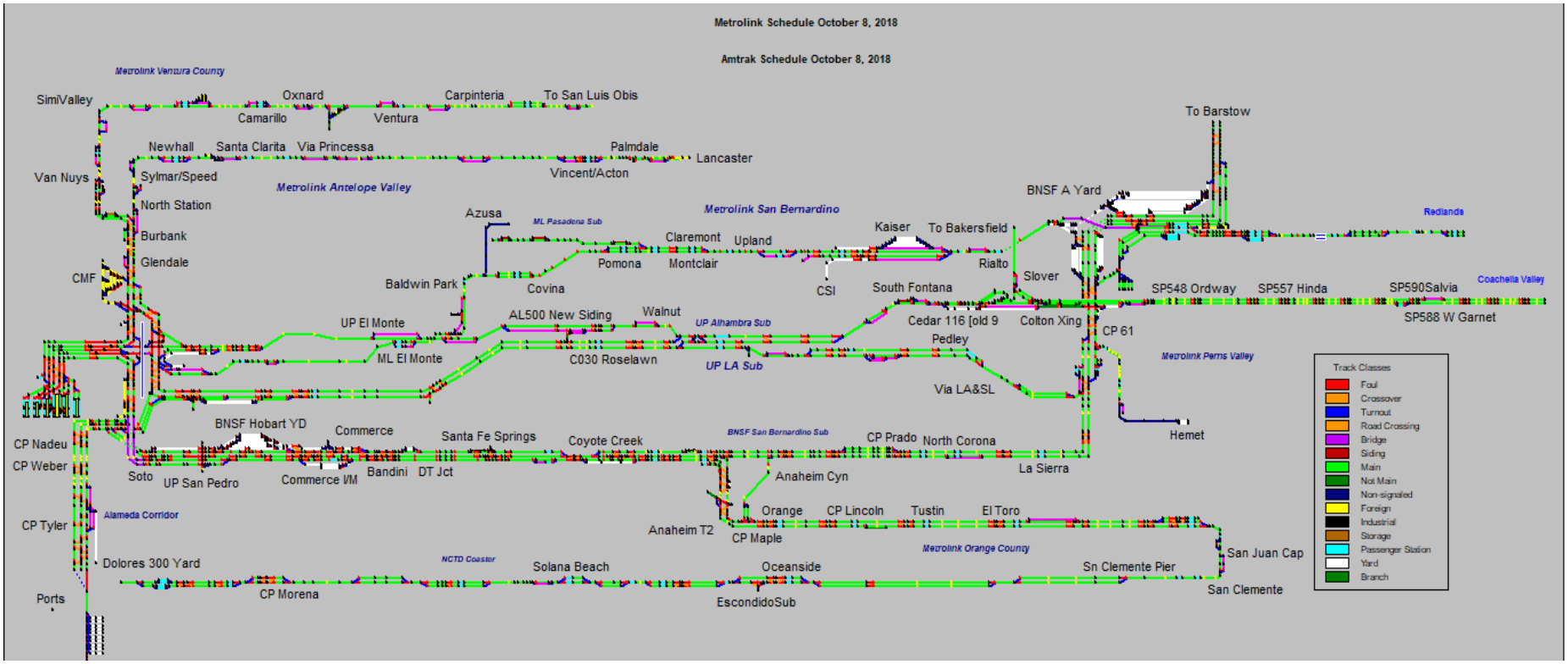
Of the above metrics, the train counts and the delay measures are the primary ones used in this simulation analysis. For passenger train performance, an additional metric, on-time performance, is shown.

3.3 Modeling Network

The RTC rail simulation was conducted on the integrated passenger and freight rail network in the SCAG region. In line with the goal of the Study to identify and prioritize line capacity improvements on passenger and freight mainlines in Southern California, the RTC simulation was focused on rail lines that handle multimodal through-freight traffic and high-volume passenger traffic. Consequently, the model excludes some lines where there is no real threat to capacity and fluid operations from increasing passenger train volumes. Such lines include BNSF and UPRR Cajon Pass lines and the UP Mojave Subdivision between Palmdale and Colton; these handle mostly or exclusively freight trains with very limited or no passenger traffic.

Port freight rail traffic was modeled by simulating the movement on the Alameda Corridor and onto BNSF and UP mainlines near downtown Los Angeles. The model includes only a simplified representation of Pacific Harbor Line (PHL) rail lines serving the San Pedro Bay Ports, as these lines were modeled in the Port of Los Angeles and Long Beach Rail Study, December 2020. Branch lines, industrial spurs and leads and lines with no through freight traffic are similarly not included. The RTC simulation results identified delays and hot spots that provided a guideline for identifying locations for additional line capacity improvements to improve the efficiency of the integrated rail network.

The RTC modeling network is shown in **Figure 25**.



Source: AECOM

Figure 25 RTC Southern California Rail Network

3.4 Modeling Scenarios Summary

This section presents a summary of five simulation cases performed for the Study. The cases are sequential, starting with a Base Case for year 2019. The subsequent future year cases assume higher freight and passenger volumes and rail network capacity improvements required to handle the higher train volumes.

3.4.1 Simulation Cases, Key Inputs, and Assumptions

The key inputs for the simulation were:

2019 Base Case

- Metrolink, *Pacific Surfliner*, COASTER, and Amtrak long-distance schedules for 2019.
- Actual Port of Los Angeles and Port of Long Beach intermodal train volumes for 2018; BNSF and UP domestic intermodal train volumes for 2018; and actual port-related carload train volumes for 2018. The 2018 actual train totals were deemed representative for 2019.
- Non-port-related carloads counts from the Surface Transportation Board's 2019 Confidential Waybill Sample.
- Physical plant as of late 2018 from current working timetables, track charts, and Google Earth.

2028 Case (Metrolink Milestone 1B Service Levels)

- International and domestic intermodal train forecasts from the Ports of Los Angeles and Long Beach. Total traffic increases, but the assumption of increasing train length mitigates growth of total trains.
- Carload train forecast generated for this Study. Driving the train increases was an assumption of a 2 percent carload increase year over year.
- Metrolink and *Pacific Surfliner* weekday rail forecasts, per Metrolink's *Cost-Benefit and Operations Analysis*, 2021, containing Milestone 1B service levels.
    - Metrolink weekend schedules were assumed to be approximately half of weekday frequencies in 2028.
    - *Pacific Surfliners* operate on daily schedules, every two hours between San Luis Obispo and Los Angeles Union Station and hourly between Los Angeles Union Station and San Diego.
- Increased COASTER service levels.
- Physical plant additions from the January 2018 SCORE list, as itemized in the June 2021 Metrolink *Cost-Benefit and Operations Analysis*. These projects are almost all on Metrolink owned and operated property, as are the associated increases in passenger train frequencies.

2035 Case (Metrolink Milestone 2 Service Levels)

- International and domestic intermodal train forecasts from the Ports of Los Angeles and Long Beach. Total traffic increases, but the assumption of increasing train length mitigates growth in the total number of freight trains.
- Carload train forecast generated for this Study. Driving the train increases was an assumption of a 2 percent carload increase year over year.
- Metrolink and *Pacific Surfliner* weekday rail forecasts, per Metrolink's June 2021 *Cost-Benefit and Operations Analysis*, containing Milestone 2 service levels.
    - Metrolink weekend schedules were assumed to be about half the weekday frequencies.
    - *Pacific Surfliners* operate on daily schedules, every two hours between San Luis Obispo and Los Angeles Union Station and hourly between Los Angeles Union Station and San Diego.
- COASTER service levels as for 2028.
- Coachella Valley service with two daily round trips. The service is assumed to be operated by Amtrak. No additional infrastructure on Yuma Subdivision assumed.
- High speed rail (HSR) not included in this simulation case.
- Shared passenger/freight use of all four conventional tracks between Soto Street and Fullerton on the BNSF San Bernardino Subdivision.

2035 Alternate Case (Modified Metrolink Milestone 2 Service Levels)

Same inputs as 2035 except for:

- Expanded Milestone 1B, not Milestone 2, service levels assumed for the Metrolink Riverside Line; reduced investment in added plant.
- Reduced night-time and very early morning service on the BNSF San Bernardino Subdivision to create freight capacity and allow for track and signal maintenance. Reduced investment in added plant between Fullerton and Riverside.
- Coachella Valley service with four daily round trips. No additional infrastructure on Yuma Subdivision assumed.
- HSR frequencies between Burbank and Los Angeles modelled to use dedicated HSR track as shown in CHSRA Environmental Impact Report (EIR)/Environmental Impact Statement (EIS) documentation[29]. HSR frequencies between Los Angeles and Anaheim modelled to use a shared pair of dedicated passenger tracks also used by Metrolink, LOSSAN and Amtrak long-distance; passenger trains totally separated from freight trains. Since no HSR timetables exist, HSR schedules were fitted into slots not required for the conventional passenger services, with maximum HSR operating speeds reduced, and elapsed times increased, accordingly.
- Proposed BNSF intermodal facility in Colton and Lenwood staging tracks near Barstow are modelled to solve for the four-track configuration (two dedicated to freight, two to passenger) between Redondo and Fullerton Junctions on the BNSF.

2050 Case (Metrolink Milestone 3 Service Levels)

- International and domestic intermodal train forecasts from the Ports of Los Angeles and Long Beach. Total traffic increases, but the assumption of increasing train length mitigates growth in total trains.
- Carload train forecast generated for this Study. Driving the train increases was an assumption of a 2 percent carload increase year over year.
- 15-minutes peak frequencies on the Metrolink Antelope Valley Line between Santa Clarita and LAUS, on the Metrolink Ventura Line between Moorpark and LAUS, and the Metrolink Orange County Line between LAUS and Laguna Niguel (Milestone 3 service levels). (Operating as a linked, one-seat ride line as in Metrolink Milestones 1B and 2.)
    - Metrolink weekend schedules were assumed to be approximately half the weekday frequencies.
    - *Pacific Surfliners* operate on daily schedules; every two hours between San Luis Obispo and Los Angeles Union Station, and hourly between Los Angeles Union Station and San Diego.
- Metrolink Riverside Line as for 2035 Alternate Case.
- Reduced night and very early morning service as for the 2035 Alternate Case.
- COASTER service levels remain unchanged.
- Coachella Valley service with four daily round trips. No additional infrastructure on Yuma Subdivision assumed (i.e., a third main track).
- HSR frequencies as for 2035 Alternate Case.
- Physical Plant as for 2035 Alternate Case.
- All passenger service is completely separate from freight service between Soto Street, Fullerton, and Atwood on the BNSF San Bernardino Subdivision.
- Proposed BNSF intermodal facility in Colton and Lenwood staging tracks near Barstow are modeled in order to solve for the four-track configuration (two dedicated to freight, two to passenger) between Redondo and Fullerton Junctions on the BNSF.

Figure shows the assumed main track configuration in green at LAUS that will be utilized by Metrolink, LOSSAN and CHSRA trains in the 2035 Alternate Case. High speed trains will use the green tracks with nodes labelled as “HSOO.”

[29] https://hsr.ca.gov/programs/environmental-planning/project-section-environmental-documents-tier-2/burbank-to-los-angeles-project-section-draft-environmental-impact-report-environmental-impact-statement/

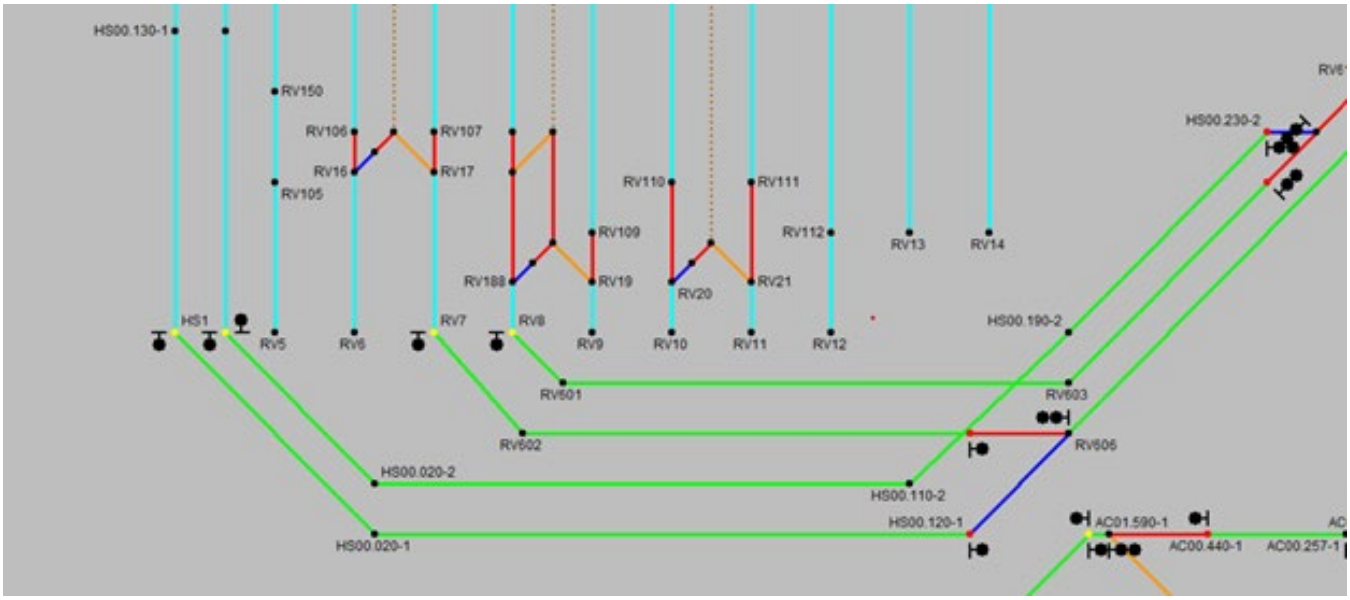


Figure 26 High Speed Rail Connection at LAUS

3.4.2 Simulation Results

The simulations were run for seven days, plus a 12-hour warm-up and a 12-hour cool-down period. Train performance was measured only for the seven days, and not for the warm-up and cool-down periods. The number of passenger trains measured in the simulations appears in **Table 19**.

The decline in trains noted for Metrolink in 2028 versus the Base Case is due to trains running through LAUS from Ventura to Laguna Niguel (combining the current Metrolink Orange County and Ventura County Lines, thus reducing the total number of trains). Metrolink train miles in 2028 increases overall by 34 percent relative to the Base Case. Also, *Pacific Surfliner*, Coachella Valley service, and Amtrak long-distance trains are all counted as Amtrak trains. HSR trains are assumed in 2035 Alternate and 2050 cases.

Amtrak trains show a decline in OTP starting in 2035. A contributing factor is that Coachella Valley trains, assumed to be operated by Amtrak for purposes of these simulations. are restricted to Amtrak *Sunset Limited* operating speeds on the existing UP Yuma Subdivision. Accordingly, they run late westward from Indio versus their proposed timetable dated November 23, 2021. A new third main track on the subdivision would increase capacity enabling the Coachella Valley trains to be scheduled with faster running times.

Table 18 Passenger Trains Simulated

Simulation Case	Amtrak	Metrolink	COASTER	CAHSR
Base Case	245	1,330	80	N/A
2028	295	1,308	134	N/A
2035	362	2,395	134	N/A
2035 Alternate	390	1,696	134	595
2050	390	2.121	134	595

Source: AECOM, 2021

The on-time performance of Amtrak, Metrolink, and HSR trains is noted in **Table 20**.

Table 19 On-time Performance of Passenger Trains

Simulation Case	Amtrak	Metrolink	CAHSR
Base Case	96.9%	96.8%	N/A
2028	99.6%	98.4%	N/A
2035	96.2%	99.6%	N/A
2035 Alternate	94.3%	98.0%	100%
2050	90.8%	98%	100%

Source: AECOM, 2021

The number of freight trains measured in the simulations appears in **Table 21**.

Table 20 Freight Trains Simulated

Railroad	Train Type	Base Case	2028	2035	2035 Alt.	2050
UP	Local	129	129	129	129	129
	Z Expedited	80	88	91	91	97
	Double Stack	173	166	173	173	183
	Manifest	81	89	95	95	101
	Auto	26	32	35	35	40
	Total	489	504	523	523	550
BNSF	Local	72	73	67	67	67
	Z/Q Expedited	117	126	130	138	148
	Double Stack	133	132	139	139	143
	Manifest	81	94	95	95	101
	Auto	20	24	27	27	29
	Total	423	449	458	466	488

Source: AECOM, 2021

Freight train performance, as measured in minutes of delay, appears in **Table 22**. The metric is total delay to trains in minutes over the measured week, as compared to unimpeded running time.

Table 21 Freight Train Delay in Minutes

Railroad	Base Case	2028	2035	2035 Alt.	2050
UP	8,550	8,926	11,897	9,728	10,702
BNSF	11,050	10,384	11,223	6,667	7,242

Source: AECOM, 2021

UP performance worsens significantly in 2035, largely because of unresolved interference from passenger train frequencies in the San Fernando Valley. However, performance for both BNSF and UP improve in the 2035 Alternate Case, due to reduced Metrolink volumes on the BNSF San Bernardino Subdivision and on the UP Los Angeles Subdivision and total separation of freight and passenger trains between Soto Street and La Sierra on the BNSF San Bernardino Subdivision.

3.4.3 Required Capital Improvements

Facilitating the passenger and freight train performance in future year simulations were assumptions of various capital improvements. These improvements include the SCORE projects, all of which are noted in Section 2, and SCORE projects plus additional projects in 2035. These additional “Beyond SCORE” projects are seen in **Figure 17** and **Table 22**. The specific SCORE and Beyond SCORE projects assumed for 2028 and 2035 are shown with cost estimates in Appendix B.

Source: AECOM, 2021

Figure 27 Beyond SCORE Projects

Table 22 Beyond SCORE Projects

Project #	Project Name	Subdivision	Metrolink Line	Track Length (miles)	Year in Service	Notes
82	Mains from Fullerton to Atwood	San Bernardino	91 Line/PVL	12.31	2035	Added main track, north side, Fullerton, to Atwood. Third main track, south side, Fullerton Junction to Atwood
83	Passenger Flyover at Atwood	San Bernardino	91 Line/PVL	2.04	2035	Passenger flyover, added north side track, to Main 3, Atwood
84	Mains at Atwood	San Bernardino	91 Line/PVL/IEOC	23.39	2035	Third and fourth main tracks, Atwood, platform extensions
85	Crossovers at Atwood	San Bernardino	91 Line/PVL	11.00	2035	Crossovers and Turnouts at Atwood
86	Main from West Hobart to Fullerton	San Bernardino	91 Line/PVL/OCL	21.43	2035	Fourth main track, West Hobart to Fullerton, Commerce Yard Lead.
87	Flyover at Commerce	San Bernardino	91 Line/PVL/OCL	0.52	2035	Passenger flyover, Main 4 at Commerce, total flyover 2746 feet, new station platform
88	Second Flyover at Commerce	San Bernardino	91 Line/PVL/OCL	1.15	2035	Second passenger flyover, Main 1 to Main 3, and new westward platform 633 feet
89	Crossovers and Turnouts from West Hobart to Fullerton	San Bernardino	91 Line/PVL/OCL	7.00	2035	Crossovers and Turnouts
90	Fullerton Station Improvements	San Bernardino	91 Line/PVL/OCL	0.21	2035	Fourth track and platform, 1100 feet
91	Main from Ontario to South Fontana	Alhambra	N/A	9.43	2035	Second main track, Ontario to South Fontana
92	Main from Weeds to Hamilton	Los Angeles	Riverside Line	27.80	2035	Third main track, Weeds to Hamilton
93	Main at Hamilton to SCRRA Junction	Los Angeles	Riverside Line	10.76	2035	Second main track, Hamilton to SCRRA Junction
94	Main from Las Posas to Oxnard	Santa Barbara	Ventura Line	23.17	2035	Second main track, CP Las Posas to Oxnard
95	Main from Montalvo to Ventura	Santa Barbara	Ventura Line	10.81	2035	Second main track, Montalvo to Ventura
96	Main from Citrus to Marlboro	Perris Valley	91/PVL	0.80	2035	Second main track, CP Citrus to CP Marlboro
97	Main from Perris Downtown to Perris South	Perris Valley	91/PVL	2.26	2035	Second main track, Perris Downtown to Perris South
98	Riverside Downtown Station Improvements	Perris Valley	91/Perris/IEOC/ Riverside Line	0.21	2035	Riverside Downtown Station, East Side third station track, approximately 1100 feet
Total Metrolink				**146 Route Miles**		

Source: AECOM, 2021

The 2035 Alternate Case assumed a lower level of capital investment versus the 2035 Case. Specifically, between Fullerton and Highgrove on the BNSF San Bernardino Subdivision, the fourth main track modeled in the earlier 2035 Case was removed except between Fullerton and Atwood, and between CP Prado Dam and La Sierra. These modifications for the third track project between Fullerton and Rana were required because the Metrolink Milestone 2 timetable produces meets between opposing Metrolink trains just east of Placentia, and again at the west end of CP Prado Dam. The case does include the northward extension of the third main track from Highgrove, under the UP flyover at Old Colton, to Gonzales. All the added UP physical plant on the Los Angeles Subdivision in the earlier 2035 case was removed except the two added second main track segments from Hamilton to Bon View and Limonite to Arlington required to close the remaining single-track gaps on the line. Accordingly, the alternate case is modeled with two main tracks the entire distance between East Yard and SCRRA Junction (West Riverside).

Lastly, the 2050 Case required no additional capital improvements. The full list of capital improvements assumed for each future year simulation case are noted with their cost estimates in Task 5 technical memorandum, along with potential funding sources. The projects required in addition to SCORE projects in 2035 are referred to in that tech memo as Beyond SCORE projects.

3.4.4 Rail Simulation Findings and Conclusions

Based on the simulations described above, the following findings and conclusions are noted below by future year simulation case.

2028 Case

- SCORE improvements provide the capacity to handle Metrolink Milestone 1B train volumes.

2035 Case

- Freight performance generally decays relative to the Base Case and 2028.
- On BNSF San Bernardino Subdivision from Hobart to Riverside La Sierra, a fourth main track is required.
- West of Fullerton, passenger trains use the two outside tracks and freights the two inside tracks.
- On UP Los Angeles Subdivision, three main tracks are needed between Soto Street and Pomona, and two main tracks are needed between Pomona and SCRRA Junction at West Riverside.
- On UP Alhambra Subdivision, two main tracks needed between Ontario and South Fontana.
- On UP Santa Barbara Subdivision, a second main track needed between Las Posas and Oxnard, also between Montalvo and Ventura.
- Freight train increases are mitigated by making trains longer.
- Metrolink Milestone 2 schedules are not completely integrated with *Pacific Surfliner* schedules, triggering a need for capacity improvements.
- The case assumed that HSR trains could operate on the two passenger tracks on the BNSF San Bernardino Subdivision between Soto Street and Fullerton. This assumption was tested in the 2035 Case Alternate.

2035 Alternate Case

- Operating HSR trains between LAUS and Anaheim across the two shared passenger-only tracks required creating an integrated timetable for all passenger trains. The Metrolink and Amtrak/LOSSAN schedules were left undisturbed, and the HSR trains were fitted into remaining slots.
- Since the HSR trains operate in slots between Metrolink trains that are stopping at Buena Park, Norwalk, and sometimes Commerce, the HSR trains cannot operate to schedules that are much, if at all, faster than the Metrolink times – 35 minutes at best. The two dedicated passenger tracks do not leave room for sidings in addition, so overtakes as between passenger trains are not possible.

- As for the BNSF and UP freight services, this case shows marked improvement in freight performance for both carriers.
    - Because of downsizing the physical plant improvements on the UP and BNSF, this case curtailed the late night/very early morning Milestone 2 schedules: the last trains in the evening are modelled to clear the network by about 9:30 pm, and the first morning trains enter the network about 4 am.
    - Delays on the UP declined in this case to about 9 percent over those in the 2028 case: performance in the San Fernando Valley improved, as did performance across the Los Angeles Subdivision, even with less added plant and a modest increase in Riverside commuter trains.
    - On the BNSF San Bernardino Subdivision, the improvement was more dramatic: 36 percent better than the 2028 case. This improvement is due entirely to the complete segregation of the freight and passenger service between Soto Street and La Sierra.
- The improvement in UP performance was achieved even with an increase in Coachella Valley service from two in the 2035 Case to four trains in the 2035 Case Alternate.

2050 Case

- The quarter-hour headways on the Metrolink Antelope Valley Line (Santa Clarita-LAUS) and on the Ventura County and Orange County Lines (Moorpark-LAUS-Laguna Niguel) can be accommodated. OTP declines slightly for Amtrak, but it remains unchanged for Metrolink and HSR from the 2035 Alternate Case.
- Freight train performance also decays slightly for both UP and BNSF relative to the 2035 Alternate Case, but delay levels remain well below those predicted for 2028 and 2035. The improved freight performance was achieved despite higher traffic volumes, as the impact of traffic increases were mitigated by increased train lengths and a more complete separation of passenger and freight trains.

Simulation Conclusion

As they are based on the Metrolink Milestone 1B and Milestone 2 service levels, the 2028 Case and the 2035 Case form the basis for the Strategic Corridor Vision developed in Section 6. The improvements supporting both cases noted above are costed in Section 4, where potential funding sources for the improvement are also summarized.

The 2035 Alternate Case is important, as it shows that all passenger trains, including HSR, can share two dedicated passenger tracks between Soto Street, Fullerton Junction and Atwood, and two reverse-signaled main tracks between Fullerton and Anaheim. The plant configuration of the BNSF San Bernardino Subdivision requires that freight trains have unimpeded access to all freight facilities west of Fullerton, including the freight yards at Basta, Buena Park, La Mirada, Santa Fe Springs, Pico Rivera, Commerce and Hobart. This access requires passenger flyovers at these locations so that freight movements do not have to cross passenger trackage at grade.

This case also imposes curfews on the passenger operation between about 9:30 pm and 4:00 am to create the required night-time freight capacity and to allow for maintenance of track and signals, and it requires a fully integrated passenger timetable for all three (or four, if LOSSAN is considered a separate one) passenger operators.

These findings validate the findings in the previous modeling work done to support discussions between BNSF, the California High Speed Rail Authority, and Caltrans: that exercise also concluded that separation of freight and passenger services between Soto Street and Fullerton would be required if HSR was to share the conventional passenger trackage with Amtrak and Metrolink, and that specific slots would be required for each passenger train to accommodate the close headways in the same direction.

The 2050 Case proves that even higher frequencies for Metrolink trains on at least two lines is possible without added improvements; and that the impacts of increasing passenger volumes, including HSR, on freight operations in shared corridors can be minimized if passenger and freight trains are separated from

one another. This case also shows that the appropriate investment in expanded physical plant by 2035 can create capacity for further growth in freight service without a substantial decay in commercial or operating performance. This is particularly true if added intermodal container transfer capacity is built in the Inland Empire for both UP and BNSF.

3.5 GHG Summary from RTC Simulation Fuel Consumption Output

This section provides a summary analysis of greenhouse gas (GHG) emissions generated in the 2028 and 2035 Cases, which form the Strategic Corridor Vision discussed in Section 6. The analysis is based primarily on fuel consumption figures and associated detail generated assumed for the RTC operations simulation effort described above.

3.5.1 Criteria Air Pollutants and GHG Emissions Summary for Freight and Passenger Rail

Criteria air pollutants and GHG emissions were estimated for the freight and passenger rail operations simulation cases (the 2019 Base Case, the 2028 Case, and the 2035 Case). The following section includes a brief introduction to criteria air pollutants and GHGs, the methodology for the emission estimates, emissions results by simulation case, and an evaluation of avoided emissions attributable to avoided personal automobile trips as a result of increased passenger rail ridership.

Criteria Air Pollutants Background

Six air pollutants have been identified by the U.S. Environmental Protection Agency (USEPA) and the California Air Resources Board (CARB) as being of concern, both on a nationwide and statewide level: ozone[30], carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), lead[31], and particulate matter (PM), which is subdivided into PM equal to or less than 10 micrometers in diameter (PM_{10}) and PM equal to or less than 2.5 micrometers in diameter ($PM_{2.5}$). Because the air quality standards for these air pollutants are regulated using human and environment health-based criteria, they are commonly referred to as criteria air pollutants.

Greenhouse Gases Background

Certain gases in the earth's atmosphere, classified as GHGs, play a critical role in determining the earth's surface temperature. A portion of the solar radiation that enters earth's atmosphere is absorbed by the earth's surface, and a smaller portion of this radiation is reflected back toward space. Infrared radiation is absorbed by GHGs; as a result, infrared radiation released from the earth that otherwise would have escaped back into space is instead "trapped," resulting in a warming of the atmosphere. This phenomenon, known as the "greenhouse effect," is responsible for maintaining a habitable climate on Earth. GHGs are present in the atmosphere naturally, are released by natural sources and anthropogenic (generated by human activity) sources, and they are formed from secondary reactions taking place in the atmosphere.

Anthropogenic GHG emissions have increased since the pre-industrial era, driven largely by economic and population growth, and are now higher than ever. This has led to atmospheric concentrations of GHGs that are unprecedented in at least the last 800,000 years. Their effects, together with those of other anthropogenic drivers, have been detected throughout the climate system and are extremely likely to have

[30] Ozone is not emitted directly into the air but is formed through a series of reactions involving volatile organic compounds (VOCs) and nitrogen oxides (NO_X) in the presence of sunlight. VOCs and NO_X are referred to as "ozone precursors." Because ozone is not directly emitted, air quality regulations are focused on reducing the ozone precursors, VOCs and NO_X.
[31] This analysis does not directly evaluate lead because little to no quantifiable and foreseeable emissions of these substances would be generated by the project. Lead emissions have significantly decreased due to the near elimination of leaded fuel use.

been the dominant cause of the observed warming since the mid-20th century[32]. The following are GHGs that are widely accepted as the principal contributors to human-induced global climate change and that are relevant to fuel combustion associated with freight and passenger rail, as well as on-road vehicle travel: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). As individual GHGs have varying heat-trapping properties and atmospheric lifetimes, GHG emissions are converted to carbon dioxide equivalent (CO_2e) units for comparison. The CO_2e is a consistent methodology for comparing GHG emissions because it normalizes the global warming effect of different GHG emissions to a consistent measure.

3.5.2 Emission Estimates Methodology

Criteria air pollutants emission estimates were calculated using the USEPA Emission Factors for Locomotives[33], which provides average emission factors in grams per brake horsepower-hour (g/bhp-hr) for hydrocarbons, nitrogen oxides (NO_X), CO, and PM_{10} by locomotive engine tier. Consistent with USEPA methodology, volatile organic compounds (VOC) emissions were assumed to be equal to approximately 1.053 times the hydrocarbon emissions. Similarly, it was assumed that $PM_{2.5}$ emissions make up approximately 97 percent of the PM_{10} emissions[34]. The horsepower and load factor could vary by train and the specific time spent in total load and notch levels can vary based on specific activity and terrain. As detailed in the USEPA methodology, a single locomotive's emission rates can also vary throughout its life as the engine ages and as ambient conditions change. Thus, the values presented in the USEPA methodology are intended to reflect average emission rates and the calculations account for average idling time and time the locomotive engine spends in each notch power level. Therefore, because the simulation cases reflect aggregate future rail activity and are not disaggregated at a single train level, the anticipated total fuel consumption per simulation case by locomotive engine tier was instead used to inform emissions estimates. Thus, the emission factors in g/bhp-hr were expressed as grams of pollutant emitted per gallon of fuel consumed (g/gallon) using brake horsepower-hour per gallon factor of 20.8 for large line-haul and passenger locomotive applications[35]. Additional methodology details are provided in Appendix C.

GHG emission estimates (CO_2, CH_4, and N_2O) and emissions of SO_X were calculated using the properties of the diesel fuel used by the locomotives as gram per gallon emissions of these pollutants are largely independent of engine parameters and are primarily dependent on fuel properties. The emission rates per gallon of diesel fuel combusted were based on the USEPA Greenhouse Gas Equivalencies Calculator – Calculations and References[36] and USEPA Emission Factors GHG Inventories[37]. The SO_X emission rate was calculated based on the approximate density of diesel fuel, the sulfur content of diesel fuel per CARB regulations (15 parts per million), and an oxidation factor. Additional methodology details are provided in Appendix C.

In addition to emission estimates associated with locomotive engine use for the passenger and freight rail, this analysis also estimated the avoided emissions from passenger cars attributable to the reduction in personal automobile trips for passenger rail riders. The avoided emissions were calculated using the estimated passenger miles and a weighted average vehicle emission factor for light duty autos, trucks, and motorcycles, for the SCAG region in the applicable simulation case years. The emission factors were based

[32] Intergovernmental Panel on Climate Change, Climate Change 2014 Synthesis Report Summary for Policymakers, 2014, https://www.ipcc.ch/site/assets/uploads/2018/02/AR5_SYR_FINAL_SPM.pdf, (accessed December 2021).
[33] United States Environmental Protection Agency, Technical Highlights Emission Factors for Locomotives, April 2009, https://nepis.epa.gov/Exe/ZyPDF.cgi/P100500B.PDF?Dockey=P100500B.PDF, (accessed December 2021).
[34] Ibid.
[35] Ibid.
[36] United States Environmental Protection Agency, 40 CFR Parts 85, 86, and 600; 49 CFR Parts 531, 533, 536, et al, Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards; Final Rule, 2010, https://www.govinfo.gov/content/pkg/FR-2010-05-07/pdf/2010-8159.pdf, (accessed December 2021).
[37] United States Environmental Protection Agency, Emission Factors for Greenhouse Gas Inventories, April 2021, https://www.epa.gov/sites/default/files/2021-04/documents/emission-factors_apr2021.pdf, (accessed December 2021).

on CARB's on-road vehicle emissions inventory, EMFAC2021[38]. Passenger miles for each simulation case were based on daily or annual passenger miles data as reported by Metrolink or ridership and average trip distance data from Amtrak, and were divided by an average vehicle occupancy factor of 1.48 based on the SCAG Regional Travel Demand Model for vehicle occupancy for all time periods (peak and non-peak periods) and all trip purposes to approximate avoided vehicle miles traveled[39]. Additional methodology details are provided in Appendix C.

3.5.3 Emission Estimates Results

The following tables summarize the total annual emissions associated with freight rail (**Table 24** through **Table 26**) and passenger rail (**Table 27** through **Table 29**) under each simulation case (the 2019 Base Case, the 2028 Case, and the 2035 Case).

Freight Rail

Table 23 Freight Rail Annual Emissions - 2019 Base Case

Tier	Annual Fuel Consumption (gallons)	VOC	NO_X	CO	PM_{10}	$PM_{2.5}$	SO_X	CO2	CH_4	N_2O	CO_2e
		tons per year						metric tons per year			
Tier 2	1,658,326.8	10.41	188.21	48.67	6.84	6.64	0.17	16,881.77	1.33	0.43	17,033.17
Tier 4	38,724,067.2	37.40	887.87	1,136.47	13.32	12.92	3.89	394,211.00	30.98	10.07	397,746.51
Total	**40,382,394.0**	**47.81**	**1,076.08**	**1,185.14**	**20.16**	**19.56**	**4.06**	**411,092.77**	**32.31**	**10.50**	**414,779.68**

Source: AECOM, 2021
Notes: VOC = volatile organic compounds; NO_X = nitrogen oxides; CO = carbon monoxide; PM_{10} = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; SO_X = sulfur oxides; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; CO_2e = carbon dioxide equivalents
Refer to Appendix C for calculations and source information.

Table 24 Freight Rail Annual Emissions - 2028 Case

Tier	Annual Fuel Consumption (gallons)	VOC	NO_X	CO	PM_{10}	$PM_{2.5}$	SO_X	CO2	CH_4	N_2O	CO_2e
		tons per year						metric tons per year			
Tier 2	1,631,973.2	10.24	185.22	47.90	6.74	6.53	0.16	16,613.49	1.31	0.42	16,762.49
Tier 4	43,502,508.4	42.01	997.43	1,276.71	14.96	14.51	4.37	442,855.54	34.80	11.31	446,827.31
Total	**45,134,481.6**	**52.26**	**1,182.65**	**1,324.60**	**21.70**	**21.05**	**4.54**	**459,469.02**	**36.11**	**11.73**	**463,589.80**

Source: AECOM
Notes: VOC = volatile organic compounds; NO_X = nitrogen oxides; CO = carbon monoxide; PM_{10} = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; SO_X = sulfur oxides; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; CO_2e = carbon dioxide equivalents
Refer to Appendix C for calculations and source information.

Table 25 Freight Rail Annual Emissions - 2035 Case

Tier	Annual Fuel Consumption (gallons)	VOC	NO_X	CO	PM_{10}	$PM_{2.5}$	SO_X	CO2	CH_4	N_2O	CO_2e
		tons per year						metric tons per year			
Tier 2	1,567,415.2	9.84	177.89	46.00	6.47	6.27	0.16	15,956.29	1.25	0.41	16,099.39
Tier 4	49,286,374.8	47.60	1,130.04	1,446.45	16.95	16.44	4.95	501,735.30	39.43	12.81	506,235.14
Total	**50,853,790.0**	**57.44**	**1,307.93**	**1,492.46**	**23.42**	**22.72**	**5.11**	**517,691.58**	**40.68**	**13.22**	**522,334.53**

Source: AECOM
Notes: VOC = volatile organic compounds; NOX = nitrogen oxides; CO = carbon monoxide; PM10 = particulate matter less than 10 microns in diameter; PM2.5 = particulate matter less than 2.5 microns in diameter; SOX = sulfur oxides; CO2 = carbon dioxide; CH4 = methane; N2O = nitrous oxide; CO2e = carbon dioxide equivalents

[38] California Air Resources Board, EMFAC2021, https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/msei-modeling-tools, (accessed December 2021).
[39] Southern California Association of Governments, Regional Travel Demand Model and 2012 Model Validation, March 2016, https://scag.ca.gov/sites/main/files/file-attachments/scag_rtdm_2012modelvalidation.pdf?1605571641, (accessed December 2021).

Passenger Rail

Table 26 Passenger Rail Annual Emissions - 2019 Base Case

Tier	Annual Fuel Consumption (gallons)	VOC	NO_X	CO	PM_{10}	$PM_{2.5}$	SO_X	CO2	CH_4	N_2O	CO_2e
		tons per year						metric tons per year			
Tier 2	474,193.2	2.98	53.82	13.92	1.96	1.90	0.05	4,827	0.38	0.12	4,870.58
Tier 4	7,801,799.2	7.53	178.88	228.97	2.68	2.60	0.78	79,422	6.24	2.03	80,134.62
Total	**8,275,992.4**	**10.51**	**232.70**	**242.88**	**4.64**	**4.50**	**0.83**	**84,249.60**	**6.62**	**2.15**	**85,005.20**

Source: AECOM
Notes: VOC = volatile organic compounds; NOX = nitrogen oxides; CO = carbon monoxide; PM10 = particulate matter less than 10 microns in diameter; PM2.5 = particulate matter less than 2.5 microns in diameter; SOX = sulfur oxides; CO2 = carbon dioxide; CH4 = methane; N2O = nitrous oxide; CO2e = carbon dioxide equivalents
Refer to Appendix C for calculations and source information.

Table 27 Passenger Rail Annual Emissions - 2028 Case

Tier	Annual Fuel Consumption (gallons)	VOC	NO_X	CO	PM_{10}	$PM_{2.5}$	SO_X	CO2	CH_4	N_2O	CO_2e
		tons per year						metric tons per year			
Tier 2	474,609.2	2.98	53.87	13.93	1.96	1.90	0.05	4,832	0.38	0.12	4,874.85
Tier 4	10,260,140.8	9.91	235.25	301.11	3.53	3.42	1.03	104,448.23	8.21	2.67	105,384.98
Total	**10,734,750.0**	**12.89**	**289.11**	**315.04**	**5.49**	**5.32**	**1.08**	**109,279.76**	**8.59**	**2.79**	**110,259.84**

Source: AECOM
Notes: VOC = volatile organic compounds; NOX = nitrogen oxides; CO = carbon monoxide; PM10 = particulate matter less than 10 microns in diameter; PM2.5 = particulate matter less than 2.5 microns in diameter; SOX = sulfur oxides; CO2 = carbon dioxide; CH4 = methane; N2O = nitrous oxide; CO2e = carbon dioxide equivalents
Refer to Appendix C for calculations and source information.

Table 28 Passenger Rail Annual Emissions - 2035 Case

Tier	Annual Fuel Consumption (gallons)	VOC	NO_X	CO	PM_{10}	$PM_{2.5}$	SO_X	CO2	CH_4	N_2O	CO_2e
		tons per year						metric tons per year			
Tier 2	682,151.6	4.28	77.42	20.02	2.82	2.73	0.07	6,944	0.55	0.18	7,006.58
Tier 4	20,405,314.8	19.71	467.85	598.85	7.02	6.81	2.05	207,726.10	16.32	5.31	209,589.11
Total	**21,087,466.4**	**23.99**	**545.28**	**618.87**	**9.83**	**9.54**	**2.12**	**214,670.41**	**16.87**	**5.48**	**216,595.69**

Source: AECOM
Notes: VOC = volatile organic compounds; NOX = nitrogen oxides; CO = carbon monoxide; PM10 = particulate matter less than 10 microns in diameter; PM2.5 = particulate matter less than 2.5 microns in diameter; SOX = sulfur oxides; CO2 = carbon dioxide; CH4 = methane; N2O = nitrous oxide; CO2e = carbon dioxide equivalents
Refer to Appendix C for calculations and source information.

3.5.4 Evaluation of Rail Benefits for Air Quality and Climate Change Planning

Passenger Rail

The transportation sector is the largest source of GHG emissions in California, accounting for approximately 40 percent of all GHG emissions in the state[40]. More motor vehicles are registered in California than in any other state, and commute times in California are among the longest in the country[41]. Access to viable public transportation, including passenger rail, is a key element in California's sustainable transportation strategy for reducing single-occupancy vehicles and the associated vehicle miles traveled; and thereby, the associated air pollutant and GHG emissions. With an increase in improvements to existing rail infrastructure to support the ambitious ridership targets and goals for improved service, emissions from passenger cars are avoided attributable to the shift in transportation mode from personal automobile trips to train trips for passenger rail riders. **Table 29** through **Table 31** present a net criteria air pollutant and GHG emissions

[40] California Air Resources Board, Current California GHG Emissions Inventory Data: 2000-2019 GHG Inventory (2021 Edition), https://ww2.arb.ca.gov/ghg-inventory-data, (accessed December 2021).
[41] United States Energy Information Administration, California State Profile and Energy Estimates, 2021, https://www.eia.gov/state/analysis.php?sid=CA, (accessed December 2021).

summary, which includes the emissions from passenger rail and subtracts the avoided passenger car emissions, under each simulation case.

Table 29 Passenger Rail Net Annual Emissions - 2019 Base Case

Description	VOC	NO_X	CO	PM_{10}	$PM_{2.5}$	SO_X	CO_2e
	tons per year						metric tons per year
Passenger Rail Emissions	10.51	232.70	242.88	4.64	4.50	0.83	85,005.20
Avoided Passenger Car Emissions	13.99	50.90	642.20	0.91	0.84	1.58	146,148.70
Net Emissions	**-3.48**	**181.79**	**-399.32**	**3.73**	**3.66**	**-0.75**	**-61,143.50**

Source: AECOM
Notes: VOC = volatile organic compounds; NOX = nitrogen oxides; CO = carbon monoxide; PM10 = particulate matter less than 10 microns in diameter; PM2.5 = particulate matter less than 2.5 microns in diameter; SOX = sulfur oxides; CO2e = carbon dioxide equivalents
Refer to Appendix C for calculations and source information.

As shown in **Table 30**, under the 2019 Base Case, the passenger rail activity results in a net reduction in criteria air pollutant emissions of VOC, CO, and SO_X. However, passenger rail activity results in a net increase of criteria air pollutants of NO_X, PM_{10}, and $PM_{2.5}$ emissions. In terms of GHG emissions, the use of passenger rail results in substantial GHG savings of approximately 61,144 metric tons of CO_2e annually.

Table 30 Passenger Rail Net Annual Emissions - 2028 Case

Description	VOC	NO_X	CO	PM_{10}	$PM_{2.5}$	SO_X	CO_2e
	tons per year						metric tons per year
Passenger Rail Emissions	12.89	289.11	315.04	5.49	5.32	1.08	110,259.84
Avoided Passenger Car Emissions	9.27	29.84	529.74	0.86	0.79	1.98	182,290.19
Net Emissions	**3.62**	**259.27**	**-214.70**	**4.62**	**4.53**	**-0.90**	**-72,030.35**

Source: AECOM
Notes: VOC = volatile organic compounds; NOX = nitrogen oxides; CO = carbon monoxide; PM10 = particulate matter less than 10 microns in diameter; PM2.5 = particulate matter less than 2.5 microns in diameter; SOX = sulfur oxides; CO2e = carbon dioxide equivalents
Refer to Appendix C for calculations and source information.

As shown in **Table 31**, under the 2028 Case, the passenger rail activity continues to result in a net reduction in criteria air pollutant emissions of CO and SO_X. However, passenger rail activity results in a net increase of criteria air pollutants of VOC, NO_X, PM_{10}, and $PM_{2.5}$ emissions. In terms of GHG emissions, the use of passenger rail continues to result in substantial GHG savings of approximately 72,030 metric tons of CO_2e annually.

Table 31 Passenger Rail Net Annual Emissions – 2035 Case

Description	VOC	NO_X	CO	PM_{10}	$PM_{2.5}$	SO_X	CO_2e
	tons per year						metric tons per year
Passenger Rail Emissions	23.99	545.28	618.87	9.83	9.54	2.12	216,595.69
Avoided Passenger Car Emissions	9.36	28.16	607.03	0.78	0.71	2.55	235,207.45
Net Emissions	**14.63**	**517.12**	**11.84**	**9.06**	**8.82**	**-0.43**	**-18,611.75**

Source: AECOM
Notes: VOC = volatile organic compounds; NOX = nitrogen oxides; CO = carbon monoxide; PM10 = particulate matter less than 10 microns in diameter; PM2.5 = particulate matter less than 2.5 microns in diameter; SOX = sulfur oxides; CO2e = carbon dioxide equivalents
Refer to Appendix C for calculations and source information.

As shown in **Table 32**, under the 2035 Case, the passenger rail activity continues to result in a net reduction in criteria air pollutant emissions of SO_X. However, passenger rail activity results in a net increase of criteria air pollutants of VOC, NO_X, CO, PM_{10}, and $PM_{2.5}$ emissions. In terms of GHG emissions, the use of passenger rail continues to result in GHG savings of approximately 18,612 metric tons of CO_2e annually.

Important Considerations: Passenger Rail

In summary, passenger rail activity results in substantial GHG emission savings; however, since locomotive engines are diesel-fueled, and locomotive diesel engines emit higher criteria air pollutant emissions on a gram per gallon of fuel or gram per mile traveled basis, passenger rail activity results in a net increase in criteria air pollutants. It should be noted that the passenger car fleet mix benefits from substantial fuel efficiency and technology improvements over time due to USEPA and California regulations, such as the Advanced Clean Cars Program and Corporate Average Fuel Economy (CAFE) standards, as well as projected new vehicle sales and increased integration of alternative-fueled passenger vehicles (electric and plug-in hybrid vehicles).

While the analysis considers an increase in Tier 4 locomotive use for the later-year simulation cases, the analysis does not account for any locomotive engine improvements in fuel efficiency or shift to renewable fuels, such as biodiesel or battery electric locomotives. For example, as described in Metrolink's Climate Action Plan, Metrolink has a target of transitioning to locomotive fleet fuel from petroleum diesel to renewable diesel by 2022. A pilot program is underway utilizing a single Tier 2 locomotive to test renewable plant-based diesel fuel. If the Tier 2 pilot proves successful, testing will begin on a single new Tier 4 locomotive. If all goes well with the Tier 4 locomotive, then Metrolink can transition its entire fleet to renewable diesel fuel. As described in Metrolink's Climate Action Plan, this transition could result in added reductions up to 80 percent of CO_2 as well as a potential annual decrease of 5 percent in hydrocarbons, 10 percent in NO_X, 30 percent in PM and 35 percent in CO emissions. Similarly, Metrolink also notes piloting electrification via dual-mode locomotive as a top measure toward accelerating a zero emissions future[42].

Furthermore, it should also be mentioned that the net emissions summary presented above is sensitive to the average vehicle occupancy factor assumed for passenger vehicles. As described in the methodology section above, the analysis assumed a vehicle occupancy factor of 1.48 for all time periods and all trip purposes (inclusive of peak and off-peak periods as well as home-based school and non-home-based trip purposes). However, this is a conservative average vehicle occupancy factor as passenger rail riders are typically work commuters during peak periods and would likely observe a lower vehicle occupancy factor. For example, the SCAG 2012 Regional Travel Demand Model estimates a 1.10 vehicle occupancy for home-based work trips[43].

Important Considerations: Freight Rail

While this analysis did not quantify the emissions reductions achieved by transporting goods and cargo by train versus trucks, due to uncertainties and variability in quantity of truck trips by specific goods (e.g., cargo weight) depending on the costs and throughput for shippers and customers of goods within the SCAG region, the analysis reviewed recent analyses conducted by CARB. As described in more detail in the *Truck vs. Train Emissions Analysis* conducted by CARB in September 2020, CARB compared both current emissions and future projected emissions of $PM_{2.5}$ and NO_X from moving cargo by both trucks and trains and determined that trucks will be the cleaner mode (in terms of $PM_{2.5}$ and NO_X emissions) to move cargo by 2023 due to the increasing regulatory requirements on truck fleets and movement towards zero emission technology[44]. CARB staff also performed an additional analysis to compare GHG emissions between trucks and trains, which showed that movement of cargo by train has consistently had lower GHG emissions;

[42] Metrolink, Climate Action Plan, March 2021, https://metrolinktrains.com/globalassets/about/agency/sustainability/climate-action-plan.pdf, (accessed December 2021).
[43] Southern California Association of Governments, Regional Travel Demand Model and 2012 Model Validation, March 2016, https://scag.ca.gov/sites/main/files/file-attachments/scag_rtdm_2012modelvalidation.pdf?1605571641, (accessed December 2021).
[44] California Air Resources Board, Draft Truck vs. Train Emissions Analysis, September 2020, https://ww2.arb.ca.gov/resources/fact-sheets/draft-truck-vs-train-emissions-analysis, (accessed December 2021).

however, the gap is closing and a full zero emissions truck fleet by 2045 would result in less emissions from trucks than trains.

CARB acknowledges that the increase in Tier 4 locomotive use in the freight rail sector would reduce NO_X and $PM_{2.5}$ emissions by over 80 percent compared to the typical trains operating in 2020. In addition, the introduction of Tier 5 technology would further reduce train emissions to keep pace with the transition to zero emission trucks in California.

An important consideration to note is that the use of freight rail and increase in physical capacity, efficiency and reliability for freight systems comprise an important strategy for alleviating congestion on existing highways[45] , which improves fuel economy for on-road vehicles and reduces queuing and stop-and-go conditions, thereby reducing emissions on highways. Furthermore, like passenger rail, the CARB analysis did not consider potential alternative locomotive and electrification technologies. For example, as detailed in the *Analysis of Freight Rail Electrification in the SCAG Region*[46], electrification of key main line railroad corridors in the Southern California region is one strategy that can reduce emissions from the freight transportation sector and would move the region closer to regional air quality attainment requirements. Like passenger rail, there are pilot programs underway to evaluate zero- and near-zero emission freight technologies. For example, Flexible Solutions for Freight Facilities[47] is a BNSF Railway-led initiative that includes the design, manufacture, and commission of a single battery electric locomotive (BEL) in commercial operations. Therefore, it can be anticipated that with the transition to near-zero and zero emission technologies and improvements to freight efficiency as directed by Governor Edmund Gerald (Jerry) Brown, Jr. in 2015 in Executive Order B-32-15[48], which calls for the development of an integrated freight action plan that establishes clear targets to improve freight efficiency, transition to zero-emission technologies, and increase the competitiveness of California's freight system, emissions from freight rail activities will decrease in the future.

[45] United States Department of Transportation, Traffic Congestion and Reliability: Linking Solutions to Problems, 2017, https://ops.fhwa.dot.gov/congestion_report_04/chapter4.htm, (accessed December 2021).
[46] Southern California Association of Governments, Analysis of Freight Rail Electrification in the SCAG Region, 2012, https://scag.ca.gov/sites/main/files/file-attachments/crgmsais_-_analysis_of_freight_rail_electrification_in_the_scag_region.pdf?1605991886, (accessed December 2021).
[47] California Air Resources Board, Flexible Solutions for Freight Facilities –San Joaquin Valley Zero- and Near Zero-Emission Enabling Freight Project, March 2020, https://ww2.arb.ca.gov/sites/default/files/movingca/pdfs/flexiblesolutions.pdf, (accessed December 2021).
[48] Office of Governor Edmund G. Brown Jr., Executive Order B-32-15, published July 17, 2015, https://www.ca.gov/archive/gov39/2015/07/17/news19046/index.html, (accessed December 2021).

4. Cost Estimates and Funding Opportunities

This section presents the cost methodology used to prepare the capital and operations and maintenance (O&M) cost estimates for the Study.

4.1 Cost Estimates Methodology and Results for Freight and Passenger Rail Improvements

4.1.1 Estimate Methodology

Scope of Capital Cost Estimates

The capital cost estimates include both SCORE projects and Beyond SCORE projects, as well as rail grade separation costs along these project segments from 2020 Connect SoCal. Cost estimates for SCORE projects are sourced from the 2018 Metrolink *SCORE Preliminary Study Report, Integrated Services and Capital Investments* report and the 2021 Metrolink SCORE *Cost-Benefit and Operations Analysis* report. Costs have been adjusted to the new year of expenditure, adding approximately 10-15 years of escalation, resulting in an increase of 40 to 60 percent over the costs presented in the 2018 cost estimates.

Capital cost estimates for the Beyond SCORE projects have been generated using unit costs prepared by AECOM for the 2018 *California State Rail Plan*, adjusted to 2021 base year dollar. The scope of the capital cost estimates includes all construction costs, design costs through final design, environmental costs and all other professional services, and program costs necessary to develop and deliver the projects to revenue service. The capital cost estimate has been prepared using a Cost Catalog method where unit cost pricing has been developed for typical project elements and applied to individual projects based on high level assumptions about the length of route, number of stations, and other key component details. This method allows the planning team flexibility to adjust level of service assumptions with relative ease to compare costs for different bus and rail service.

Capital costs are based on average system costs of similar systems by mode type and are not based on detailed design decisions or assumptions. No specific cost savings can be determined at this stage regarding design modifications or substitutions since the costs are averages.

Scope of Operations and Maintenance Cost Estimates

The O&M cost estimates include all standard operations, equipment, repair, fuel, and energy costs used in typical operations. These costs do not include capital improvements or replacement costs. Operations and maintenance costs are based on an average cost per annual revenue mile for SCRRA (Metrolink), LOSSAN (*Pacific Surfliner*), and Amtrak long-distance services (the *Coast Starlight*, the *Sunset Limited*, and the *Southwest Chief*) operating across the RTC simulation network, as discussed in Section 3.

Basis of Estimate

The cost estimates are based on a project list generated from the rail simulation modeling effort described in Section 3. These estimates include a comprehensive cost for all SCORE projects and Beyond SCORE projects that are required by the RTC rail simulation model for the network to operate efficiently with the anticipated passenger service headways and the forecasted container and carload train volumes used in this Study.

4.1.2 Capital Cost Estimate

Table 33 presents the Summary of Capital Costs for the Southern California Passenger and Freight Rail Network necessary to facilitate the combination of forecasted freight volumes and desired passenger rail service in the year 2035. This table includes all SCORE projects (included in the 2018 Metrolink SCORE report), Beyond SCORE projects, and grade crossing and safety improvement projects. Note that the **Grade Crossings and Separation Improvements** are SCAG estimates from 2020 Connect SoCal, are represent potential future projects region-wide and were not part of the RTC simulation analysis or Economic Analysis. Grade crossing and separation improvements were overlayed across line capacity improvements to provide a comprehensive corridor capital cost approach.

Table 32 Executive Capital Cost Summary- SCORE and Beyond SCORE

	SCORE		BEYOND SCORE		TOTAL	
	Total Cost in Million BYD 2021$	Total Cost in Millions Revised YOE	Total Cost in Million BYD 2021$	Total Cost in Millions YOE	Total Cost in Million BYD 2021$	Total Cost in Millions YOE
Line Capacity Improvements						
BNSF (Class 1 Freight) ROW	$2,469	$3,524	$2,047	$3,206	$4,516	$6,730
UP (Class 1 Freight) ROW	Not Available	Not Available	$1,471	$2,304	$1,471	$2,304
SCRRA (Commuter Passenger) ROW	$3,209	$4,479	$106	$168	$3,315	$4,647
Subtotal Line Capacity and MSF Improvements	$5,678	$8,003	$3,624	$5,678	$9,302	$13,681
Grade Crossings and Separation Improvements						
Constrained List*					$5,900	$5,900
TOTAL	**$5,678**	**$8,003**	**$3,624**	**$5,678**	**$15,202**	**$19,581**

Source: AECOM, 2021, Note: Grade Crossings and Separation Improvements utilized YOE costs from 2020 Connect SoCal and are the same for BYD 2021$ and YOE columns.

4.1.3 Operations and Maintenance Cost Estimate

The 2019 Base Year operations and maintenance (O&M) costs for Metrolink, Amtrak long-distance, and LOSSAN *Pacific Surfliner* trains across the RTC simulation network totaled to an estimated $415.7 million annually. The calculation is based on 92,722 weekly passenger train miles (an RTC output) multiplied by an average $86 per train mile for all three passenger services.

The $86-per-train mile figure is largely driven by Metrolink's $88 per train mile, per SCRRA's *Fiscal Year 2018-19 Adopted Budget*, as Metrolink generated about 63 percent of total train miles for all three services. O&M cost for Amtrak's daily *Southwest Chief*, daily *Coast Daylight*, and tri-weekly *Sunset Limited* averaged to about $65 per train mile. LOSSAN's *Pacific Surfliner* O&M cost, with multiple departures daily, averaged to about $85 per train mile[49]. Future year O&M costs will grow with train volume and a 3.5 percent annual escalation to account for potential cost inflation. Mitigating the increase will be two factors:

- Economies of scale, which lowers O&M costs. Higher frequencies for Metrolink and LOSSAN allow an illustrative 6 percent reduction in O&M in 2028 in year of expenditure dollars. A further ramping up of Metrolink train volumes allows for a 45 percent reduction in 2035 from 2019 to $48 per train mile, as predicted in Metrolink's 2021 *Cost-Benefit and Operations Analysis*.

[49] Amtrak and LOSSAN O&M costs per train mile derived from Amtrak System Timetable of June 2018 and Amtrak Monthly Performance report, September 2019.

- Metrolink's increasing share of total train miles, which will reach 79 percent in 2035.

As shown in **Table 34**, in 2028, total costs are estimated to reach $720.2 million annually in 2028 dollars given 125,458 weekly train miles. By 2035, O&M costs are estimated at $1,227.6 million annually in 2035 dollars given 252,719 weekly train miles. The average cost per train mile dips in 2035, as a result of the large expansion of Metrolink service (Milestone 2 service levels) and Metrolink's lower operating cost structure relative to Amtrak and LOSSAN in outer years.

Table 33 Estimated O&M Costs per Simulation Case

O&M Costs and Train Miles	2019 Base Case	2028 Case in YOE Dollars	2035 Case in YOE Dollars
Average O&M Cost per Train Mile	$86	$110	$93
Weekly Train Miles	92,722	125,458	252,719
Annual Train Miles	4,821,528	6,523,837	13,141,378
Annual O&M	$415,708,972	$720,151,464	$1,227,552,612

Source: AECOM, 2021

4.2 Funding Opportunities Summary

4.2.1 Federal Funding Options

The Federal Railroad Administration (FRA), the Federal Transit Administration (FTA) and U.S. Department of Transportation (USDOT) all have funding opportunities to different extents for passenger and freight rail projects in Southern California, such as the 2021 Federal Spending Bill, the Consolidated Rail Infrastructure and Safety Improvements (CRISI) Grant, the Urbanized Area Formula Funding and the Capital Investment Grants, as well as the USDOT Raise and Infrastructure For Rebuilding America (INFRA) Grant Programs. The most relevant funding programs from the federal administration are summarized below.

FRA

In November 2021, the five-year Passenger and Freight Rail Funding through the Infrastructure and Investment Jobs Act (IIJA) was signed into law by the Biden Administration and is poised to provide a generational opportunity to repair and modernize the transportation system across the US. IIJA appropriates a total of $66 billion in funding towards passenger and freight rail programs for FY 2022 through FY 2026, including:

- Federal-State Partnership for Intercity Passenger Rail Grants (est. $36 billion)
- Amtrak (est. $16 billion)
- Consolidated Rail Infrastructure and Safety Improvements (CRISI) Program ($5 billion)
- Hazards at Railway-Highway Crossings (est. $3 billion)

Additional funds are available through railroad improvement financing: authorizing $250 million over five years to provide credit assistance.[50]

Eligibility for these funding opportunities is consistent with FRA's competitive discretionary grant programs (e.g. State, Interstate Compact, Public agency, political subdivision, Amtrak, Class II railroad, any rail carrier, Transportation Research Board, University, or Non-profit Labor organization).[51]

Specifically, as mentioned above, IIJA provides $5 billion to the FRA CRISI competitive grant program for projects that improve the safety, efficiency, and reliability of intercity passenger and freight rail. IIJA expands

[50] The White House. November 2021. Fact Sheet: The Bipartisan Infrastructure Bill. https://www.whitehouse.gov/briefing-room/statements-releases/2021/11/06/fact-sheet-the-bipartisan-infrastructure-deal/
[51] CalSTA. 2021. The Infrastructure Investment and Jobs Act of 2021. https://calsta.ca.gov/-/media/calsta-media/documents/calsta-high-level-iija-analysis-a11y.pdf.

CRISI's eligibility to tribes and short line associations and clarifies eligibility for projects that prevent trespassing, fund innovative rail technologies, and improve hazardous material response plans.[52] Approximately $362 million was available for award in FY 2021 CRISI funding, and a wide range of projects are eligible for this program.[53]

For passenger and freight rail projects in Southern California, the likelihood of getting funding from IIJA formulaic and discretionary programs is high. IIJA will provide $40.19 billion in state formula funds for transportation projects in California over the next five years, including a 42 percent funding increase in FY 2022.[54]

FTA

The Urbanized Area Formula Funding program (49 U.S.C. 5307 and 5340) provides funding for transit capital and operating assistance and for transportation-related planning in urbanized areas, which is defined as a Census-designated area with a population of 50,000 or more (as determined by the U.S. Department of Commerce, Bureau of the Census). Public agencies with the legal authority to receive and dispense federal funds are considered eligible recipients of this program. According to FTA, eligible activities include planning, engineering, design and evaluation of transit projects and other technical transportation-related studies; capital investments in bus and bus-related activities such as replacement of buses, overhaul of buses, rebuilding of buses, crime prevention and security equipment and construction of maintenance and passenger facilities; and capital investments in new and existing fixed guideway systems including rolling stock, overhaul and rebuilding of vehicles, track, signals, communications, and computer hardware and software.[55]

The discretionary Capital Investment Grant (CIG) program provides funding for fixed guideway investments (such as new and expanded rapid rail, commuter rail, light rail, streetcars, bus rapid transit, and ferries, as well as corridor-based bus rapid transit investments that emulate the features of rail). Four categories are considered as eligible projects for this program, including New Starts, Small Starts, Core Capacity and Programs of Interrelated Projects. The CIG program is estimated to have over $2.3 billion in funding made available for eligible recipients, including state and local government agencies (transit agencies included).[56]

The passenger and freight rail projects in Southern California are very likely to get funding from these funding programs administrated by FTA as described above.

USDOT

The Rebuilding American Infrastructure with Sustainability and Equity (RAISE) program provides a unique opportunity for USDOT to invest in road, rail, transit and port projects across the US. The maximum grant award is $25 million, and no more than $100 million can be awarded to a single State. Up to $30 million will be awarded to planning grants, including at least $10 million to Areas of Persistent Poverty. The Department will award an equitable amount, not to exceed half of funding, to projects located in urban and rural areas respectively.[57]

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[52] CalSTA. 2021. The Infrastructure Investment and Jobs Act of 2021. https://calsta.ca.gov/-/media/calsta-media/documents/calsta-high-level-iija-analysis-a11y.pdf.
[53] FRA. 2021. CRISI Program. https://railroads.dot.gov/grants-loans/competitive-discretionary-grant-programs/consolidated-rail-infrastructure-and-safety-2
[54] American Road and Transportation Builders Association (ARTBA). 2021. Economic Impacts: Infrastructure Investment & Jobs Act. https://www.artba.org/wp-content/uploads/federal-investment/iija/CA.pdf
[55] USDOT. 2021. Urbanized Area Formula Program Grants. https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/funding/grants/37961/fast-act-section-5307-fact-sheet_0.pdf
[56] USDOT. 2021. Fixed Guideway Capital Investment Grants. https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/5309_Capital_Investment_Grant_Fact_Sheet.pdf
[57] USDOT. 2021. RAISE Discretionary Grants. https://www.transportation.gov/RAISEgrants

4.2.2 State Funding Options

Several state funding options are also available for passenger and freight rail projects in Southern California, as administrated by the California Department of Transportation (Caltrans), California State Transportation Agency (CalSTA), California Air Resources Board (CARB) and State Highway Account (SHA). The most relevant funding programs from the state are summarized below.

Caltrans

The Mills-Alquist-Deddeh Act (SB 325) was enacted by the California Legislature to improve existing public transportation services and encourage regional transportation coordination. Known as the Transportation Development Act (TDA) of 1971, this law provides funding to be allocated to transit and non-transit related purposes that comply with regional transportation plans. TDA established two funding sources; the Local Transportation Fund (LTF) and the State Transit Assistance (STA) fund, from which the STA funding was dedicated for transportation planning and mass transportation projects. The STA funds are appropriated by the legislature to the State Controller's Office, which then allocates the tax revenue to planning agencies and other selected agencies by formula. It is required that half of this funding be allocated based on population and other half be allocated according to transit operator revenues from the prior fiscal year.[58]

The STA is funded by fuel sales and excise taxes and the transportation improvement fee established under SB 1, and can be used for operating and capital purposes. Total funding amount is estimated to be $14.2 billion.[59]

CalSTA

The Transit and Intercity Rail Capital Program (TIRCP) receives a portion of the Transportation Improvement Fee revenues established by SB 1 and a continuous appropriation of 10 percent from the quarterly Cap-and-Trade auction proceeds deposited in the Greenhouse Gas Reduction Fund (GGRF), plus any annual budget allocations provided by enacted budget bills to fund capital improvements that will modernize the state's transportation systems. Rail capital projects, including intercity rail, commuter rail, light rail and other fixed guideway projects are all eligible for TIRCP grants, and the TIRCP funding estimate, award amount and the adopted program for TIRCP is based on anticipated revenue.[60] Approximately $500 million in TIRCP funding was awarded in each of the past two years.

CARB

The Global Warming Solutions Act of 2006 (AB 32) established the goal of reducing greenhouse gas emissions statewide to 1990 levels; subsequently, the California Air Resources Board adopted a regulation to establish a cap-and-trade program that places a "cap" on the aggregate GHG emissions from entities responsible for roughly 85 percent of the state's GHG emissions to achieve the goal set by AB 32. As part of the cap-and-trade program, CARB conducts quarterly auctions where it sells emission allowances. Revenues from the sale of these allowances fund projects that support the goals of AB 32, including transit and rail investments. Funds associated with non-transportation and High-Speed Rail are not included in this amount. Transit and rail investments will qualify for this funding opportunity, which has been estimated to be $2.2 billion in total.[61]

[58] Caltrans. 2021. Transportation Development Act. https://dot.ca.gov/programs/rail-and-mass-transportation/transportation-development-act
[59] California Transit Association. 2021. Transit Funding Overview. https://caltransit.org/advocacy/transit-funding-overview/
[60] CalSTA. 2021. Discussion Draft – 2022 Transit and Inter-city Rail Capital Program Guidelines. https://calsta.ca.gov/-/media/calsta-media/documents/tircp-cycle-5-discussion-draft-guidelines---20210809.pdf
[61] California ARB. 2021. Cap-and-Trade Program. https://ww2.arb.ca.gov/our-work/programs/cap-and-trade-program

STIP

The State Transportation Improvement Program (STIP) is a five-year capital improvement program that provides funding from the State Highway Account for projects that increase the capacity of the transportation system. Projects on state highways, local roads, intercity rail, or public transit systems can all potentially qualify for this funding opportunity. The Regional Transportation Planning Agencies (RTPAs) propose 75 percent of STIP funding for regional transportation projects in Regional Transportation Improvement Programs (RTIPs); Caltrans proposes 25 percent of STIP funding for interregional transportation projects in the Interregional Transportation Improvement Program (ITIP). The total funding amount is estimated to be around $5.1 billion.[62]

4.2.3 Local Funding Options

In addition to federal and state funding sources, Southern California counties and transportation agencies have been generating significant local funding in order to deliver transportation projects on time.[63] Five of the six counties in the SCAG region have imposed a half-percent or more sales tax to fund transportation projects. Los Angeles County's Proposition A, Proposition C, Measure R and Measure M are four one-half cent sales tax measures totaling two cents to support the delivery of transportation improvements. The ballot measures and estimated funding amounts are summarized below. In addition to local sales tax measures most of the county's funding Metrolink use significant LTF and STA to fund Metrolink operations. In addition, FTA 5337 Funds are used for Preventative Maintenace at Metrolink as well. Funding for operations and maintenance of rail service, especially expansion service, is challenging, as fare revenues will be insufficient to fund operations and historically there has been little dedicated ongoing funding for O&M at the state and federal levels.

Los Angeles County

Most recently, in 2008, LA County voters passed Measure R to increase the sales tax by a half-cent to finance new transportation projects and programs, as well as accelerate those already in the pipeline. Seven categories of projects are included in the Measure R Expenditure Plan: 35 percent of the revenue will go to new rail and bus rapid transit projects; 3 percent to Metrolink projects; 2 percent to Metro Rail system improvement projects; 20 percent to carpool lanes, highways and other highway related improvements; 5 percent to rail operations; 20 percent to bus operations; and 15 percent for Local Return programs. Measure R was expected to provide $40 billion of additional tax revenue over 30 years.[64]

Eight years later, in 2016, the majority of the voters in LA County voted for Measure M, which made measure R permanent and added an additional half-cent sales tax. Measure M was set to generate $120 billion (2015 base year value) over 40 years to expand rail, rapid bus, and bike networks.[65] Roughly 3 to 8 percent of Measure M's revenue can potentially be available for regional passenger and freight rail projects in LA County.

Imperial County

The Imperial County Transportation Commission (ICTC) is the administrator of the Imperial County Local Transportation Authority's (ICLTA) Measure D Program. Measure D was originally adopted by voters in 1989 for a 20-year period to increase sales tax by a half-cent and dedicated the additional tax revenue for specific transportation projects. In 2008, the majority of the voters approved an extension of the local sales tax for an

[62] California Transportation Commission. 2021. State Transportation Improvement Program (STIP). https://catc.ca.gov/programs/state-transportation-improvement-program
[63] SCAG. 2021. Connect SoCal – The 2020-2045 Regional Transportation Plan/Sustainable Communities Strategy Chapter 4. https://scag.ca.gov/sites/main/files/file-attachments/0903fconnectsocal-04-plan.pdf?1604533578
[64] Metro. 2021. Measure R. https://www.metro.net/about/measure-r/
[65] Metro. 2021. Measure M. https://www.dropbox.com/s/vs6sse7hzyw8s0h/2017-MeasureM-ordinance-with-expenditure-plan.pdf?dl=0

additional 40 years until 2050. Over $140 million was generated between 1990 and 2010.[66] However, the Measure D revenue will mostly be used for local roadway projects, leaving scarce opportunity for passenger and freight rail to benefit from this funding.

Orange County

Measure M (also known as OC Go) is a 30-year one-half cent sales tax for transportation improvements in Orange County through 2041 as approved by voters in 2006. As of fall 2021, OC Go is expected to generate approximately $13.2 billion through 2041. Forty-three percent of the revenue will be used to fund freeway projects, 32 percent for streets, and 25 percent for transit, which includes the continuation and service expansion of Metrolink in Orange County, track and rail station improvements, as well as provision of transit connections to Metrolink.[67] Therefore, passenger rail projects and programs in Orange County will very likely benefit from this funding source.

Riverside County

Measure A of Riverside County was originally approved by voters in 1988 to increase the sales tax by a half-cent for a list of transportation projects to address the growing congestion problem. RCTC appropriated the $1.2 billion generated between 1990 and 2020 to all the major roadways in the county, as well as to public transit and commuter rail projects. In 2002, Measure A was extended by Riverside County voters to continue to fund transportation improvements through 2039.[68] Supporting regional rail is a high priority for RCTC which owns and maintains all the rail stations in the county funded by Measure A and also supports grade separation projects benefiting both freight and passenger service.

San Bernardino County

Measure I is the half-cent sales tax collected throughout San Bernardino County for transportation improvements. It was first approved in 1989, and it was extended through 2040 by voters in 2004. SBCTA administers Measure I revenue. A total of $1.8 billion was generated between 1990 and 2010. The funds are allocated based on the Measure I 2010-2040 Ordinance and Expenditure Plan and the Strategic Plan policies that define the framework for the programs and projects referenced in the measure.[69] Measure I has a return-to-source provision so that revenue collected within a subarea can only be used in that subarea. According to the 10-Year Delivery Plan, Metrolink will receive 8 percent of revenue collected in the Valley Subarea for the following eligible expenditures: the purchase of expansion commuter rail passenger cars and locomotives for use on Metrolink lines serving San Bernardino County; construction of additional track capacity necessary to operate more Metrolink passenger trains; construction of Metrolink station expansion parking; provision of local funds to leverage state and federal funds used to maintain the railroad track, signal systems, and road crossings; construction and operation of a new passenger rail service between the cities of San Bernardino and Redlands; and the construction and operation of an extension of the LA Metro Gold Line to the Montclair Transit Center.[70]

[66] ICLTA. 2011. Measure D: Improving Transportation in Imperial County. http://www.selfhelpcounties.org/countyupdates/Imperial.pdf
[67] OCTA. 2021. OC Go: Local Tax Dollars at Work. https://www.octa.net/About-OC-Go/OC-Go-(2011-2041)/
[68] RCTC. 2021. Funding and Programming. https://www.rctc.org/funding-and-planning/#69ef89f5-2451-81519424358044
[69] SBCTA. 2021. Measure I Funding. https://www.gosbcta.com/funding/measure-i/
[70] SBCTA. 2017. Measure I 2010-2040 Strategic Plan, Revised 2017. https://www.gosbcta.com/wp-content/uploads/2019/09/MeasureIStrategicPlan-Part1-rev0917.pdf

4.2.4 Funding Matrix for Beyond SCORE Projects

Table 34 and **Table 35** present a summary of the funding sources for which the Beyond Score Projects may be eligible. The funds are identified as "Yes", "Likely", and "Maybe" eligible. Funds indicated as "Yes" means the project is eligible for submitting for the funds. Funds indicated as "Likely" means the project is likely eligible for submitting for the funds and it is recommended that these funds be considered when developing a funding plan for these projects. Funding indicated as "Maybe" means the project may be eligible for these funds, depending on the project elements included in the project definition, the value of the project, and other considerations within the funding constraints.

Table 34 Federal Funding Sources for Beyond SCORE Projects

#	Project	CRISI	RAISE	Fed/ State Partner	Infra	5307	CIG Core Capacity
82	Project 5.1: Mains from Fullerton to Atwood	Likely	Likely	Maybe	Likely	Yes	Likely
83	Project 5.2: Passenger Flyover at Atwood	Likely	Likely	Maybe	Likely	Yes	Likely
84	Project 5.3: Mains at Atwood	Likely	Likely	Maybe	Likely	Yes	Likely
85	Project 5.4: Crossovers at Atwood	Likely	Likely	Maybe	Likely	Yes	Likely
86	Project 6.1: Main from West Hobart to Fullerton	Likely	Likely	Maybe	Likely	Yes	Likely
87	Project 6.2: Flyover at Commerce	Likely	Likely	Maybe	Likely	Yes	Likely
88	Project 6.3: Second Flyover at Commerce	Likely	Likely	Maybe	Likely	Yes	Likely
89	Project 6.4: Crossovers and Turnouts from West Hobart to Fullerton	Likely	Likely	Maybe	Maybe	Yes	Likely
90	Project 6.5: Fullerton Station Improvements	Likely	Likely	Maybe		Yes	Maybe
91	Project 7.1: Main from Ontario to South Fontana	Likely	Likely	Maybe	Likely		
92	Project 9.1: Main from Weeds to Hamilton	Likely	Likely		Likely	Yes	Likely
93	Project 9.2: Main at Hamilton to SCRRA Junction	Likely	Likely		Likely	Yes	Likely
94	Project 11.1: Main from Las Posas to Oxnard	Likely	Likely	Maybe	Likely	Yes	Likely
95	Project 11.2: Main from Montalvo to Ventura	Likely	Likely	Maybe	Likely	Yes	Likely
96	Project 14.1: Main from Citrus to Marlboro	Likely	Likely	Maybe	Maybe	Yes	Likely
97	Project 15.1: Main from Perris Downtown to Perris South	Likely	Likely		Likely	Yes	Likely
98	Project 15.2: Riverside Downtown Station Improvements	Likely				Yes	Maybe

Source: AECOM, 2021

Table 35 State and Local Funding Sources for Beyond SCORE Projects

#	Project	TIRCP	STIP	STA	Cap & Trade	LA (M)	Orange (M)	San B (I)	Riverside (A)
82	Project 5.1: Mains from Fullerton to Atwood	Likely	Maybe	Maybe			Maybe		
83	Project 5.2: Passenger Flyover at Atwood	Likely	Maybe	Maybe			Maybe		
84	Project 5.3: Mains at Atwood	Likely	Maybe	Maybe			Maybe		
85	Project 5.4: Crossovers at Atwood	Likely	Maybe	Maybe			Maybe		
86	Project 6.1: Main from West Hobart to Fullerton	Likely	Maybe	Maybe	Maybe	Maybe			
87	Project 6.2: Flyover at Commerce	Likely	Maybe	Maybe	Maybe	Maybe			
88	Project 6.3: Second Flyover at Commerce	Likely	Maybe	Maybe	Maybe	Maybe			
89	Project 6.4: Crossovers and Turnouts from West Hobart to Fullerton	Likely	Maybe	Maybe	Maybe	Maybe			
90	Project 6.5: Fullerton Station Improvements	Maybe	Maybe	Maybe	Maybe		Maybe		
91	Project 7.1: Main from Ontario to South Fontana			Maybe				Maybe	
92	Project 9.1: Main from Weeds to Hamilton	Likely	Maybe	Maybe		Maybe			
93	Project 9.2: Main at Hamilton to SCRRA Junction	Likely	Maybe	Maybe					Maybe
94	Project 11.1: Main from Las Posas to Oxnard	Likely	Maybe	Maybe					
95	Project 11.2: Main from Montalvo to Ventura	Likely	Maybe	Maybe					
96	Project 14.1: Main from Citrus to Marlboro	Likely	Maybe	Maybe	Maybe		Maybe		
97	Project 15.1: Main from Perris Downtown to Perris South	Likely	Maybe	Maybe					Maybe
98	Project 15.2: Riverside Downtown Station Improvements	Maybe	Maybe	Maybe					Maybe

Source: AECOM, 2021

4.3 P3 Delivery Opportunities

Public-private partnership (P3) delivery methods involve the inclusion of a private interest in the funding of capital projects by including anticipated revenue streams or operational costs to a developer to offset capital cost. These may include operation and maintenance as part of the service, as well as design and construction services. This is known as Design Build Operate Maintain (DBOM) delivery. Financing may also be included in a Design Build Finance Operate Maintain (DBFOM), which may allow the execution of a capital project that may otherwise be lacking funds for construction.

- **Advantages**
  - Infuses private capital into municipal project, creating or supplementing existing funding
  - Can result in an operationally efficient facility or system due to incentive
  - Can reduce administrative and operational burden on municipality
  - Can shift risk of unforeseen changes, costs or efficiencies away from owner
- **Disadvantages**
  - Criteria and Requirement Documents must protect the owner's interest and function of the system for its intended use
  - Longevity and expected lifecycle of physical product must match the complete life expectancy duration, not merely the DBFOM duration of operation
- **Best Practices**
  - Explicit requirements regarding longevity, quality, efficiency and operation of system
  - Proforma and Financial Viability of underwriting and operating forms on developer team
  - Experienced and Qualified Owner's representative
- **Examples**
  - Eagle Commuter Rail Project (Denver Union Station) (DBFOM, Denver)
  - Hudson-Bergen Light Rail (DBOM, New Jersey)
  - Tren Urbano (DBOM, Puerto Rico)
  - Inglewood Transit Connector (DBFOM, LA County) - Planned

5. Shared-Use Restrictions

In this section, the current limits for the Metrolink commuter trains and *Pacific Surfliner* corridor trains on BNSF and UP lines are summarized. Limits of *Pacific Surfliner* on Metrolink dispatched line are also noted.

5.1 Existing Shared-use Agreements

5.1.1 Metrolink Limits on Freight Railroads

Operated by SCRRA, Metrolink is the commuter rail system in the greater Los Angeles area. Peak period- and peak direction-oriented, Metrolink operates commuter trains on seven lines, including several that are owned and dispatched by BNSF and UP.

On the UP Santa Barbara Subdivision, between Moorpark and Montalvo (East Ventura), Metrolink is limited to three round trips Monday through Friday and one round trip on Saturday, per Commuter Rail Access Agreement dated March 6, 1998.

On the UP Los Angeles Subdivision, between Soto Street, near Redondo Junction and Los Angeles Union Station, and SCRRA Junction at West Riverside, Metrolink is limited to six round trips Monday through Friday and four round trips Saturday and Sunday, per Riverside Operating Agreement dated December 3, 1991, as amended.

On the BNSF San Bernardino Subdivision, Metrolink is limited the following daily movements, per Shared Use Agreement dated October 30, 1992, as amended:

- Hobart to Fullerton, 50 trains
- Fullerton to Riverside, 36 trains
- Riverside to San Bernardino, eight revenue trains and eight non-revenue trains

According to SCRRA, in general freight railroads operating over SCRRA member agency owned rights-of way as tenants can run as many freight trains as needed to serve their customers. If the level of freight trains increases to a point that adversely affects passenger service on the line, then the tenant freight railroad must pay for agreed upon capacity improvements to alleviate the potential problem.[71]

5.1.2 Pacific Surfliner Limits on Metrolink Dispatched Lines and on Freight Railroads

LOSSAN operates the regional *Pacific Surfliner* intercity trains on the 351-mile LOSSAN corridor consisting of, from north to south:

- The UP Santa Barbara Subdivision between San Luis Obispo and Moorpark;
- The Metrolink Ventura County Line between Moorpark and LAUS;
- The Metrolink Orange County Line between LAUS and Oceanside, including the BNSF San Bernardino Subdivision between Redondo Junction and Fullerton; and,
- The North County Transit District's (NCTD) line between San Diego County line and San Diego.

The Ventura County Line between Moorpark and LAUS is in public ownership and dispatched by Metrolink. The Orange County Line between LAUS and Fullerton, including the Metrolink River Subdivision and the BNSF San Bernardino Subdivision, is jointly dispatched by Metrolink and BNSF. The line south of Fullerton

[71] Per Bruce Ferguson, Metrolink, October 29, 2021

to San Diego is in public ownership. The line segment is dispatched by Metrolink to Oceanside and south of Oceanside to San Diego by NCTD.

Metrolink Dispatched Lines

As the operator of the *Pacific Surfliner*, LOSSAN does not have limitations by agreement for what it can operate on Metrolink or NCTD owned / dispatched territory. Schedules are typically adjusted twice annually (usually in October and April) for all three passenger services (*Pacific Surfliner* Metrolink and the Oceanside-San Diego COASTER commuter service operated by NCTD). Any desired *Pacific Surfliner* service increase is discussed and coordinated with Metrolink and NCTD months before any schedule change to ensure there is the capacity to operate additional service and that the proposed schedules for each service do not overlap or conflict with each other.

Furthermore, per the terms of an existing Memorandum of Understanding (MOU) between Amtrak (which shares in the operation of the *Pacific Surfliner*) and Metrolink, *Pacific Surfliner* service during peak periods is limited to no more than hourly frequencies between Moorpark and Oceanside. This agreement has not always been strictly adhered to, as certain elements of the MOU are no longer applicable or were contrary to what Metrolink was wanting from LOSSAN. Regardless, LOSSAN is looking to negotiate with Metrolink to update this MOU, which technically can limit the number of *Pacific Surfliner* slots operating currently during peak periods on the Metrolink-controlled territory.

BNSF Railway

Per the existing capital improvement agreement between BNSF, Metrolink, and their member agencies, Amtrak (including the *Pacific Surfliner*) is identified as having 34 slots upon full completion of the triple track between Fullerton and Los Angeles (the line segment currently is triple track).

Union Pacific Railroad

In 2020, LOSSAN negotiated and executed a capital improvement agreement with the UP that laid out a capital program along the Santa Barbara Subdivision that would allow for a maximum of 14 slots for the *Pacific Surfliner* between Moorpark and Goleta and six slots between Goleta and San Luis Obispo upon completion of the capital projects identified in the agreement. At the time of this writing, LOSSAN has completed those capital projects that allow for the six slots between Goleta and San Luis Obispo, but not yet for the full 14 slots between Moorpark and Goleta. Until these projects are complete, LOSSAN is limited to only 12 slots between Moorpark and Goleta[72].

5.1.3 Amtrak Long-Distance Services

The National Rail Passenger Corporation (commonly known as Amtrak) operates regular long-distance intercity services on various mainlines in the study area:

- The *Southwest Chief*: one round trip daily on the BNSF San Bernardino Subdivision and the Metrolink River Subdivision to and from Los Angles Union Station;
- The *Sunset Limited* (combined with the *Texas Eagle*): three round trips per week on the UP Alhambra Subdivision and the Metrolink River Subdivision to and from LAUS; and,
- The *Coast Starlight*: one round trip daily on the UP Santa Barbara Subdivision, Metrolink Ventura County Line (Moorpark to Burbank), and the Metrolink Valley and River Subdivisions (Burbank to LAUS).

Amtrak's right of access to rail main lines in the U.S. is specified in the Rail Passenger Service Act of 1970 and subsequent agreements (now codified at 49 U.S.C. §§ 24101 et seq.) Any increases in service levels will require negotiation with the host railroads.

[72] Per James Campbell, LOSSAN, December 16, 2021.

5.2 Shared-use Operational Restrictions

As noted in Section 3, the 2028 and 2035 simulation cases were selected as the basis for the Strategic Corridor Vision discussed in Section 6. The conclusion of the 2028 and 2035 cases was that Metrolink and LOSSAN train performance, along with BNSF and UP train performance, require major infrastructure improvements to remove operational restrictions for increasing train volumes on all these lines. These improvements are fundamental to removing chokepoints on the study area main line rail network.

5.3 Strategy for Expanded Shared-use Opportunities

To identify a strategy for securing expanded access for commuter and intercity operations on freight railroads, thoughts on shared-use best practices were gathered from industry leaders with direct experience with shared-use operations. The question put to all of them was: What are some approaches and best practices that passenger agencies can use to work successfully with host freight railroads toward expanding passenger access?

5.3.1 Freight Railroad Motivations

A useful starting point for understanding how to approach freight railroads for access is to understand freight railroad priorities. The seven Class I or large railroads in U.S. are, for the most part, publicly held companies. That is, corporate shares are publicly traded on exchanges, and corporate executives have a fiduciary responsibility to shareholders to maximize returns. They are also charged with assuring the sustainability and long-term viability of the railroads. Their business model is focused on the efficient haulage of freight, a prerequisite of which is a flexible rail network capable of responding to market demands. Predictably, the freight railroads' priorities will include ensuring sufficient capacity on their lines to handle the traffic base.

Capacity refers to the ability of a rail line to handle the traffic that a railroad seeks to run across it. For example, the capacity of a single-track main line with Centralized Traffic Control[73] and passing sidings at regular intervals (e.g., every six to eight miles) is about 30 trains of various types (e.g., unit, bulk, intermodal and even passenger trains) per day[74]. If the current volume on the line is 15 trains per day, theoretically the line is operating at 50 percent of its capacity. The other 50 percent is capacity that the freight railroad can use to grow its business, generate more revenue, and pay higher dividends to shareholders.

In this example, a passenger rail agency's request for access on the line is a request to consume some of that capacity. To agree to this request, the railroad will want assurances that the capacity surplus that it enjoys today is preserved. Typically, the freight railroad's position translates at a minimum into a requirement for the passenger agency to replace the capacity it seeks through installation of new main line track.

5.3.2 Figuring out the Capacity Question

When freight railroad and passenger operators begin discussions about the possible shared use of a freight line, the characterization of the line's capacity and the demand on that capacity related to the introduction of passenger trains take center stage.

There are various ways of answering the capacity question. One way is through the use of operations simulation programs, such as the Rail Traffic Controller (RTC) program that was used extensively in this Study. The program will show the impact on freight railroad performance of the introduction of new

[73] Where a dispatcher in a remote location directs trains across a segment of track using wayside signals.
[74] National Rail Freight Infrastructure Capacity and Investment Study, Association of American Railroads, September 2007, page A-11.

passenger trains. If freight trains are delayed, capacity improvements can be added to eliminate the delay. Growth assumptions for freight and passenger train assumptions can be tested, so that delay impacts and appropriate mitigation can be identified for future years. These simulations can inform the freight and passenger operators of potential outcomes and ultimately facilitate a successful negotiation of terms for access.

5.3.3 Securing Shared-use Access

When it comes to the shared use of a busy freight rail line, “The question is, how can we build more capacity,” said Paul Worley, a Rail & Transit Practice lead for Mott MacDonald and former Rail Division Director for the North Carolina Department of Transportation (NCDOT)[75]. In 2011, NCDOT successfully negotiated for the expansion of state-sponsored intercity rail service on the North Carolina Railroad corridor between Raleigh and Charlotte, which is operated by Norfolk Southern Railway (NS).

Generally speaking, a passenger operator is going to have to buy its way onto a freight railroad, Worley said. Specifically, that means paying for the design and construction of additional track capacity, crossing consolidation and safety improvements, and paying the host railroad to maintain the improvements.

Worley recommended seeking a master agreement with the host freight railroad. The master agreement could allow the passenger agency to build capacity as dollars become available. In this way, the agency can at least get started with new service.

An alternative approach to such a pay-as-you-go paradigm is to do what the Commonwealth of Virginia did and buy a whole rail corridor or a share of the existing rail right-of-way from CSX Transportation (CSXT) and Norfolk Southern (NS). Virginia is acquiring 384 miles of CSXT right-of-way and 223 miles of track in rail corridors paralleling I-95, I-64, and I-85, with Virginia and CSXT splitting the I-95 rail corridor right-of-way between Petersburg and Washington, DC. Also, Virginia is acquiring 28.5 miles of the NS-owned right-of-way (V-Line) from the Salem Crossovers to Christiansburg. These investments allow Virginia to nearly double Amtrak state-supported intercity service and increase Virginia Railway Express (VRE) commuter service (including first-time-ever weekend and late-night service) during the next decade.

Acquiring the half-ownership of CSXT right-of-way allowed the building of “what VRE and the state need,” said Christine Hoeffner, Manager, Project Development for VRE[76]. The purchases are a step toward a vision of full separation of freight and passenger operations where possible.

With two tracks, one would be for passenger and the other for freight, Hoeffner said. With three tracks, two would be for freight and one for passenger. With four tracks, two would be for freight and two for passenger.

But getting the deal done was not easy. Freight railroads are hesitant to add passenger trains because their own trains may be running late or having other problems.

“But Virginia focused on adding service,”, said Michael McLaughlin, currently the Chief Operating Officer for the Virginia Passenger Rail Authority (VPRA) and the former Chief of Rail for the Virginia Department of Rail and Public Transportation (VRPT), which led the negotiation for the state[77]. In doing so, “Virginia convinced the railroads that its plan would work well for them, too, and so the deal got done.”

Freight railroads’ hesitancy toward new shared-use concepts is grounded in the perception that passenger rail simply complicates freight operations. Layering a scheduled passenger rail operation on top of a largely unscheduled one will reduce operating flexibility absent capacity improvements.

[75] Per conversation of December 2, 2021.
[76] Per conversation on November 11, 2021.
[77] Per conversation on December 2, 2021.

“Freight railroads will never really operate on schedules as punctual as commuter schedules,” said Andrew Fox, former President of the Chicago South Shore & South Bend Railroad, which shares track with the Northern Indiana Commuter Transportation District (NICTD) between Chicago, Michigan City, and South Bend[78]. “They always seek to preserve the freedom to go whenever they need to go.”

5.3.4 Shared-use Agreements: Deals Have to Work for the Host Railroad

As for establishing new passenger service or an expanded passenger service, “The freight railroad has to get something out of the deal,” said Mark Bristol, UP’s Assistant Vice President, Network Development[79]. UP hosts multiple intercity passenger and commuter operations throughout its network.

“The good news is, there are lots of ways to do that,” Bristol said. Historically, access was granted to UP lines only if the passenger entity could replace all of the capacity it consumes. Said another way, “Put more iron in the ground,” Bristol said. That was the original passenger business model, meant to assure the railroad had sufficient capacity in view of growing demand for the UP’s freight service.

Today, however, there are other ways to gain access to UP’s network. On non-core routes, such as the California Coast Line, UP is willing to sell capacity to passenger rail sponsors who might want to add new service in return for a contribution to maintenance and a franchise access fee. In this model, it may also be possible to do shorter term deals where the state can terminate service if ridership does not materialize.

On core routes, such as the Yuma Subdivision (Colton to Yuma, Arizona), where UP train volumes will remain high, UP will insist on more main track to preserve its capacity, if it were to allow new passenger services.

“It is also important to remember that ‘shared-use’ doesn’t mean the passenger operator gets the route for 18 hours per day, and the freight trains can all run at night,” Bristol said. “Sharing the route means finding solutions that meet the needs of freight customers and passengers alike.”

One example identified by Bristol of a successful shared-use relationship is Altamont Corridor Express (ACE), the commuter rail service between Stockton, in California’s Central Valley, and San Jose. Operated by the San Joaquin Regional Rail Commission (SJRRC), ACE runs on UP for 83 miles between Stockton and Santa Clara, where it transitions onto the Caltrain Peninsula Line for the final two-mile segment to Diridon Station in San Jose.

According to Jim Stoetzel, a rail operations consultant to ACE, SJRRC has contributed about $10 million a year to UP for maintenance and construction improvements[80].

“It’s a lot like getting married,” Stoetzel said of ACE’s relationship with UP. It means continually enhancing the ability for the corridor to provide quality passenger services. The size of the investment demonstrates how complex the relationship is. The contributions are as much a part of operations as crews and maintenance.

5.3.5 It All Starts with an Operating Plan

In considering a new or expanded passenger service, “You need an operating plan,” said DJ Mitchell, Assistant Vice President, Passenger Operations, for BNSF Railway[81]. The operating plan is a detailed

[78] Per conversation on November 24, 2021.
[79] Per conversation on December 3, 2021.
[80] Per conversation on November 20, 2021.
[81] Per conversation on December 6, 2021.

timetable the meets the requirements of the passenger agency. Second, planners need to see if the operating plan matches the physical plan that exists.

Clouding the issue today is the Covid pandemic. It is difficult to craft an operating plan when the demand of passenger rail services is uncertain. Also, passenger rail planners need to account for the reality that freight operations are largely unscheduled. This reality requires building in flexibility with new infrastructure. One way to do so is to add staging and storing capacity at yards so freight trains are not held out of yards on the main line.

Furthermore, if there are multiple passenger operations (e.g., intercity and commuter) on a route, the services need an integrated passenger plan, which then can be folded into the host freight railroad operation.

Mitchell identified four steps that should be followed in planning for the shared use of a rail line:

- Determine the passenger footprint.
- Determine the freight footprint.
- Integrate the passenger and freight operations.
- When the available capacity runs out, figure out what kind of capacity is needed and where it needs to be built.

Traditionally, figuring out the capacity question and identifying and validating effective solutions to minimize and ultimately eliminate delays to both freight and passenger service has been left to operations simulation, as was done for this study. But there are other approaches.

For example, DB Engineering & Consulting USA has recently completed a study of the Fullerton-Anaheim-Oceanside-San Diego Line[82] and is studying the BNSF San Bernardino Subdivision[83], both shared-use lines. This work envisions the managing of the lines with individual time slots allocated to specific trains – both freight and passenger. The San Bernardino work uses a standard framework that quantifies the impact of operating plans for freight and passenger services without requiring an operator to adhere to a strict schedule.

“A slot is based on one 8,500-foot-long freight train,” said Clayton Johanson, a Principal Consultant for DB[84]. A shorter, faster passenger train takes up more than one slot. With a harmonized passenger plan and an understanding of the freight train demand and characteristics (length, speed, and stopping pattern), the slots needed to run the railroad efficiently, with minimal delay due to operating variability, can be quantified. And with less variation in freight operations, more slots can be created.

5.3.6 Simplifying the Challenge for Host Railroads

The benefit of integrating separate passenger rail agency operations on a host freight railroad was echoed by Peter Espy, former Rail Director for the Texas Department of Transportation, which sponsors the Oklahoma City to Fort Worth *Heartland Flyer* along with Oklahoma Department of Transportation[85]. The train runs on BNSF.

Where possible passenger rail agencies should team up and “present something coordinated for the freight railroad to consider”, Espy said. Doing so would be a big help to the freight railroad, which would otherwise be dealing with separate agencies. “If Amtrak approaches the host railroad about one thing, and commuter agency does the same, while they all may be talking about the same service idea, the situation can confuse a freight railroad,” Espy said.

[82] San Diego Pathing Study, sponsored by BNSF Railway and North County Transit District, September 2020.
[83] San Bernardino Pathing Study, sponsored by BNSF and Caltrans, ongoing.
[84] Per conversation on November 24, 2021.
[85] Per conversation on December 7, 2021.

Also, if there is an idea circulating that involves the use of a railroad's property, and a passenger agency is involved, it is better that the agency lets the railroad know about it before the idea gets out into the press, forcing the freight railroad to go on the defensive, Espy said. While the railroad and the agency may never agree on the idea, the railroad will respect the agency more if it hears about the idea from the agency first.

"Doing so will build trust," he said.

5.3.7 Trust: Fundamental building Block for Shared-use Solutions

To build on and enhance that trust, a good first exercise for passenger rail planners is to start thinking like a freight railroad.

"You have to consider what shared use does to the supply chain," said Tim Hoeffner, former Director of the Office of Rail at Michigan Department of Transportation[86]. In 2012 MDOT spent $135 million to purchase an NS main line. The state got the dispatching and a provision for commuter rail in the future, while NS retained the freight rights on the line.

As stated earlier, freight railroads exist to move freight and maximize returns of shareholders. Hosting passenger rail services are not really part of that business model. They can be, but only with assurances that passenger rail contributes in some way to the freight rail bottom line. The shared-use examples noted here, crafted with BNSF, UP, CSXT, and NS, stand as evidence that shared use can work for freight and passenger railroads.

"It comes down to trust," Hoeffner added. "You might have to agree to things that seem outlandish, but you are building for the future. It may turn out to be a better deal than it seems today."

5.3.8 A Strategic Approach for Expanding Shared Use

DJ Mitchell's recommendation of a four-step process is a straightforward, logical approach to sorting out needs for expanded shared use. Likewise was Peter Espy's recommendation that, in approaching the freight railroads for expanded access, multiple passenger operations should try to coordinate their requests, enabling host freight railroads to better understand the requests and the implications to freight operations.

Most importantly, taking a long view is important. All stakeholders to shared-use negotiations are not just hoping to resolve current needs, but also the needs of passenger and freight rail well into the future. And as Tim Hoeffner surmised, while the future may require passenger agencies to agree to things they never envisioned, the deal may turn out better than ever anticipated.

[86] Per conversation on November 24, 2021.

6. Strategic Corridor Vision

As noted in Section 3, the 2028 and 2035 cases form the basis for the Study's Strategic Corridor Vision. In support of that vision, an economic assessment was conducted using an Economic Impact Analysis (EIA).

- **EIA** addresses how an economy is likely to change in response to an action. EIA describes the impacts of a project in terms of its impacts on a region's employment, wages, Gross Regional or State Product, and taxes.

The EIA results describe broader regional impacts. Additionally, the EIA is based on economic multipliers developed in the study: *Metrolink's Economic Potential: Southern California Optimized Rail Expansion (SCORE) Economic Impact Analysis*.[87] The multipliers were used to determine the economic impacts of the SCORE project using updated cost and performance forecasts.

The EIA in this document builds upon the information developed in Section 2, which outlines underlying forecasts. Additionally, information was adapted from the study Draft FINAL *Cost-Benefit and Operations Analysis* Southern California Optimized Rail Expansion Program, November 2021 which provided forecasts of costs and operational parameters for the Metrolink portion of the SCORE project.

6.1 Economic Impact Analysis

The purpose of Economic Impact Analysis (EIA) is typically to forecast personal income, employment, and business impacts for a defined project, program, or policy. This is generally accomplished by using an economic impact model such as REMI, IMPLAN, RIMS, etc. which calculate the economic impacts of projects in terms of variables such as employment (number of job-years supported, labor income (compensation of employees, Gross State Product (economic output minus intermediate inputs, accounting for the additional output created at that stage of production, and tax revenues. The models determine how project investments ripple through the regional economy with jobs and economic activity generated through multiplier effects.

There are three types of impacts: direct, indirect, and induced. These terms are also commonly referred to as initial, secondary, and tertiary impacts that ripple throughout the economy when a change is made to a given input level. These are described as:

- **The direct impact** of an economic disturbance is an initial change in the economy such as the direct outlays for the rail project, i.e., spending on materials, equipment, labor, and other inputs.
- **The indirect, or secondary, impact** due to the suppliers of the inputs purchasing their inputs for production and hiring workers to meet demand.
- **The induced, or tertiary, impact** resulting from the workers of suppliers purchasing more goods and services.

The total economic impacts on the SCAG economy are the sum of direct, secondary, and tertiary effects. The sum of these effects divided by the direct impact provides a ratio which is the multiplier for the variable being examined. The analyses conducted for the rail improvements relied on the multipliers developed for the *SCORE Economic Impact Analysis* conducted by the Los Angeles County Economic Development Corporation (LAEDC) for the Southern California Regional Rail Authority.[88]

The *SCORE Economic Impact Analysis* assessed the impact of the construction investment for SCORE and the associated impacts from forecasted changes in travel demand, regional labor accessibility and reduced

[87] https://metrolinktrains.com/globalassets/about/agency/score/laedc-score-impact-study.pdf

[88] https://metrolinktrains.com/globalassets/about/agency/score/laedc-score-impact-study.pdf

transportation costs from saved time. The multipliers developed in the study are used with the investments described in this analysis to estimate the broader economic impacts of the rail improvements.

Construction Spending Impacts

Table 36 presents the construction multipliers and impacts used in this analysis. The multipliers from the LAEDC's economic modeling show that rail construction has a large potential for growth in employment and resulting labor income, which, in turn, strengthens regional economic output. These impacts last only as long as the construction is being done (2035).

Table 36 LAEDC Construction Multipliers and Impacts per Billion Dollars of Construction Expenditures

Variable	Multiplier	Impact per $1 Billion in Rail Construction Spending
Jobs	1.75	11,310
Income	1.67	$722,520,000
GDP	1.09	$1,090,400,000
Output	1.89	$1,887,940,000

Source: Cambridge Systematics based on work by Los Angeles County Economic Development Corporation, 2021

Table 37 presents the results of the economic impacts of the rail improvements over the 13-year construction period.

To summarize, the construction spending for the rail improvements would create 153 thousand job-years of employment, worth $9.8 billion in wages. The value added to the state's economy (Gross Regional Product) is nearly $14.7 billion. Overall regional output would be increased by $25.5 billion.

Table 37 Total Economic Impact of SCAG Rail Construction

Year	Labor (Job-Years)	Millions of Nominal Dollars		
		Wages	Gross Domestic (Regional) Product	Regional Output
2023	380	$25	$35	$65
2024	575	$35	$55	$95
2025	870	$55	$85	$145
2026	995	$65	$95	$165
2027	3,955	$255	$380	$660
2028	5,540	$355	$535	$925
2029	4,965	$315	$480	$830
2030	19,640	$1,255	$1,895	$3,280
2031	22,885	$1,460	$2,205	$3,820
2032	23,235	$1,485	$2,240	$3,880
2033	23,235	$1,485	$2,240	$3,880
2034	23,235	$1,485	$2,240	$3,880
2035	23,235	$1,485	$2,240	$3,880
Total	152,740	$9,755	$14,725	$25,495

Source: Cambridge Systematics based on work by Los Angeles County Economic Development Corporation, 2021

Ridership and Productivity Impacts

Beyond the construction spending impacts, additional analysis was performed by the LAEDC based upon increases in ridership and productivity gains projected through 2050. Though the scope of the study differs somewhat from this analysis, the long-term ridership and productivity impacts were associated with the level of capital investment and used to estimate the ongoing long-term economic impacts of the SCAG rail project. **Table 39** presents the long-term ridership and productivity impacts of the rail improvements.

Table 38 Long-Term Ridership and Productivity Impacts of SCAG Rail Improvements

Variable	Ridership and Productivity Impacts per $1 Billion in Rail Construction Spending	Ridership and Productivity Impacts Through 2050
Jobs	$122,400	1.7 million
Income	$16,650,000,000	$225 billion
GDP	$61,542,000,000	$830 billion
Output	$105,300,000,000	$1,420 billion

Source: Cambridge Systematics based on work by Los Angeles County Economic Development Corporation, 2021

Beyond the immediate construction impacts of the SCAG rail improvements, the long-term (out to 2050) ridership and productivity Impacts to the region are considerable. It is estimated that the rail improvements will enable 1.7 million in new job-years' worth nearly $225 billion in wages. Value added or Gross Regional Product is estimated to increase by $830 billion, and regional output will increase by nearly $1.4 trillion.

6.2 Other Benefits Considered

In addition to the EIA, other important benefits meriting consideration include rail network resiliency, improved connectivity to HSR and unserved markets, economic development, and regional equity for transportation improvements.

6.2.1 Rail Network Resiliency

The SCORE and Beyond SCORE projects envisioned in this Study will enable passenger and freight rail operators to run higher volumes of passenger and freight trains across the regional main line network fluidly and efficiently well into the future. Put another way, they will enable the ability of rail operators to respond effectively to changing conditions. Such enhanced resiliency would serve the region and the nation well should events create unforeseen demands on the system, as in the case of a natural disaster or war, or as has been recently witnessed, a pandemic. Efficiency and fluidity of the system are necessary to preserve and grow as congestion and bottlenecks can quickly have a negative impact on the economy – for the consumption of goods, and movement of people.

Such enhanced capacity will provide greater flexibility in handling future freight and passenger market demands and help ensure that freight rail service remains a viable alternative in Southern California. These investments in the rail system will also help address climate change in two ways, first by "hardening" the rail infrastructure to better accommodate its potential effects, and second by enhancing the attractiveness of rail with its lower carbon footprint *vis á vis* automobile highway travel.

6.2.2 Improved Connectivity to High-Speed Rail and Unserved Markets

An overarching tenant of the 2018 *California State Rail Plan* is that high speed rail will serve as the trunkline unifying northern, central, and southern regions of the state. The higher commuter and regional intercity service levels assumed in this Study will serve to improve connectivity to HSR and thus enhance the utility and attractiveness of that mode.

With Milestone 2 service levels implemented by 2035, Metrolink trains will be operating on all lines with half-hour frequencies in both directions all day. As most Metrolink service lines terminate at LAUS, the trains will provide convenient connections to CA HSR trains there for residents of the SCAG region. Higher frequencies on the Orange County Line will also provide convenient connections to CA HSR trains at Anaheim. Connections to HSR at LAUS and Anaheim will only be enhanced with even more frequent Milestone 3 service levels in 2050. Brightline West will also connect to the Metrolink system and CA HSR at Rancho Cucamonga and Palmdale in the future.

This Study also highlights providing future service and connectivity to currently unserved passenger rail markets. Examples of these include the Coachella Valley Rail service, and the rail connection between the Victor and Antelope Valleys.

6.2.3 Boost to Economic Development and Housing Choices

The higher service levels envisioned for Milestone 2 and 3 in 2035 and 2050, respectively, will improve mobility options for commuters seeking improved access to established work centers in downtown Los Angeles and Orange County and in developing work centers in the Inland Empire. With more trains, workers will have more choices on how they move across the region. The so-called Great Resignation, an outcome to some degree of the ongoing COVID-19 pandemic, only highlights how much workers are likely to value flexibility and choices where they seek employment.

Predictably, with more trains, station areas will become more desirable locations for mixed-use development, including housing. Such transit-oriented development (TOD), increasingly common in many metropolitan regions in the U.S., including along the growing rail transit network in the Los Angeles region, will have increasing opportunities to occur at the region's commuter and intercity rail stations as well. The State of California is providing robust grant funding to various government agencies to address the housing, and affordable housing, shortage. SCAG and Metrolink are beginning a study to develop strategies to increase TOD around Metrolink station areas using Regional Early Action Planning (REAP) funds. Metrolink's 2021 *Strategic Business Plan* conducted a market assessment that recognized the potential of TOD to support the regional housing and transportation goals[89].

TOD along Metrolink and LOSSAN service lines can provide a step in the right direction in terms of helping to mitigate the region's housing crisis. In this respect, it may be useful to look at the TOD policy of Caltrain, the commuter rail operation on the San Francisco Peninsula. That policy calls for residential development to offer at least 20 percent of units onsite at below market rents. At least 10 percent of units are targeted to households with incomes of no more than 80 percent of Area Median Income (AMI), and at least 10 percent of units are targeted to households with incomes of no more than 50 percent of AMI[90].

6.2.4 Regional Equity in Transportation Improvements

With Milestone 2 service levels achieved, the region's residents and workers using all Metrolink's seven lines will be provided further mobility choices to benefit equally from the improvements. Furthermore, with the start-up of the Coachella Valley intercity service and commuter service to Hemet and San Jacinto, residents in more remote areas of the region, not well served or served at all by rail today, would have new and attractive mobility options. As noted in Section 2, high residential growth is expected along the UP Yuma Subdivision (which runs through Coachella Valley) and the Perris Valley Line.

Construction of these improvements will also mitigate some of the direct impacts from rail operations on line-side communities through installation of sound barriers, low noise track structures, reduced locomotive

[89] https://metrolinktrains.com/globalassets/about/agency/strategic-plan/metrolink-strategic-plan-final---full-report--r.pdf
[90] https://www.caltrain.com/Assets/__Agendas+and+Minutes/JPB/2020/Tod+Policy.pdf

idling, and elimination of grade crossings. Many of these improvements will result in improved safety through more secure rights-of-way and a reduction in potential interactions between rail operations and area residents and visitors at rail grade crossings.

Overall, these rail improvements have the potential to enhance the quality of life for the region, including disadvantaged communities, through an environmentally cleaner, more accessible, and safer transportation system, which will provide alternatives to conventional motor vehicle transportation in the study area.

6.3 Project Implementation Strategy

The economic and other benefits that have the potential to result from the realization of a regional rail network through the major capital investments envisioned in this Study are considerable. However, it is unlikely that passenger and freight rail operators and CTCs can fund the entire suite of network improvements solely through near-term funding opportunities. The Study has identified a menu of improvements to meet longer-term service level needs for both freight and passenger operators. Further work will need to be accomplished to answer whether these longer-term service level improvements will be a function of implementing individual projects over time, and how a phased approach may be considered.

The challenge, for freight and passenger railroads, other rail stakeholders, and the CTCs will be to pursue the projects in a coordinated way, so that, at the end of the day, the projects implemented contribute to a rail network supportive of the regional transportation goals set forth in SCAG's 2020 Connect SoCal regional transportation plan[91]. That plan's Core Vision "centers on maintaining and better managing the transportation network we have for moving people and goods, while expanding mobility choices by locating housing, jobs and transit closer together and increasing investment in transit and complete streets."

While freight, intercity and commuter rail services operate on shared tracks throughout much of the region, no formal institutional arrangement currently coordinates investment priorities across these public and private entities that serve different stakeholders. Funding for passenger and freight rail projects has increased in recent years at the federal and state levels, yet the need for infrastructure and technology to improve regional operations surpasses funding availability, creating stiff competition among agencies applying for funding. Furthermore, the need to maintain the line separating public funding from private benefits calls for coordinated investment strategies that secure, support, and leverage funding from freight railroads for projects on private right-of-way that provide both private and public benefits.

One way to build consensus around project implementation consistent with regional transportation goals may be to formalize a collaborative group inclusive of passenger and freight rail stakeholders whose charge would be to formalize a level of agreement committing these stakeholders to a uniform process, to prioritize investments that build toward a network capable of delivering the anticipated synergistic benefits greater than the sum of its parts. Successful examples of collaborative strategies to implement a complex series of investments have been demonstrated in California and elsewhere:

- Most notable is the longstanding Chicago Region Environmental and Transportation Efficiency (CREATE) Program, a Public-Private Partnership (P3) between freight railroads, passenger railroads, and local, state, and federal entities.[92] With a current estimated budget from initiation to completion of $4.6 billion, CREATE is focused on implementing 70 projects consisting of new infrastructure, technology upgrades, and safety enhancements throughout the Chicago region. Established in 2003, the Program operates under a voluntary framework (Joint Statement of Understanding), with partner participation based on their relationships to the railroad networks within

[91] https://scag.ca.gov/read-plan-adopted-final-plan
[92] www.createprogram.org

the Program area and their willingness to cooperate on project planning and delivery efforts and to contribute funding. As of 2021, over 30 of the 70 projects had been completed, and over $1.6 billion in funding has been secured from federal, state, local, and private partners.

- Another example is the Northern California Megaregional Rail Working Group which was formed by Caltrans Division of Rail and Mass Transportation (DRMT) and the California State Transportation Agency (CalSTA) to support and facilitate rail planning in the megaregion to: deliver the California Integrated Travel Program (Cal-ITP), integrate services and schedules, enhance multimodal connectivity, and coordinate planning. The purpose of this group is to improve efficiencies, decrease redundancies, and build the coordination and governance structures necessary for delivering many different projects that need to be strategically planned and funded as not to preclude future improvements on adjacent corridors throughout the megaregion. CalSTA is interested in establishing a new megaregional rail working group in partnership with passenger and freight rail stakeholders in Southern California.

As a practical matter, a Southern California working group and process would benefit from the four-step shared-use network strategy that this Study has already accomplished as the foundational starting point. All critical freight and passenger rail stakeholders, including the State, have been at the table through the TAC. These TAC members have provided multiple pieces of information culminating in a 2035 Alternate scenario encompassing all current projects and going further by identifying projects beyond this to optimally operate through the 2050 horizon year. A clear next step for the TAC is the consideration of developing a comprehensive phased program and/or investment plan to seek funding opportunities. This approach would balance shorter- and mid-term needs, while rail stakeholders would also benefit from maintaining the long view, working toward regional goals that allow residents and industry to share equitably in a brighter transportation future.

7. Conclusions and Next Steps

7.1 Conclusions

The rail simulation analysis conducted in this Study shows that future freight and passenger volumes can operate on shared-use corridors efficiently out to year 2050 with the combination of planned and newly identified capacity enhancing projects. The planned projects include those in Metrolink's SCORE Program as well as those planned to be completed by BNSF, UPRR, the San Pedro Bay Ports, the California High Speed Rail Authority, Brightline West, as well as rail grade separation projects throughout the region. The newly identified projects include 17 Beyond Score projects totaling 146 route-miles of additional main line and special trackwork enhancements spread across the San Bernardino, Alhambra, Santa Barbara, Los Angeles, Orange, and Perris Valley subdivisions.

The SCORE and Beyond SCORE rail improvements are estimated to cost approximately $8 billion in year of expenditure for the SCORE projects plus an additional $5.7 billion in year of expenditure for the Beyond SCORE projects. Rail grade separation projects are estimated to cost approximately $5.9 billion in YOE. The projects produce large scale economic benefits to the region, with value added or Gross Regional Product estimated to increase by $831 billion and regional output estimated to increase by nearly $1.4 trillion through 2050, if the cooperation between parties – public and private – needed to realize the potential of the capacity enhancing projects is achieved. This translates to improved mobility options for one of the largest regions in the U.S., while also maintaining economic competitiveness for the largest Port complex in the Western Hemisphere, supporting both regional and national economies.

7.2 Next Steps

SCAG offers this analysis to its rail transportation stakeholders to inform the decisions they will be making regarding service expansion and capital improvements. This Study should be seen as the first step in a process of how freight and passenger rail operators can plan together to fund and construct a robust regional rail system propelling the economy and providing both efficient freight service and attractive mobility options for the SCAG region's residents. Immediate opportunities from this work include informing the 2024 Connect SoCal Update; and providing context, including key findings and an approach to inform the momentum being generated across the SCAG region through state-led listening sessions and dialogue with federal and other agencies. The Study's TAC is organized to serve as the collaborative mechanism moving forward on these efforts, notably, the opportunity to develop a rail-based investment plan to compete for rail-related federal and state and other funding opportunities.