TRANSPORTATION SYSTEM

GOODS MOVEMENT

SOUTHERN CALIFORNIA ASSOCIATION OF GOVERNMENTS

CONNECT SoCal

TECHNICAL REPORT

ADOPTED ON SEPTEMBER 3, 2020

INTRODUCTION 1

GOODS MOVEMENT TECHNICAL REPORT 2

GOODS MOVEMENT SYSTEMS VISION 6

COMPONENTS OF THE REGIONAL GOODS MOVEMENT SYSTEM 9

SUPPLY CHAIN AND THE SCAG REGION 17

CONNECT SOCAL – ACHIEVING THE REGIONAL GOODS MOVEMENT VISION 36

GOODS MOVEMENT ENVIRONMENTAL CONDITIONS & TECHNOLOGY ADVANCEMENT STRATEGIES 57

GOODS MOVEMENT PROJECT LIST 73

APPENDIX 1 OF 1 125

CONNECT SoCal

TECHNICAL REPORT

GOODS MOVEMENT

ADOPTED ON SEPTEMBER 3, 2020

connectsocal.org

TRANSPORTATION SYSTEM

Goods Movement

INTRODUCTION

Goods movement, and its associated industries and sectors, has traditionally been seen as reluctant and slow to change. However, when change does occur, it is normally profound and far-reaching. Since the adoption of the 2016 - 2040 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS), there have been significant drivers of change in the goods movement industry including emerging and new technologies, more complex supply chain strategies, evolving consumer demands and shifts in trade policies. Connect SoCal recognizes that these factors will play a crucial role in the ongoing development and advancement of policies, infrastructure and strategies to address regional goods movement challenges. These challenges include, but are not limited to:

Domestic Competition: The SCAG region is the premier trade gateway for the U.S. It faces escalating competition from other domestic gateways seeking to realize the economic benefits that accompany increased trade. These gateways continue to improve infrastructure and facilities to compete with the SCAG region. While the overall volume of trade continues to grow, some components of the regional goods movement system are experiencing losses in market share.

E-Commerce: E-commerce continues to be one of the most influential factors shaping goods movement. Distribution networks are changing to accommodate new paradigms stemming from e-commerce. Consumer expectations of expedited and free (or low cost) shipping are pushing businesses to move toward the use of urban fulfillment centers that help meet customer needs

and reduce costs (e.g., inventory costs, fuel costs, costs of delay, etc.). The ubiquity of e-commerce also begs questions related to the impacts of growing congestion (especially on neighborhood streets), competition for valuable curb space for deliveries and whether Vehicle-Miles-Traveled (VMT) are decreasing as a result of consumer trip substitution or increasing as consumers simply buy more online in addition to normal trips.

Technology and Automation: The advancement of automation is expected to have considerable impacts throughout regional supply chains. Warehouses are increasingly integrating automation to improve operational efficiencies in response to the dramatic surge in direct-to-consumer e-commerce. Additionally, continued developments and demonstrations of automated truck technologies will alter the goods movement environment with far-reaching impacts ranging from employment to highway safety.

Federal Trade Policy: Changing federal trade policies are already affecting global trade. While the full ramifications are uncertain, protectionism and broken and new agreements and trade wars with China and other nations may have a significant impact on international trade volumes moving through the region, and subsequently the regional goods movement system. The longevity and empirical impacts of these policies is yet to be fully determined.

Workforce Development: The 2016 RTP/SCS included strategies to ensure that the region has the port and landside transportation infrastructure necessary to handle forecasted trade volumes, and strived to ensure goods movement jobs stay in Southern California. However, changing supply chains and evolving technologies will challenge the regional workforce. Goods movement jobs previously offered low barriers to entry and upward career mobility to low and semi-skilled workers that often allowed them to achieve security and middle-class incomes. A smaller labor pool, coupled with increasingly competitive wages from other sectors, may be placing growing pressure on traditional goods movement related businesses to find qualified workers without raising costs. Most importantly, as automation is adopted more holistically throughout supply chains, the region faces serious challenges for those whose jobs may be changed or eliminated as a result.

Last-Mile Delivery: Last-mile delivery represents the final leg of the supply chain as goods are delivered from production to consumption—generally at building loading docks, driveways or curbside. Bringing goods to markets for their distribution is a primary driver of local economies, making the delivery of goods an essential component of life in the SCAG region. Last-mile deliveries happen in complex environments, and they involve interactions among several elements including producers, delivery providers, consumers, buildings, loading/unloading areas, streets and vehicles. In urbanized and higher-density locations, last mile deliveries often compete for limited public space as passenger vehicles, pedestrians, bicyclists and buses navigate the same streets for curbside access. The complexity of goods movement and deliveries, combined with the constant innovation of various actors in the industry, necessitates tailored and nuanced strategies involving multidisciplinary approaches to core issues.

Zero and Near-Zero Emission Vehicles: The SCAG region is designated as a federal non-attainment area, meaning that it fails to meet National Ambient Air Quality Standards (NAAQS), for criteria pollutants that are harmful to human health. In addition, California has set ambitious goals to reduce greenhouse gas (GHG) emissions. Many criteria pollutants, such as nitrogen oxides (NOx), sulfur oxides (SOx), and particulate matter ($PM_{2.5}$ and PM10) are precursors to the formation of GHGs and/or negatively affect human health. In the South Coast Air Basin (SCAB), mobile goods movement vehicles and equipment are responsible for 52 percent of NOx emissions and 10.7 percent of $PM_{2.5}$ emissions. To address these challenges, Connect SoCal puts forth an aggressive technology advancement roadmap to further develop and deploy zero and near-zero emissions technologies that will reduce harmful emissions. The state of zero and near-zero emission technologies has advanced in the past four years with progress made in developing prototypes and the early deployment of vehicles. Continued investment is still needed to further develop and deploy these technologies, and to provide the infrastructure needed to support them.

GOODS MOVEMENT TECHNICAL REPORT

Connect SoCal recognizes the opportunities and challenges that come with goods movement, and includes a focus on its rapidly changing nature. This

document, the Goods Movement Technical Report, offers a broad overview of goods movement in Southern California by defining what the goods movement system is, including its most critical components; highlighting its importance and connections to the economy and local industrial sectors; summarizing international and domestic trade flows and their relations to the region; addressing environmental and air quality issues; articulating a regional vision and how it can be achieved; and illustrating the path to 2045 by promoting an effective set of regional strategies.

WHAT IS GOODS MOVEMENT?

Goods movement generally refers to the movement of raw, semi-finished and finished materials and products used by businesses and residents across the transportation system. These goods move in myriad ways and through complex systems, often using multiple modes of transportation (e.g., ships, trucks, trains, planes, etc.). Products may be produced in the U.S. or another country, and make their way to businesses, retail stores or directly to consumers. The efficient movement of these goods is a critical component of a strong economy and improves quality of life in the SCAG region. Goods movement supports industries and activities that provide jobs, tax revenue and resources that bolster innovation, creativity and access to local and world markets through trade. This movement depends directly on the physical infrastructure that comprises the transportation network such as highways, rail lines, ports and networks of warehousing and other distribution facilities. Maintaining this existing infrastructure, and making improvements where appropriate, is key to ensuring the competitiveness of a growing economy. However, goods movement also has negative impacts and externalities. Growing trade and increased volumes of goods moving across the transportation system contribute to greater congestion, safety concerns, harmful emissions of dangerous pollutants, wear-and-tear on roadways and impacts on local neighborhoods.

WHY GOODS MOVEMENT MATTERS TO THE REGION AND THE WORLD

BROAD ECONOMIC BENEFITS

Goods movement in the SCAG region is a cornerstone of the local economy, and directly and indirectly facilitates economic development throughout the U.S. While the performance of the logistics industry is often used as a proxy for estimating the economic impact of goods movement, SCAG considers the contributions of five major industrial sectors that are most closely associated with, and rely directly on, the goods movement system: manufacturing, construction, retail trade, wholesale trade and transportation and warehousing. When SCAG considers the economic impacts of goods movement activity, it often refers to the impacts of these sectors.

One of the ways this economic impact is measured is through gross regional product (GRP). Similar to gross domestic product (GDP), which is often used as an indicator of a nation's economic health, GRP is a monetary measure of the market value of the goods and services produced in the region. In 2017, goods movement dependent industries in the SCAG region contributed $348 billion, or 27.7 percent, to regional GRP. Between 2012 and 2017, overall regional GRP grew more than 21 percent from approximately $996 billion to more than $1.25 trillion. This was driven primarily by increases in the construction industry, specifically in Los Angeles and Orange Counties, and buoyed by a 37 percent increase in Riverside and San Bernardino Counties.

Goods movement also provides jobs and employment that contribute to the local and national economies. In 2017, goods movement dependent industries in the SCAG region employed nearly 2.3 million people, almost 37 percent of all employees. Employment in goods movement dependent industries experienced growth of 8.5 percent in the number of employees between 2012 and 2017, exceeding the 8 percent growth experienced by all sectors combined. Growth was driven by relative per capita increases in the construction and transportation and warehousing sectors, as well as significant increases in absolute numbers of jobs in the retail sector, especially in Los Angeles County.

TABLE 1 Change in Average Annual Pay for Goods Movement Dependent Industries in the SCAG Region 2012-2016

	Change in Nominal Dollars			Change in Real Dollars		
Goods Movement Dependent Industry - SCAG Region	2012 Average Annual Pay (Nominal Dollars)	2016 Average Annual Pay (Nominal Dollars)	Change	2012 Average Annual Pay - Real Dollars	Change in Average Annual Pay in Real Dollars (2012 - 2016)	Change in Average Annual Pay in Real Dollars by Percentage (2012 - 2016)
Manufacturing	$53,381	$58,170	8.2%	$55,802	$2,369	4.2%
Wholesale trade	$57,888	$57,005	-1.6%	$60,514	$(3,509)	-5.8%
Construction	$51,003	$65,242	21.8%	$53,317	$11,926	22.4%
Retail trade	$27,931	$30,469	8.3%	$29,197	$1,272	4.4%
Transportation and warehousing	$45,707	$51,951	12.0%	$47,780	$4,171	8.7%
Goods Movement Dependent Sectors	$45,026	$49,283	8.6%	$47,068	$2,215	4.7%
Goods Movement Dependent Sectors (Without Retail)	$53,133	$73,580	27.8%	$55,543	$18,037	32.5%

Source: U.S. Census Bureau

Jobs in goods movement dependent industries are generally well-paying, with annual average compensation in the construction, manufacturing, and wholesale trade sectors outpacing the average annual compensation for all regional industry sectors. Average annual pay for the five goods movement dependent sectors was $49,283 in 2016, an increase of 8.6 percent in nominal dollars, and 4.8 percent in real dollars, compared to 2012. This was greater than the increase in annual average pay for all sectors combined which stood at 7.1 percent in nominal dollars and 2.9 percent in real dollars. Moreover, when excluding the retail sector which typically has much lower annual average pay per employee for many reasons (e.g., large number of part-time employees, increasing pressure from better-paying alternative employment, lack of benefits, online competition, etc.), the annual average pay per employee of $73,580 for goods movement dependent industries in 2016 was nearly $21,000, and 40 percent, higher than all sectors combined. More details on how specific sectors compare to regional totals can be seen in **TABLE 1**. Traditionally, these jobs have been critically important in that they pay well, generally had lower barriers-to-entry (especially important for low and semi-skilled workers) and offered the possibility of upward career mobility, particularly those in the transportation and warehousing sector.

Of particular importance are the impacts that the physical gateways have on the regional economy. Combined, the region's three seaports (Port of Los Angeles, Port of Long Beach, and Port of Hueneme), international airports (including Los Angeles International and Ontario International), and Calexico East – Mexicali II commercial land border crossing make significant contributions to the regional economy. In 2016, these gateways were responsible for over 60,000 direct jobs and more than 1.6 million trade-related jobs throughout the SCAG region. The Ports of Los Angeles and Long Beach alone are responsible for approximately 992,000 jobs (1 in every 9) in the SCAG region, and over 2.7 million jobs throughout the U.S.

Many of these economic impacts are attributable to the region's importance as a gateway for inbound international trade. This is enhanced by the extensive transportation system that is critical in helping the region attract and retain trade-related industries like those involved in wholesale trade, retail trade, or logistics and warehousing. However, the region's international trade-related infrastructure also is important for outbound, or export trade. Export trade is often considered wealth-generating freight because it is associated with an inflow of dollars to regional businesses. In 2016, the value of goods imported and exported from the SCAG region was $369 billion and $125 billion, respectively.

REGIONAL GLOBAL PROFILE

Forward-thinking leaders in business and government helped create the goods movement system that benefits the region today. While California is an economic and cultural powerhouse, the influence and impact of trade and goods movement in Southern California is woven into the global supply chain and the daily lives of people and businesses in countries around the world. This is especially true of some of the largest trade partners of the U.S., including Mexico and Pacific Rim nations, where Southern California continues to be the leading gateway for nations experiencing rapid economic growth (e.g., China, Vietnam, South Korea, etc.). As an example, the remarkable growth in container trade through the Ports of Los Angeles and Long Beach over the last 30 years is the story of the expansion of Asian economies coupled with the growing importance of Pacific Rim trade. By the mid-1980s, as Asian trade began to boom, the West Coast port share of containerized trade exceeded that of the Atlantic Coast for the first time since 1979, and by 2016, West Coast ports held a 44 percent share of U.S. containerized trade (including Guam, Hawaii and Puerto Rico). The connecting landside infrastructure of rail lines and intermodal terminals, and warehouse and distribution centers in Southern California supported this growth and ensured efficient delivery of imports throughout the U.S. at lower costs to American consumers.

While recent investments in the expansion of the Panama Canal, Gulf and East Coast port infrastructure, and new warehouse and distribution facilities have accompanied port-of-entry diversification for many of the nation's largest importers, continuing growth in Asian trade is likely to continue to drive demand for Southern California's ports. The current positive economic climate, driven by stable U.S. GDP and emerging world economies, is poised to continue to create products for imports to the U.S. and elsewhere, but will also create demand for exports from the U.S. to meet the needs of an emerging global

middle class. Both China and Southeast Asia are expected to continue as the fastest growing regions for U.S. import trade over the next 20 years, and offer the prospect for growing exports to China as its middle class prospers and general incomes rise.

Despite these prospects, recent tariffs and trade-related issues with major trading partners such as China, Mexico, Canada, the European Union, and India, as well as other U.S. foreign policies, have created less certainty about short-term growth projections versus the long-term. The clearest indication of this in the U.S. has been displayed through the Federal Reserve's recent shift in its policy towards easing the costs of borrowing money rather than tightening. Major global economies including the U.S., China and Europe have recently witnessed slowing economic growth for manufacturing and other industries, as well as lower prices for raw materials, components and other inputs in the production process. These trends point to a slowing economic cycle globally.

GOODS MOVEMENT SYSTEM VISION

The volume of trade, position of the region as a key node in global supply chains, and enormous consumer market with extensive landside transportation infrastructure, demands that SCAG develop strategies to accommodate growing freight movement. As the Metropolitan Planning Organization (MPO) for the region, SCAG has adopted a vision for the region's goods movement system.

SCAG supports a world-class, coordinated Southern California goods movement system that accommodates growth in the throughput of freight to the region and nation in ways that support the region's economic vitality, attainment of clean air standards, and quality of life for our communities.

Connect SoCal promotes this vision by:

- Maintaining the long-term economic competitiveness of the region
- Promoting local and regional job creation and retention
- Increasing freight and passenger mobility
- Improving the safety of goods movement activities
- Mitigating environmental impacts of goods movement operations

MAINTAINING THE LONG-TERM ECONOMIC COMPETITIVENESS OF THE REGION

Goods movement is fundamental to the SCAG economy and plays a vital role in the Californian and national economies. Understanding the importance of goods movement to the economy, Connect SoCal strives to ensure that regional businesses have access to the transportation services necessary to grow and thrive in Southern California. Some of these businesses, particularly national manufacturing firms and consumer products distributors (who maintain large import warehouses and national distribution centers in the region), form much of Southern California's export base. These businesses consider many factors in making location and expansion decisions, and transportation cost and service reliability are among those factors. Ensuring that the future system can meet the needs of these businesses is a critical objective of Connect SoCal.

Investment in improvements to the regional transportation system also facilitates service to regional markets. A substantial fraction of goods movement demand in Southern California is associated with providing goods and services to local residents.

PROMOTING LOCAL AND REGIONAL JOB CREATION AND RETENTION

Ensuring that Southern California has the port and landside transportation infrastructure necessary to handle increasing growth is important for the U.S. as trade through Southern California's container ports supports jobs throughout the nation. International trade activity[1] is important to the regional economy, creating well-paying jobs in the logistics services sector as well as new opportunities for both import and export-oriented firms in Southern California. Connect SoCal endeavors to ensure that those jobs stay in Southern California

1 International trade activities are those that support the exchange of capital, goods, and services across international borders or territories.

by providing the modern, high-efficiency transportation connections that meet the needs of the nation's importers and exporters. However, changing supply chain paradigms and the emergence of new technologies will push the region to conduct regular evaluations and updates to goods movement strategies to address their impacts on the regional goods movement workforce.

INCREASING FREIGHT AND PASSENGER MOBILITY

The fluid movement of goods and people that meets user needs and expectations is essential for the region to achieve a world class transportation system. A fundamental objective of Connect SoCal is to allow for growth without deterioration in the overall performance of the goods movement system. This means ensuring that rail volumes can double without exceeding acceptable delay levels and addressing truck delays through the development of a highway bottleneck relief strategy and other congestion mitigation strategies and projects to increase efficiency on the transportation network.

IMPROVING THE SAFETY OF GOODS MOVEMENT ACTIVITIES

In 2016, there were nearly 3,700 truck-involved accidents in SCAG region, an increase of 22.8 percent versus 2012, and over 130 of them resulted in fatalities. Reducing conflicts between goods movement and passenger movement is critical to realize a safer system. Connect SoCal prioritizes ensuring the safety and mobility of the region's residents, including drivers and passengers, transit riders, pedestrians, micromobility users and bicyclists. SCAG tries to achieve this by gathering data on truck collisions, possible factors and affected populations in Connect SoCal. A greater separation of passenger and goods movement is envisioned to make the system safer for all users.

MITIGATING ENVIRONMENTAL IMPACTS OF GOODS MOVEMENT OPERATIONS

The goods movement system can and must improve its operations in a way that provides for a healthy environment and livable communities. A zero and near-zero emissions goods movement system is a critical part of this vision. This will be achieved in part by the development, deployment and commercialization of zero and near-zero emission technologies. Significant investment is needed to reach this goal, as are market-based incentives, regulatory and market certainty and investments in supporting infrastructure to help promote clean goods movement technologies. A technology advancement plan included in this report includes action steps and commitments of SCAG and key regional partners to reach this goal.

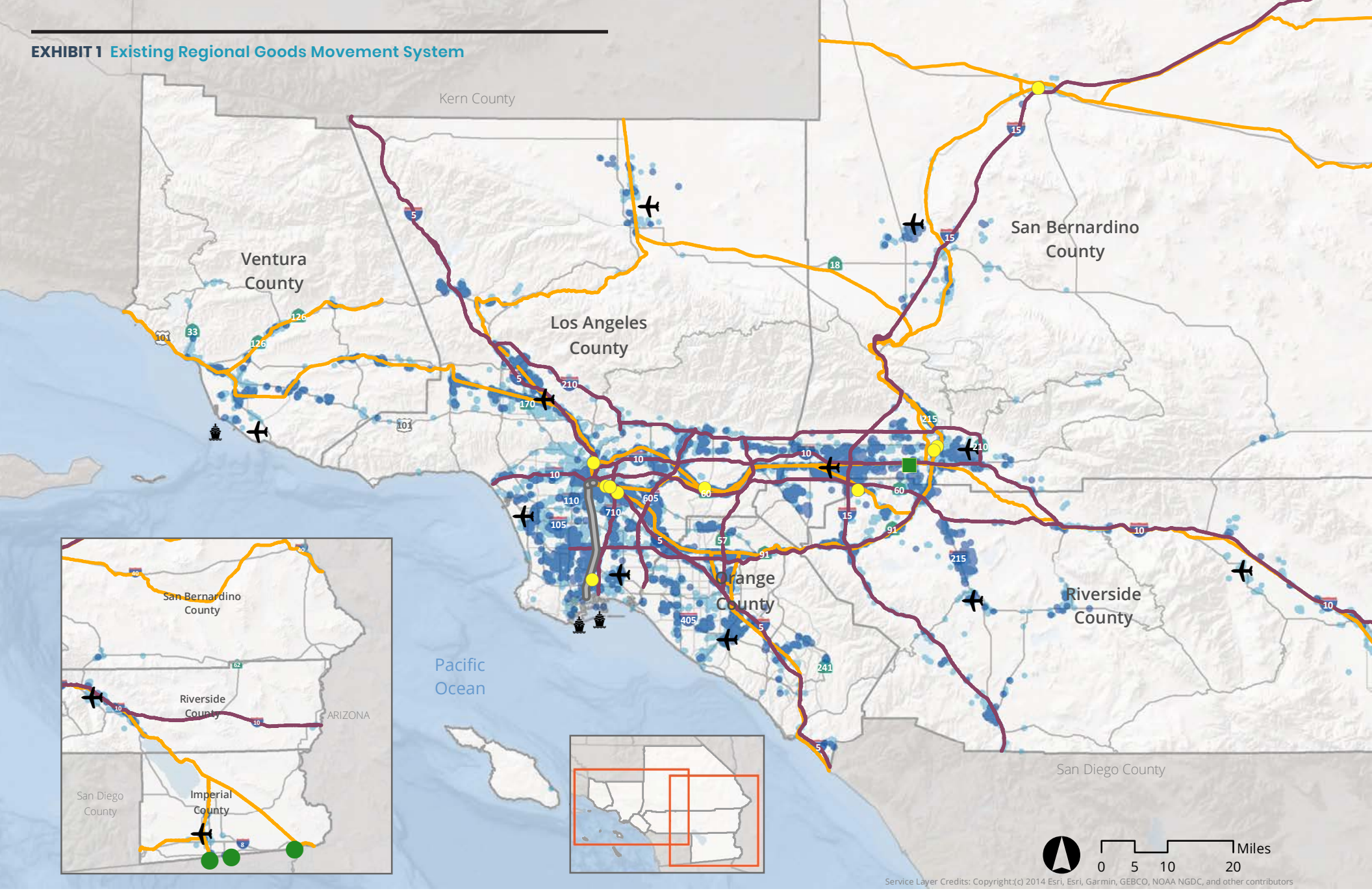
HIGHLIGHT AREA: REGIONAL GOODS MOVEMENT WORKFORCE DEVELOPMENT

As new technologies and automation are adopted more holistically throughout supply chains, the region faces challenges for those whose jobs may be changed or eliminated as a result. This is especially difficult in a region where those without a high school diploma ranges between 15.3 percent (Orange County) to 31.6 percent (Imperial County)[2] is coupled with demands for more sophisticated technical skills for emerging goods movement jobs.

Currently, the U.S. is nearing, or at, full employment meaning that finding labor is more difficult for businesses (including goods movement and goods movement dependent businesses). Goods movement jobs have traditionally offered career mobility to middle-class incomes, but a changing employment landscape has generated new challenges. For example, new legislation increasing minimum wages means that goods movement jobs are often competing with less intense and more appealing work environments that now

2 In 2017, the percentage of the population without a high-school diploma or higher was: 31.6 percent in Imperial County, 21.8 percent in Los Angeles County, 20.8 percent in San Bernardino County, 18.9 percent in Riverside County, 16 percent in Ventura County, and 15.3 percent in Orange County. Source: US. Census Bureau, American FactFinder.

EXHIBIT 1 Existing Regional Goods Movement System



- Airport
- Ports
- Ports of Entry
- Intermodal Facilities
- Classification Facilities
- Major Freight Highway Corridors
- Main Line Rail
- Alameda Corridor

Warehouses

- >= 50,000 sq ft
- < 50,000 sq ft

Source: SCAG 2019, CoStar Realty Information Inc.

offer the same chance for upward career mobility. A smaller available labor pool, paired with increasingly competitive wages from other sectors, may be placing growing pressure on goods movement businesses to find qualified workers without raising costs.

Freight and logistics training faces mismatches and major challenges as technology continues to evolve and affect the types and levels of knowledge necessary for workers to participate in the regional freight workforce. In addition, there is often a significant lack of awareness among younger generations about the job opportunities offered by the freight industry. It is extremely important to make students aware of diverse opportunities in the industry. One of the major dilemmas that the industry faces in is its image. Freight jobs are often looked upon as "dead-end jobs" though they have historically provided considerable personal economic security and growth for workers. It is important to outreach to students, parents and others who influence new workforce participants early in the process to make them aware of the opportunities offered by goods movement industries. Goods movement skills have been taught on the job, or by learning from managers in the past while other disciplines are taught in classroom settings. Connect SoCal supports regional programs that aim to merge the two and leverage options to integrate classroom education to promote access for students to enter the labor force.

COMPONENTS OF THE REGIONAL GOODS MOVEMENT SYSTEM

The regional goods movement system comprises interconnected infrastructure components designed to serve commercial activities spurred by regional, national and global demand. It provides the backbone for the flow of goods between businesses and consumers. Numerous demand factors (e.g., types of products, destinations, urgency, costs, etc.) create unique markets that must be accommodated by varying types of goods movement activities. These markets depend directly on the regional transportation network that provides the mobility and speed necessary to support economic growth. These mobility needs, coupled with air quality, environmental and community challenges posed by regional goods movement activities, serve as the rationale for developing a comprehensive plan to enhance the regional goods movement system.

SEAPORTS

The SCAG region is home to three deep-water ports: the Ports of Los Angeles and Long Beach (San Pedro Bay Ports), and the Port of Hueneme in Ventura County. The San Pedro Bay Ports are the largest container complex (by volume) in the U.S. and ninth busiest in the world.[3] The Port of Hueneme specializes in automobiles, fresh fruit and produce, and other break bulk and project cargo.

Containerized trade between the U.S. and Asia constitutes the majority of international cargo transiting the SCAG region, with approximately 32 percent of all containers in the U.S. moving through the San Pedro Bay Ports.[4] Despite some recent modest shifts in container volumes to other U.S., Canadian and Mexican ports, the total container volume for the San Pedro Bay Ports is still expected to grow to over 34 million by 2045, a 120 percent increase over the next three decades. Imports, which constitute most of the containers that move through the San Pedro Bay Ports, may be categorized as local or discretionary. Local containerized traffic is that which is ultimately consumed in a geographical area local to the San Pedro Bay Ports (Southern California, Southern Nevada, Arizona, New Mexico and southern portions of Utah and Colorado). Discretionary containerized traffic is that which terminates outside this region. Recent analysis indicates that local traffic carrying containerized imports accounts for approximately 35 percent of the San Pedro Bay Ports' total import-related traffic. The other 65 percent is assumed to be discretionary traffic, routed through the San Pedro Bay Ports for economic reasons.

Beyond local or discretionary (moves to locations outside of the region), imports can be further categorized as Direct or Transloaded. When containers arrive at the San Pedro Bay Ports, the way they move is largely determined by final consumption points, inventory needs and transportation costs. Transloading

3 Source: World Shipping Council.
4 Source: American Association of Port Authorities: Port Industry Statistics - 2016.

is broadly defined as activities that involve the deconsolidation of the contents of marine containers, which are usually 40-foot equivalent units (FEUs), and reloading of their contents into 53-foot domestic intermodal containers or trailers transported by trucks for local markets or by rail outside the region. Transloading allows for the movement of increased amounts of goods while utilizing less equipment, resulting in significant cost savings through economies of scale and other transportation-related savings. It sometimes provides value-added services as well. Existing infrastructure, equipment and trade flows in the region provide a substantial competitive advantage and serve as a major economic incentive for importers to move freight requiring transloading through Southern California.

The Port of Los Angeles has nine container terminals with four on-dock rail yards. The Port also has eight liquid bulk terminals, one automobile terminal, three break bulk terminals, three dry bulk terminals and a cruise terminal with three berths. It comprises 4,200 acres of land, with 1,634 acres of container terminals. Current entitlements (i.e., development with existing approvals) would allow container terminal acreage to increase to 1,737 acres. According to the Port of Los Angeles master plan, acreage will expand to 2,165 acres with full build out.

The Port of Long Beach has six container terminals, five of which have on-dock rail yards. A seventh container terminal on Pier S is under construction. The Port also has seven liquid bulk terminals, eight break bulk and roll-on and roll-off terminals, seven dry bulk terminals, and one cruise terminal. It comprises 3,200 acres of land (1,371 acres of which is container terminals). Current entitlements would allow container terminal acreage to increase to 1,523 acres. According to the Port of Long Beach's master plans, with full build-out, container terminal acreage will expand to 1,703 acres

The Port of Hueneme has 223,000 square feet of refrigerated terminal space available for fresh fruit importers and exporters. Bananas and fresh fruit comprise the single largest commodity type handled at the Port of Hueneme. In 1998, the District entered into a lease for the distribution of liquid fertilizer. Today, Yara North America, one of the world's largest fertilizer suppliers, operates a state-of-the-art automated terminal at the Port of Hueneme for distribution of fertilizer to the agriculture industry in the surrounding area.

RAILROADS

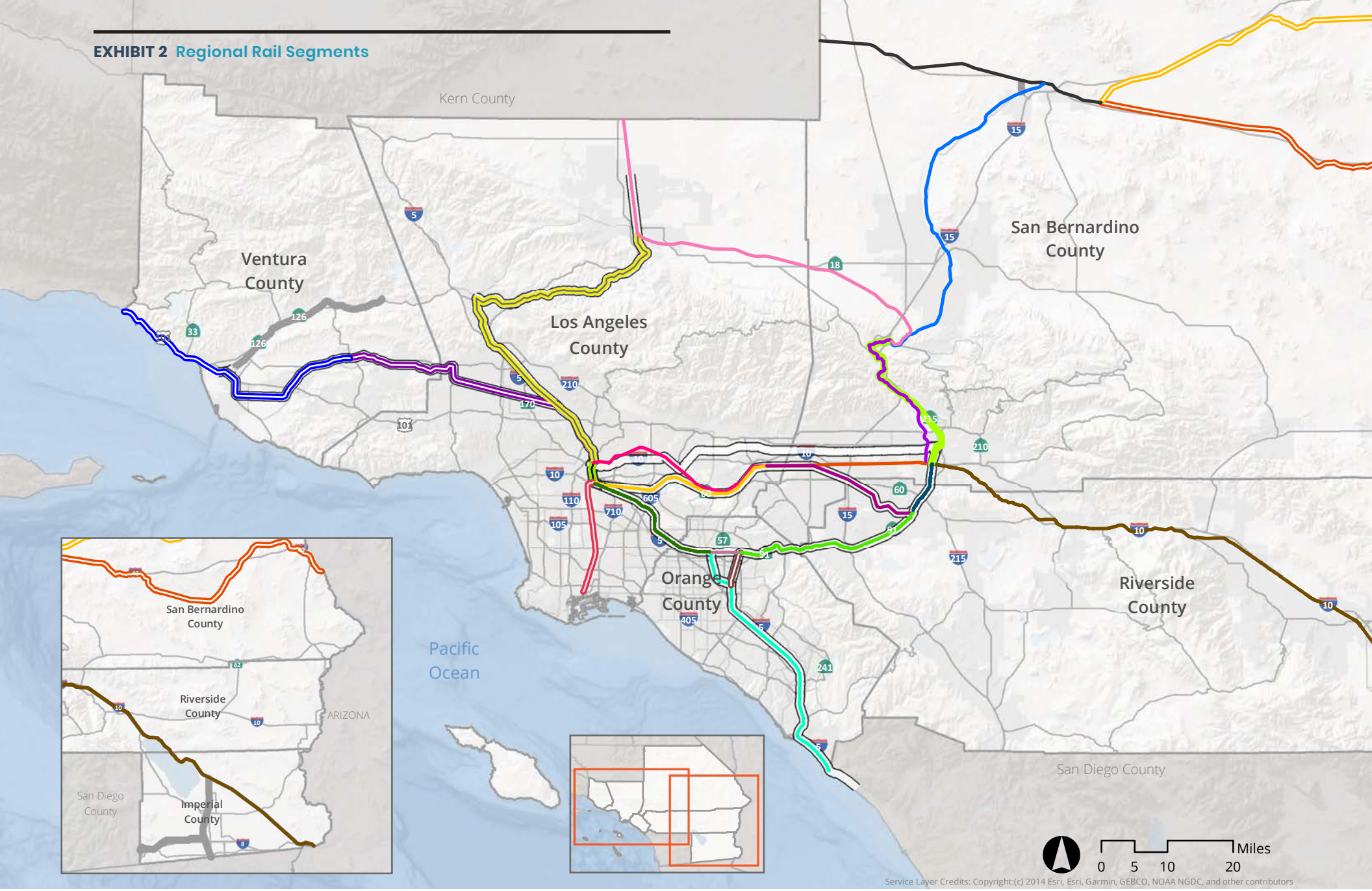
Critical to the growth of the region's economy, the BNSF Railway (BNSF) and Union Pacific Railroad Company (UPRR), the region's two Class I railroads, carry international and domestic cargo to and from distant parts of the country. The BNSF mainline operates on the Transcontinental Line (Cajon and San Bernardino Subdivisions). The UPRR operates on the Coast Line, Saugus Line through Santa Clarita, Alhambra and LA Subdivisions and Yuma Subdivision to El Paso.

Both railroads operate on the Alameda Corridor that connects directly to the San Pedro Bay Ports and on the Alameda Corridor-East which serves rail moving easterly and westerly through the SCAG region. The San Pedro Bay Ports also provide several on-dock rail terminals along with the six major intermodal terminals operated by BNSF and UPRR outside of the San Pedro Bay Ports. Three Class III railroads operate in the region and provide short-haul services: Pacific Harbor Line (PHL), Los Angeles Junction Railway (LAJ) and the Ventura County Railroad (VCRR). PHL provides rail transportation, maintenance, and dispatching services within the San Pedro Bay Ports area. The LAJ provides industrial switching services in the Cities of Vernon, Maywood, Bell and Commerce. The LAJ also provides connection to both UPRR and BNSF. The VCRR extends for just over 12 miles on four branches serving the industrial areas of south Oxnard,[5] the Port of Hueneme and U.S. Naval Base Ventura County Port Hueneme Division, and and connects with the UPRR Coast Maine Line in downtown Oxnard.

The San Pedro Bay Ports are served by the Alameda Corridor. The Alameda Corridor has three main tracks, 10 miles of which are in a lowered trench between SR-91 and approximately 25th Street near downtown Los Angeles. All harbor-related trains (i.e., trains that originate or are destined for the on-dock and near-dock terminals) of UPRR and BNSF use the Alameda Corridor to

5 Source: Port of Hueneme.

EXHIBIT 2 Regional Rail Segments



BNSF San Bernardino Sub
- Fullerton Jct. to Atwood
- Hobart to Fullerton Jct.
- Atwood to W Riverside
- W Riverside to Colton

BNSF Cajon Subdivision
- Colton to Silverwood
- Silverwood to Barstow

UP Alhambra Subdivision
- Yuma Jct. to Pomona
- Pomona to W Colton

UP LA Subdivision
- East LA to Pomona
- Pomona to W Riverside

UP Mojave Subdivision
- W Colton to Silverwood
- Silverwood to Mojave

Other Rail lines
- UP East Bank
- UP Coast Line
- UP Santa Clarita
- Cima Subdivison
- Olive Subdivision
- BNSF Orange Sub
- Needle Subdivision
- Santa Barbara Subdivision
- Mojave Subdivision
- Alameda Corridor
- UP Yuma Subdivision
- Commuter Rail
- Main Line Rail

Source: SCAG, 2019

access regional rail mainlines that begin near downtown Los Angeles. These trains do not pick up or drop off rail cars at the downtown intermodal terminals but continue on to locations in the interior U.S. The Alameda Corridor was developed to consolidate rail traffic from four previously separate rail lines into a single corridor and eliminate at-grade crossings that divided communities along those rail lines. It has improved speeds, increased throughput and mitigated impacts on communities. The Alameda Corridor eliminated all at-grade crossings between the Ports and the intermodal railyards located on Washington Boulevard (BNSF Hobart Yard and UPRR's East Los Angeles). To transition from the Alameda Corridor to the Alhambra Subdivision, the UPRR utilizes trackage rights over Metrolink's East Bank Line, which runs parallel to the Los Angeles River on the east side of downtown Los Angeles. There are no grade crossings on the East Bank line. The UPRR Los Angeles Subdivision terminates at West Riverside Junction where it joins the BNSF San Bernardino Subdivision. The BNSF San Bernardino Subdivision continues north of Colton Crossing and transitions to the BNSF Cajon Subdivision. The Cajon line continues north to Barstow and Daggett, and then east toward Needles, California and beyond. UPRR trains exercise trackage rights over the BNSF Subdivision from West Riverside Junction to San Bernardino, and over the Cajon Subdivision from San Bernardino to Daggett, which is a short distance east of Barstow. The UPRR Alhambra Subdivision.and the BNSF San Bernardino Subdivision cross at Colton Crossing in San Bernardino County. East of Colton Crossing, the UPRR Yuma Subdivision passes through the Palm Springs area, Indio, and to Arizona and beyond. UPRR also operates on the Coast Mainline, which serves as a connection between the City of Oxnard and all major West Coast destinations. As the only intercity freight rail provider in the city, this line provides an important link for the delivery of goods out of Oxnard.

There are six intermodal terminals operated by the Class I railroads in the SCAG region. By reducing the number of times freight itself is handled, these terminals facilitate increased efficiency and speed, reduced damage and greater security. They are:

- Hobart Yard in Commerce (operated by BNSF);
- San Bernardino Yard (operated by BNSF);
- East Los Angeles Yard (ELA) at the west end of the UPRR Los Angeles Subdivision (operated by UPRR);
- Los Angeles Transportation Center (LATC) at the west end of the UPRR Alhambra Subdivision (operated by UPRR);
- City of Industry on the UPRR Alhambra Subdivision (operated by UPRR); and
- Intermodal Container Transfer Facility (ICTF) near the south end of the Alameda Corridor (operated by UPRR).

In addition to these intermodal terminals, there are railyards that serve carload traffic of various types. UPRR has a large carload freight classification yard at West Colton (at the east end of the Alhambra Subdivision). A large UPRR auto unloading terminal is located in Mira Loma (midway between Pomona and West Riverside on the Los Angeles Subdivision). BNSF also has an automobile facility located in the City of San Bernardino off the San Bernardino Subdivision line.

HIGHWAY SYSTEM

The SCAG region has 56,276 total road miles, and 135,578 lane miles (which includes local roads, arterials, and connector facilities) and 1,634 miles of highways and Interstates. This roadway system provides mobility for truck trips of all types to locations in the region and connections outside it. The regional roadway system serves multiple functions and can be thought of as the connecting tissue that ties together the multimodal freight transportation system in Southern California, providing critical last mile connections to intermodal terminals, marine terminals, airports, border crossings, warehouses and distribution centers, and manufacturing facilities. The highway system allow trucks to perform several critical roles that support goods movement in the region.

Southern California remains the leading manufacturing center in the U.S. While the region provides many non-transportation advantages to manufacturers (such as access to a large consumer market), its access to efficient and reliable transportation, especially the regional roadway system, contributes to its attractiveness for certain types of manufacturing. Trucking

connections to suppliers and markets are an important element in many manufacturing supply chains. These involve both intraregional connections to clusters of related businesses and long-haul corridors. Significant amounts of regional manufacturing are located along key roadway corridors that facilitate connections to the Interstate system, intermodal rail facilities and air cargo facilities. Another critical roadway function that supports regional manufacturing is the ability to make interregional connections. The Interstate highway system serves as the primary connection between the region, national markets and suppliers with significant support from several state routes. These interregional corridors are also important to regional and national distribution centers that are significant components of growing logistics activities in Southern California. Arterial highways throughout the region provide direct connections to commercial centers and residential areas that allow for deliveries to stores, homes, construction sites and service businesses. For this system to function effectively, it must rely on a core set of highways that facilitate east-west and north-south connections. These are similar to the routes that support regional manufacturing but also include roads serving population clusters such as Interstate 405 (I-405).

Major regional international gateways in the region rely on roadway connections. Interstate 710 (I-710) offers direct access to the San Pedro Bay Ports, as well as points north and connections to almost every major east-west highway. It acts as a primary access corridor to the intermodal rail terminals that handle the majority of international intermodal cargo (ICTF, Hobart Yard, and East Los Angeles Yard), marine terminals at the San Pedro Bay Ports and large concentrations of warehouses, transloading facilities and logistics service providers in the Gateway Cities subregion. Similarly, Interstate 110 (I-110) provides access to certain marine terminals at the Port of Los Angeles. In addition, the local arterial roadway system plays a critical role providing "last mile" connections to the San Pedro Bay Ports and intermodal terminals. State Route 47 (SR-47)/State Route (SR-103) near the San Pedro Bay Ports is an example of this type of facility. There are three bridges connecting the roadway system to Terminal Island: Vincent Thomas Bridge on the west, Commodore Schuyler F. Heim Bridge on the north, and Gerald Desmond Bridge on the east.

The primary access route to the Port of Hueneme is U.S. 101, along with the secondary routes of State Route 126 (SR-126) and State Route 1 (SR-1). As specified in the City of Oxnard's General Plan, the preferred arterial access route for trucks is Hueneme Road and Rice Avenue.

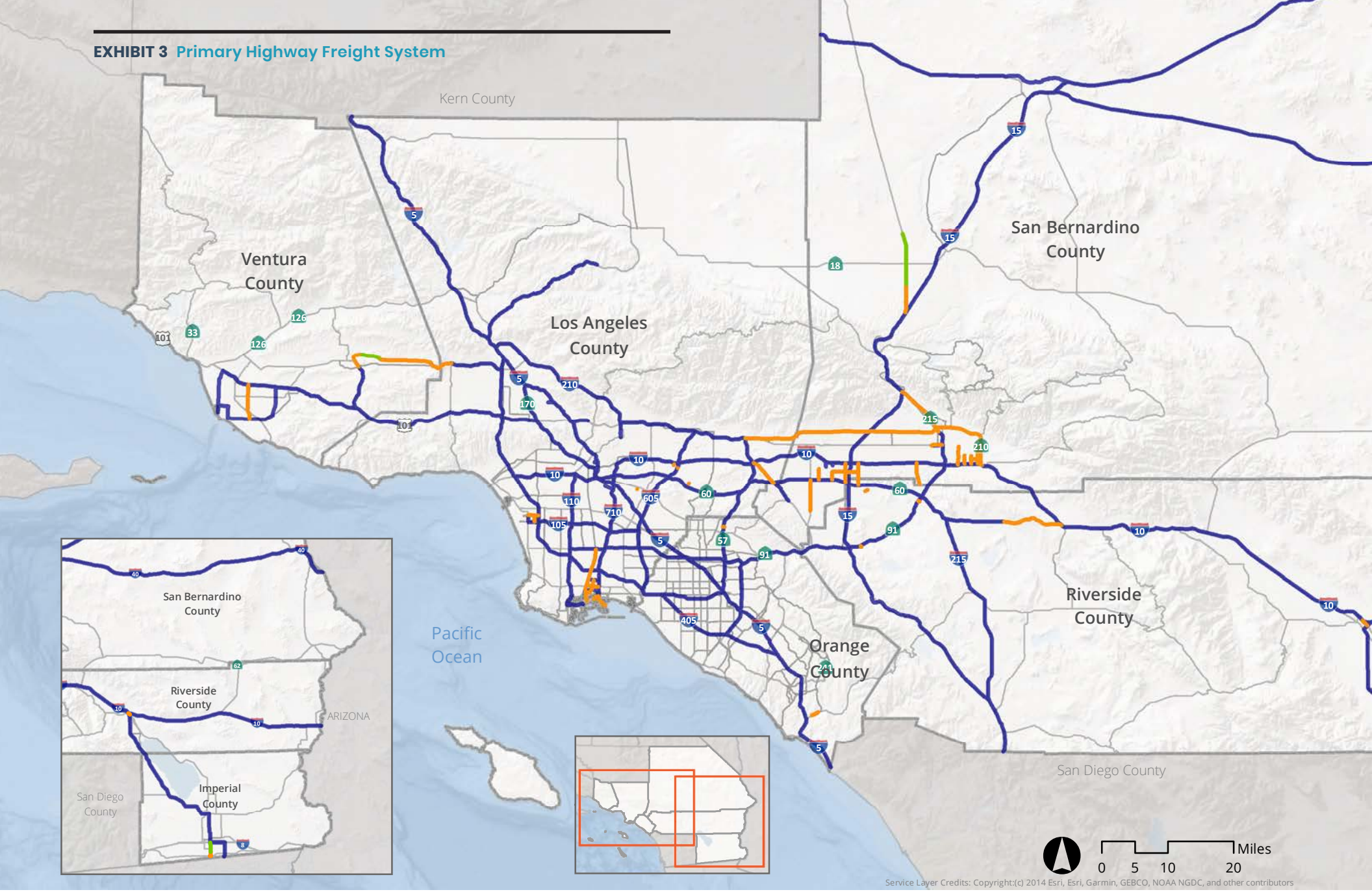
Two of the largest air cargo complexes at Los Angeles International Airport (LAX) are located along West Century Boulevard and State Route 90 (SR-90/ Imperial Highway). Along with La Cienega Boulevard (connecting Century Boulevard and Imperial Highway), these roadways were identified by the Los Angeles Department of Transportation as the major arterial truck routes serving air cargo at LAX. Major freeway connections are provided by I-405 and Interstate 105 (I-105).

Many of the region's warehouse and distribution facilities are clustered along key goods movement highway corridors:

- I-405 provides access to clusters of air cargo facilities where sorting and consolidation/de-consolidation activities occur near LAX;
- I-710 provides access to logistics service providers, truck terminals and transload facilities serving the San Pedro Bay Ports, as well as providing connections to the warehouse concentrations in Downtown Los Angeles and East Los Angeles.
- Interstate 5 (I-5) provides access to warehouse clusters in the Gateway Cities subregion and in areas in northern Orange County (such as warehousing clusters in Anaheim); and
- East-west corridors, including State Route 60 (SR-60) and Interstate 10 (I-10), provide access to major warehouse clusters in the San Gabriel Valley (especially in the City of Industry) and the Inland Empire (including major concentrations in Ontario, Fontana, and Mira Loma);[6] SR-60 is a primary access route to many of these locations with over 50 percent of the region's warehouse space located within five miles of the highway.

6 These tend to be larger modern warehouses that include many large trucking terminals, air cargo facilities near Ontario Airport, import warehouses, and RDCs.

EXHIBIT 3 Primary Highway Freight System



Primary Highway Freight System (PHFS) Critical Urban Freight Corridors (CUFCs) Critical Rural Freight Corridors (CRFCs)

Note: Map includes recent submittals of CUFC/CRFC segments to FHWA

Source: U.S. Department of Transportation. SCAG, 2019.

TABLE 2 Primary Highway Freight Network – Southern California Summary

County	Total Miles of Primary Freight Network	Regional Share
Imperial	86.11	5.3%
Los Angeles	485.15	29.7%
Orange	127.65	7.8%
Riverside	324.12	19.8%
San Bernardino	537.68	32.9%
Ventura	72.98	4.5%
Grand Total	1633.69	100.0%

Source: U.S. Department of Transportation. Table includes recent submittals of CUFC/CRFC segments to FHWA

Sections of I-10, Interstate (I-15), SR-60 and State Route 91 (SR-91), which carry the highest volumes of truck traffic in the region, averaged more than 25,000 trucks per day in 2016. Other major components of the regional highway network also serve significant numbers of trucks. These include I-5, I-405 and Interstate (I-210). More than 20,000 trucks per day travel on some sections these roadways. These roads carry a mix of cargo types, including local, domestic and international. The arterial roadway system also plays a critical role in goods movement, providing first and last-mile connections to regional ports, manufacturing facilities, intermodal terminals, warehousing and distribution centers and retail outlets.

Previous federal legislation and transportation reauthorizations directed the Federal Highway Administration (FHWA) to create the Primary Freight Network (PFN), a component of the National Freight Network (NFN), intended to "assist states in strategically directing resources toward improved system performance for the efficient movement of freight on the highway portion of the nation's freight transportation system." With the passage of the Fixing America's Surface Transportation (FAST) Act, the Primary Highway Freight System (PHFS) was designated using a 41,000 mile highway network. In the SCAG region, about 1,633 miles of highways were designated as a part of the PHFS, with Los Angeles and San Bernardino Counties accounting for approximately 60 percent of the total coverage. **TABLE 2** shows the breakdown of the PHFS miles by county in the SCAG region.

AIRPORTS

There are seven airports that provide air cargo services in the SCAG region. Collectively, they handled nearly 3.3 million tons of air cargo in 2018.[7] Combined, Los Angeles International Airport (LAX) and Ontario International Airport (ONT) handled approximately 97 percent of the region's international and domestic air cargo during 2018, including international goods valued at

7 Source: Caltrans, Los Angeles World Airports (LAWA), Ontario International Airport.

$120 billion.[8,9] Most of the remaining air cargo moves through Bob Hope, Long Beach, John Wayne, and Palm Spring International Airports.

Air cargo handled at the region's airports is served by a mix of commercial passenger carriers (often referred to as "belly cargo"), integrated carriers (such as Federal Express (FedEx) and United Parcel Service (UPS)) who provide integrated air and truck service, and air cargo carriers. Air cargo can be broken down by freight or mail with most freight including high-value and/or time-sensitive shipments.

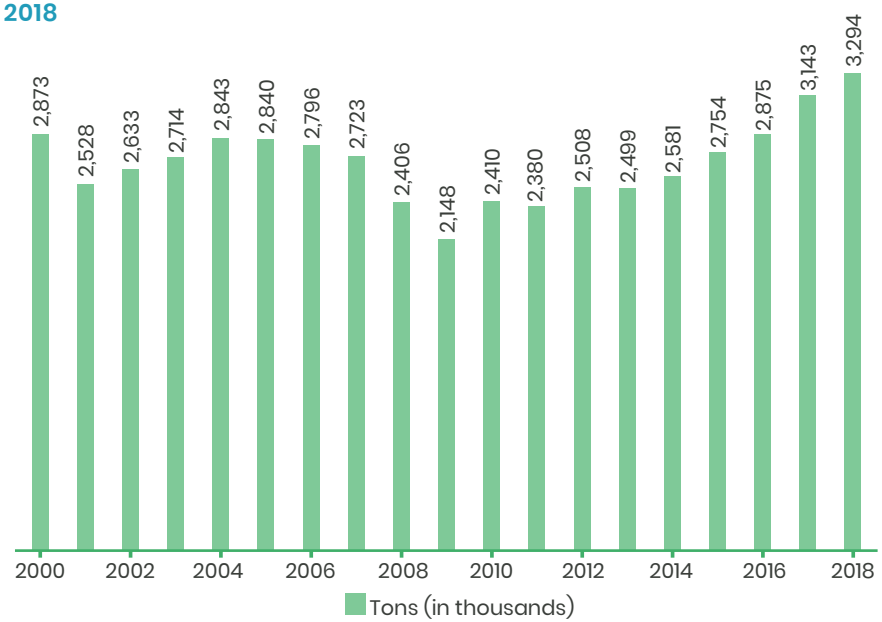
LAX has a large cargo operation that includes over two million square feet of air cargo space comprised of the 98-acre Century Cargo complex, the 57.4-acre Imperial Cargo complex, the Imperial Cargo Center and a number of terminals on the south side of the airport. These facilities include distribution and sortation facilities, air cargo containers, ground equipment and air freighter cargo loading and unloading spaces. Less than five percent of LAX's air cargo was mail related, and 65 percent of freight cargo was international. International cargo, is primarily transported by freighters, but a substantial majority, over 40 percent, is transported by international air passenger carriers as belly cargo. Major international destinations include Asia, Mexico and Europe.

ONT has almost three acres of cargo building and office space to support all-cargo and air mail. UPS has a 156-acre West Coast Distribution Center adjacent to the airport, including air freighter storage for loading and unloading, directly connected to the airport and warehouse and distribution facilities, and direct service to China. Recent air cargo developments have included new Air Prime cargo services operated by Amazon, and FedEx's lease extension and plans to invest $100 million to relocate its operations to over 50 acres in the northwest portion of the airport. In contrast to LAX, ONT's freight cargo is transported domestically (nearly 90 percent), with less than four percent of total air cargo being mail-related.

In addition to these existing operations, there are three airports in the region that have plans for improved air cargo operations. The March Air Force Base/ March Inland Port (MIP) entered into agreement with Amazon to operate six flights a day with operations beginning late 2018.[10] The San Bernardino International Airport (SBD) is aggressively marketing itself as a cargo facility by providing expedited Customs clearance, significant space for new development, excellent freeway access and a Foreign Trade Zone. The Southern California Logistics Airport in Victorville is envisioned to be a domestic and international air cargo facility, with a 4,740-acre business complex, including manufacturing, industrial multimodal and office facilities. All regional airports handling cargo have direct access via major interstates and highways to the region's vast industrial warehouse facilities and direct connections for domestic and national

8 The value of goods moving through LAX in 2018 was $120 billion, a 16.4 percent increase over 2016.
9 Source: United States Census Bureau, Foreign Trade, USA Trade Online

FIGURE 1 Air Cargo Tonnage through SCAG Regional Airports 2000–2018



Source: Caltrans, Los Angeles World Airports and Ontario International Airport

10 McMillan, Rob. Eyewitness news (October 2018). "Amazon to start operations at March Air Reserve Base".

cargo via rail and truck modes.

INTERNATIONAL LAND PORTS PORTS-OF-ENTRY (POEs)

International border crossings between the U.S. and Mexico are critical components of the freight transportation system in Southern California as they link global supply chains. The region hosts international truck and rail border crossings with Mexico in Imperial County. There are currently three land POEs in the county that process commercial truck and rail traffic – Calexico West-Mexicali I, Calexico East- Mexicali II, and Adrade-Los Algodones. The vast majority of trucks (approximately 98 percent), which handle most of the trade flow between the U.S. and Mexico, cross the border at Calexico East-Mexicali II. This POE is located approximately 130 miles east of San Diego and 60 miles west of Yuma, Arizona and includes nine passenger lanes, four pedestrian lanes and three commercial lanes (including one FAST lane). The Calexico-East Mexicali II POE is connected to the regional freight truck network via State Route 7 (SR-7), which directly serves the POE and connects to Interstate 8 (I-8). State Route 86 (SR-86) is the major truck corridor connecting Calexico to the rest of the SCAG region. International cross-border trade has continued to grow, driven by factories and warehouse and distribution facility developments on both sides of the border, agricultural commodities crossing in Imperial County and via exports through the San Pedro Bay Ports. With a focus on improvements for both rail and truck modes, expectations for increasing international trade from the border region and through the San Pedro Bay Ports is poised to continue.

DISTRIBUTION CENTERS, WAREHOUSING AND TRANSLOADING FACILITIES

Since 2016, the region has witnessed continued growth for warehousing, distribution, cold storage and truck terminal facilities, with the square footage of total facility space now exceeding 1.2 billion. The mix of building sizes remains skewed to larger footprints with every two out of three buildings greater than 50,000 square feet. The majority of growth continues to occur in the Inland Empire as the counties of Riverside and San Bernardino have the most developable land zoned for industrial uses. Key trends driving growth include increasing trade and e-commerce.

As import and export container demand through the San Pedro Bay Ports has increased, there has been a corresponding need for greater transloading and other value-added services. This has led to both warehouse and distribution facility increases for shippers like Amazon and Home Depot, as well as for third-party logistics providers (3PLs). Driven by the accelerating penetration of e-commerce and expectations of consumers, Amazon, FedEx and UPS have seen significant growth in regional air cargo operations. This has resulted in continued expansion of Amazon, and other regional fulfillment centers. Many traditional retail companies have increasingly adapted their business models to accommodate the digital and mobile purchases of goods, leading to the development of fulfillment centers for companies like Walmart, Staples and Kohl's, among others. Many of these facilities are clustered along key goods movement corridors. Port-related warehousing is concentrated in the Gateway Cities subregion, while national and regional distribution facilities tend to be located in the Inland Empire.

CONSUMER BASE

The SCAG region is home to over 19 million people making up more than over six million households. The region also employs nearly 8.4 million people and has approximately 150,000 businesses. Collectively, the SCAG region generated approximately $1.2 trillion GDP in 2016, ranking 15th in the world above Mexico and just below Spain,[11] and second only to the New York/New Jersey region in the U.S.[12] By 2045, the SCAG region is expected to add almost 3.7 million new residents (19.5 percent increase), almost two million new households (27.1 percent increase), and over 1.75 million new employees (19.8 percent increase). This growth in residents and income is expected to drive consumer spending and demand for goods, increasing pressure on the regional transportation network.

11 Source: The World Bank.
12 Source: U.S. Department of Commerce, Bureau of Economic Analysis (BEA).

SUPPLY CHAINS AND THE SCAG REGION

Supply chains typically refer to end-to-end processes, starting from product demand forecasting and production planning, material sourcing, manufacturing and product delivery, to intermediate nodes such as distribution centers and warehouses, to consumption nodes such as stores. In a lifecycle model, the reuse, recycling or disposal of products could also be considered a portion of their supply chain. The force of rapid globalization and increases in information technology have raised the importance of international gateways as consumers demand faster order fulfillment and companies promise to deliver through sophisticated distribution networks. Southern California is a key global trade gateway as many trade routes are connected through the regional transportation system to the rest of the nation and the world. However, supply chain strategies are becoming increasingly complex and imposing greater demands on the transportation network.

OVERVIEW OF SUPPLY CHAINS

Businesses continuously evaluate their supply chain strategies. Generally, functional products with steady demand, long product life and low profit margins (e.g., daily items such as toilet paper, canned foods, general purpose nails and screws) require efficient supply chains to minimize inventory and transportation costs. Innovative products with high demand uncertainties, inventory costs, seasonality and profit margins (e.g., high-end electronics, fashion items, seasonal furniture, etc.) require responsive supply chains to ensure that the products are available at the right time and in the right quantities. Businesses also factor in supply chain trade-offs (i.e., making choices to accept less of one thing in order to receive more of something else). There are several prominent forces that have facilitated the rapid globalization of supply chains including the GDP growth rates of foreign countries, the availability of skilled labor in different parts of the world, advanced technology, consumer demand preferences, trade policies and political and economic factors.

Strategies are shaped in response to a combination of market forces and regulations, and therefore may evolve in unexpected ways. Of all the factors currently shaping trends in supply chain and logistics, e-commerce continues to be one of the most influential. Distribution networks are changing to accommodate the new paradigms stemming from e-commerce. Consumer expectations of expedited and free (or low cost) shipping are pushing businesses to move toward the use of urban fulfillment centers that help meet customer needs and reduce costs (e.g., inventory costs, fuel costs, costs of delay, etc.). The advancement of automation is also expected to have a considerable influence throughout the regional supply chain.

HIGHLIGHT AREA: THE THREE PRIMARY TYPES OF IMPORT CARGO CHANNELS

Inland Point Intermodal (IPI) is cargo that is moved in the original marine container from the overseas origin to an inland U.S. destination via rail on a single ocean carrier bill of lading. The destinations for the cargo are generally far from the SCAG region (over 1,500 miles). IPI cargo may be loaded at on-dock rail terminals at the San Pedro Bay Ports or drayed by truck to near-dock (approximately 4 miles from the ports) or off-dock rail terminals, where it is loaded on trains. At the destination, the containers are picked up at rail terminals and delivered by dray trucks to their final destinations. It has been estimated that IPI imports amounted to about 31 percent of total loaded imports at the San Pedro Bay Ports in 2016.

Transloading involves unloading a marine container at a facility and then reloading the cargo into a larger domestic container or trailer, usually 53-feet in length, which is then either delivered via truck or rail. Typically, the original marine container is driven by a dray truck from the ports to an import warehouse/transloading facility within the SCAG region where the containers are unloaded, and then reloaded, in larger domestic containers or trailers. These domestic trailers are then driven either to an intermodal railyard, where they are loaded on trains, or to their final destination. In many cases, other value-added activities occur at these transload facilities, generating jobs and economic activity in the SCAG region. A portion of transloaded cargo may be reloaded immediately using a cross-dock facility, but most are warehoused in Southern California for some time before reshipment. Extensive

transloading activities are a major competitive advantage the region holds over other gateways.

Local without Intent to Transload (Local) is cargo in marine containers that is delivered to local warehouses for consumption within the greater region (Southern California, Southern Nevada, Arizona, New Mexico, and southern portions of Utah and Colorado). These locations are best served by the San Pedro Bay ports because they provide the lowest landside transportation costs. These movements are handled almost exclusively by truck.

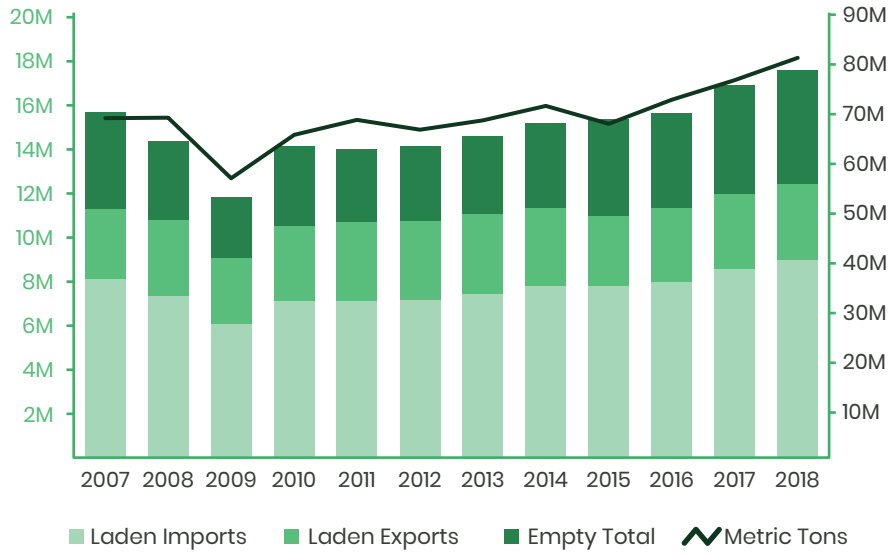
TYPES OF REGIONAL TRADE FLOWS

INTERNATIONAL TRADE FLOWS

The SCAG region is the largest international trade gateway in the U.S. The majority of international goods flow easterly from the region and can be moved by a variety of transport modes. This includes direct on-dock rail from port terminals, off-dock transloaded international containers and domestic intermodal containers at intermodal rail yards, and transferred goods from warehouses in the Inland Empire to Ontario International Airport (ONT) among others. Goods are moved through supply chains to destinations like Chicago, Dallas and Memphis. For local markets, the same dynamics are at play as the region's roadways play a vital role in interconnecting the thousands of retail outlets for consumption channels, while also supporting markets in the Southwest U.S.

Since 2016, there have been significant changes beyond the region's control that have impacted international trade flows including new vessel sharing alliances (VSAs),[13] completion of the Panama Canal expansion, increased competition for market share from other North American ports and emerging federal foreign trade policies. Most notable has been the trade war with China, but ongoing trade negotiations with Japan and Europe, and an attempt to reach agreement on a revised trilateral trade agreement among the United States, Mexico, and Canada (USMCA), have also complicated matters. Locally, changes have included PierPass's fee structure shift to an all-day model, as well as efforts to streamline multimodal operating efficiencies through General Electric's (GE) Transportation's Port Optimizer solution and the DrayFLEX project, sponsored by the Los Angeles County Metropolitan Transportation Authority (Metro). Despite these changes, freight activity has recently surged, with 2018 seeing record volumes of goods compared to the previous peak cycle, placing increasing pressure on the movement of goods throughout the region. Today, the region not only finds itself in a highly competitive environment, but also with the need to consider innovative strategies and solutions beyond traditional freight investments or operational approaches to support and sustain economic growth.

FIGURE 2 San Pedro Bay Ports TEU & Volume Performance 2007 - 2018



Source: Ports of Los Angeles and Long Beach

13 A Vessel Sharing Agreement (VSA) is usually reached between various partners within a shipping consortium who agree to operate a liner service along a specified route using a specified number of vessels.

SEAPORTS AND REGIONAL TRADE FLOWS

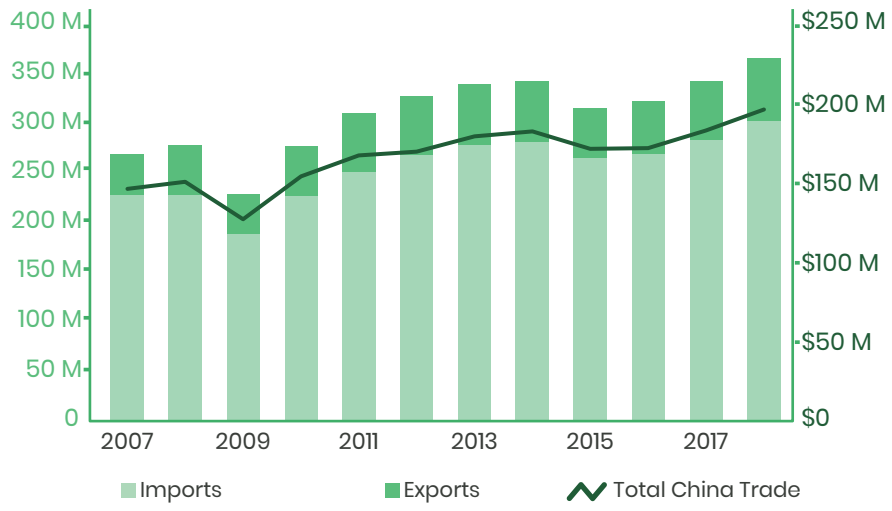
During the previous peak in 2007, 15.7 million twenty-foot equivalent container units (TEUs) moved through the San Pedro Bay Ports. In 2018, this number increased to 17.6 million TEUs, setting a new annual record with the mix of goods continuing to be heavily skewed toward imports from Asia.[14] Globally, 2019 trends have shown substantial declines from modal pricing surges for freight rates in 2018, as well as a slowing demand for goods. Combined with uncertainties surrounding U.S. trade policies and tariffs, stemming mostly from the current trade war with China.

International containerized trade value for the San Pedro Bay Ports increased from $270 billion in 2007 to $366 billion in 2018, including import value growth from $228 billion to $303 billion, and export value growth from $42 billion to $63 billion. In 2018, the U.S. had a $240 billion trade deficit. The deficit was substantially driven by trade with China which has been a focal point of the current U.S. Administration's foreign trade policies. In 2018, China accounted for nearly 55 percent of the total trade value (60 percent of imports and 24 percent of exports) transiting the San Pedro Bay Ports. Despite the implementation of tariffs on Chinese goods, import value in 2018 grew by nearly 8 percent from 2017, though export value declined by three percent over the past decade. Prior to 2018, import and export value had averaged annual increases of two and three percent. The surge for imports in 2018 was largely driven by business decisions to front-load imports prior to tariff increases (a 25 percent tariff was implemented on $34 billion of goods imported from China on July 6, 2018[15]) and

14 Source: Ports of Los Angeles and Long Beach.

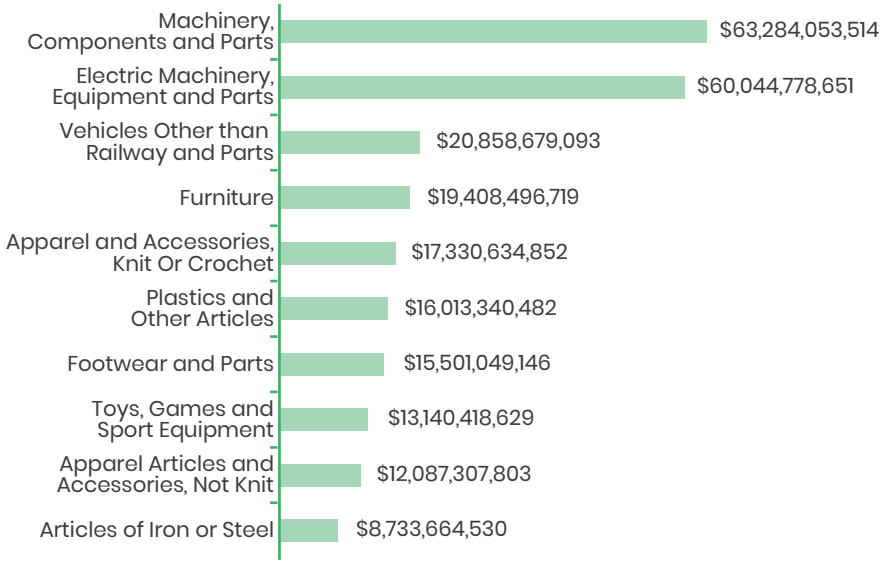
15 Office of the United States Trade Representative.

FIGURE 3 San Pedro Bay Ports Containerized Trade Value



Source: U.S. Census Bureau, Foreign Trade

FIGURE 4 Top 10 Commodities Traded Through the San Pedro Bay Ports 2018



Source: U.S. Census Bureau, Foreign Trade

offset further anticipated tariff increases enacted throughout 2019. The trade war with China remains highly sensitive. This type of environment has placed less certainty regarding short-term performance and expectations.

Annual growth rates have varied between laden TEUs, containerized trade value and metric tons from 2007 to 2018. Both laden TEUs and metric tons have grown from one to one and a half percent per year, while trade value has grown closer to three percent per year, suggesting that commodity mix and pricing has been the core driver for trade value, with volumes being less robust.

VSAs have dramatically shifted global market share among carriers. Three major shipping alliances,[16] including 2M (Maersk and MSC), Ocean Alliance (Cosco-OOCL, CMA CGM and Evergreen), and THE Alliance (Hapag-Lloyd, ONE and Yang Ming) now control 80 percent of the global market, based on global container carrying capacity.[17] These alliances have allowed carriers to build and operate much larger ships while reducing unit costs across multiple carriers. This growth has also resulted in impacts on landside port infrastructure with an increase in the number of lifts and time required to offload and on-load containers, leading to new surges for terminals, railroads and trucks, and impacting container dwell times. The formation of larger alliances has led to concerns regarding the buying power of the alliance carriers, leading to competition between terminal operators and ultimately the risk of lower returns on investments for the port industry as a whole.

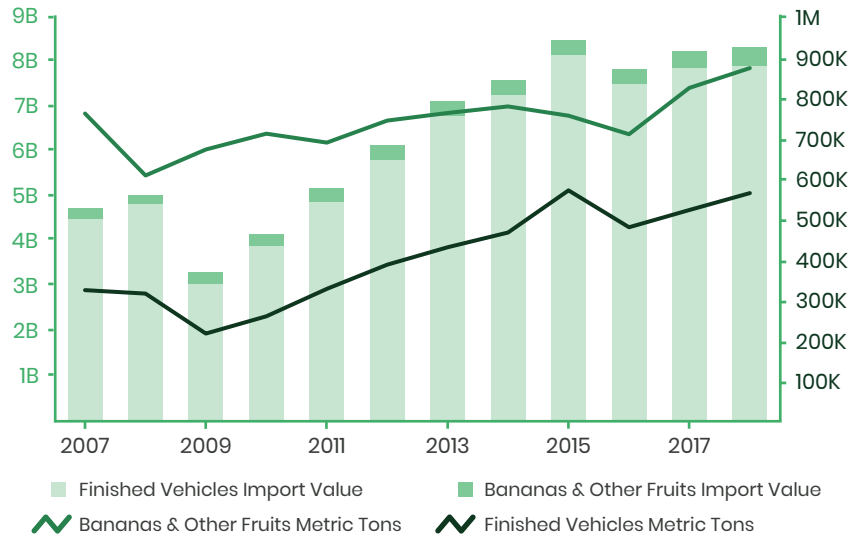
The Panama Canal Expansion project was completed in June 2016. Since this time, the San Pedro Bay Ports have averaged annual TEU growth greater than six percent indicating that direct impacts from the new project in isolation have been minimal. However, when considering port-related investments in the Gulf and East coasts of the U.S., Canada, and Mexico, the ability of the Panama Canal to accommodate larger ships has played a role in creating a more competitive landscape for the San Pedro Bay Ports (and region) for international trade as shippers have more seaport options to consider in moving cargo. Cargo diversion, especially for discretionary cargo, remains a regional concern as some Gulf and East coast ports have greater developable land opportunities and fewer regulatory challenges than the SCAG region. Concurrently, both Canada and Mexico have continued to invest in port-related freight enhancements on the West Coast as well. The ports of Prince Rupert and Vancouver have had substantial success in taking market share from the Northwest Seaport Alliance (NSA – ports of Seattle and Tacoma), while Mexico's ports of Manzanillo and Lazaro Cardenas have also witnessed strong growth.

The Port of Hueneme primarily serves two distinct consumer markets: bananas and other fruits, and finished vehicles. In 2018, imports accounted for $8.9 billion, or nearly 90 percent of total trade through the Port of Hueneme with finished vehicles comprising the substantial portion of the total.[18] From a volume perspective, bananas and other fruits continue to outpace finished

16 A shipping alliance involves ocean carriers signing a cooperative agreement to allow the sharing of assets.
17 The Maritime Executive. (November, 2018). Alliances Raise Overcapacity and Competition Concerns.

18 Source: U.S. Census Bureau. Foreign Trade. USA Trade Online.

FIGURE 5 Port of Hueneme Trade Value and Tonnage



Source: U.S. Census Bureau, Foreign Trade, U.S. Army Corps of Engineers, Waterborne Commerce Statistics Center

vehicles, but the ratio between the two has declined as finished vehicle tonnage growth has increased at an annual rate greater than 300 percent when compared with banana and other fruits tonnage growth.

The current trade environment as it relates to the region's seaports has created less certainty around short-term TEU, trade volume and trade growth trends. It has had a clear impact on export businesses in the U.S., especially the agricultural sector which has been a target for retaliation. On an annual basis, exports from the SCAG region have remained robust, but weakness has been observed very recently. Uncertainty complicates planning and budgeting for investments, especially for the many port customers (e.g., shippers, service providers, carriers, etc.) utilizing port facilities. These challenges in the private sector have a ripple effect for regional planning and policy decisions, and recent overall container growth for North America has been erratic. Despite the San Pedro Bay Ports experiencing growth (though slow), overall container performance for the U.S. and North America as a whole has been marginally negative. Despite these current headwinds, over the long-term the container capacity growth forecast for the San Pedro Bay Ports is expected to return towards a rate of four percent, in line with historic TEU growth.

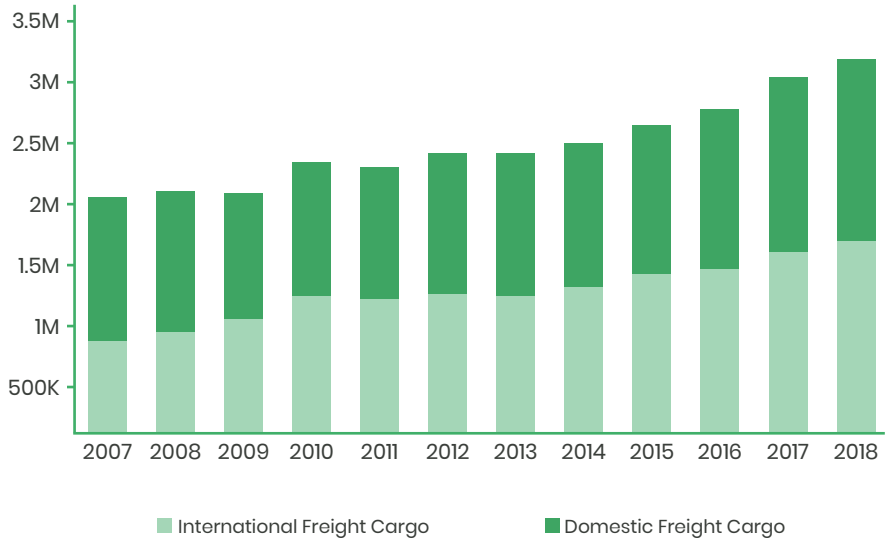
AIR CARGO AND REGIONAL TRADE FLOWS

Air cargo in the SCAG region grew quickly in the previous few decades, increasing from nearly one million tons in 1979 to 3.3 million tons in 2018. While there has been downward pressure on air cargo for various reasons including the events of September 11, 2001, the steep economic recession beginning in 2007 and the increased diversion of domestic air cargo to ground transport modes (many express packages that can be delivered overnight by truck are now shipped by truck instead of air cargo), regional airports have seen significant increases recently, with sustained acceleration since 2013. A large contributor to this renewed growth has been driven by the corresponding impacts of e-commerce. As e-commerce has grown, so have consumer appetites for faster deliveries, higher return capabilities of ordered goods and more complex shopping options at traditional retail stores through omni-channel solutions. Between 2016 and 2018, the value of international goods moving through regional airports increased by $19 billion, or 18.4 percent, with both imports and exports increasing 23.1 percent and 13.7 percent, respectively.[19]

LAX and ONT handled over 1.5 million tons of international freight cargo in 2018; LAX volumes accounted for over 95 percent of the combined total with ONT[20,21] making it the third busiest international freight cargo airport in the U.S behind Miami and Anchorage. Annual international air freight has continued to outpace domestic air freight, with growth remaining at seven percent per year from 2007 through 2018 versus two percent for domestic air freight. Despite sustained robust growth in the Trans-Pacific trade lane for the region's international air freight, growth has weakened substantially since Fall 2018, reaching double-digit declines in tonnage in 2019 from the previous year, likely

19 Ibid.
20 Source: Los Angeles World Airports.
21 Source: Ontario International Airport.

FIGURE 6 LAX and ONT Freight Cargo (in Short Tons)



Source: Los Angeles World Airports, Ontario International Airport

a result of factors such as trade tariffs, tensions and uncertainty.

Performance of the Trans-Pacific trade lane can be viewed as an indication of the strength of the high-tech manufacturing economy with high value/low density parts and pieces assembled into high-value tech devices in Asian markets such as Shanghai, and shipped all over the world, including to destinations in the U.S. [22] Inbound moves encompassing parts and components to Asia are typically a reflection of finished good outbound volumes, and both import and export volumes for LAX have fallen of late. With trade impacts being at the forefront, short-term projections have become less clear.

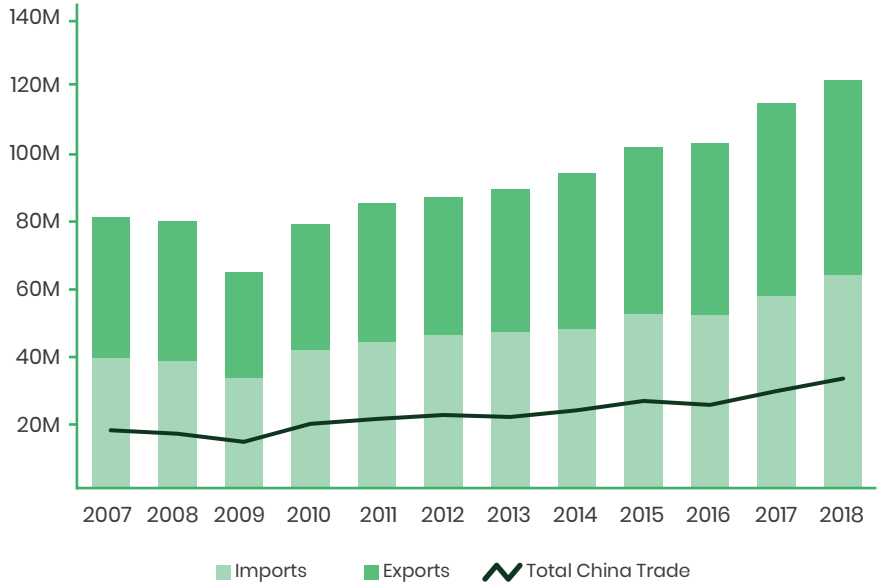
International trade value for LAX and ONT increased by over 33 percent from $80 billion in 2007 to $120 billion in 2018, including import value growth from $38 to $62 billion and export value growth from $42 to $57 billion, generating a nearly even trade balance.[23] Despite a $15 billion trade deficit with China in 2018, China accounted for 27 percent of the region's total air freight trade value (37 percent for imports, 15 percent for exports). When including the entire Asia market, international trade value is close to 60 percent of the total as a result of the high-tech manufacturing economy. International volume has grown at a much faster pace versus pricing. The relationship of higher volume growth and lower pricing is also indicative of longer term trends as input costs have declined for high-tech components and finished products over time. Over 82 percent of international air freight at LAX is handled by scheduled passenger airlines or their cargo divisions that operate freighter aircraft.

International and domestic air freight and mail cargo for the region is expected

22 Source: Cass Freight Index.

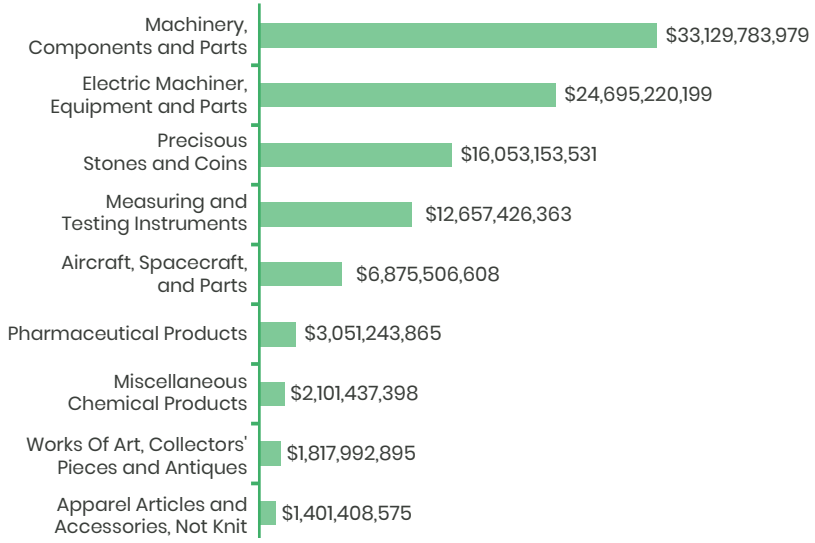
23 Source: U.S. Census Bureau. Foreign Trade. USA Trade Online.

FIGURE 7 LAX and ONT Freight Cargo Trade Value



Source: U.S. Census Bureau, Foreign Trade

FIGURE 8 Top 10 Commodities Traded Through LAX and ONT 2018



Source: U.S. Census Bureau, Foreign Trade

to grow by 3.3 percent annually over the next 25 years, totaling 7.8 million metric tons by 2045. This reflects an increase from the 2016 RTP/SCS as a strong uptick in domestic air freight over the past four years has contributed to the revised baseline year and higher annual growth expectations. Preparing for this growth will be a major challenge for LAX over the coming decades as the existing urban footprint may limit its ability to address warehousing and office requirements, aeronautical infrastructure needs, auto parking demands and other landside operational issues.

INTERNATIONAL PORTS-OF-ENTRY (POES) AND TRADE FLOWS

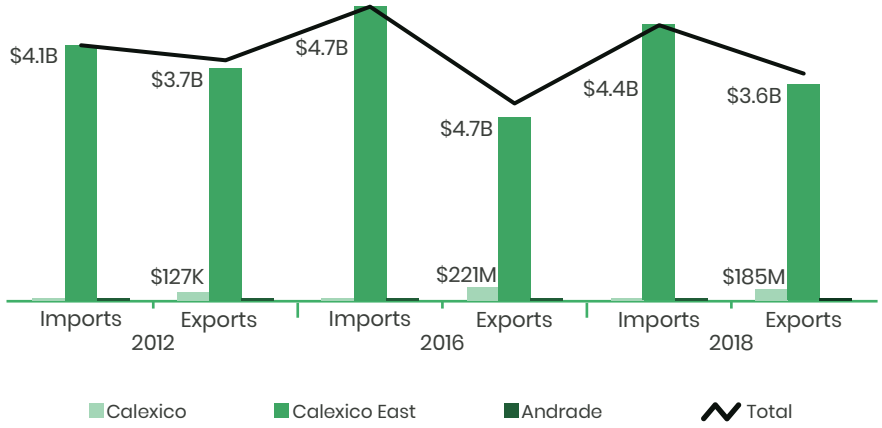
Mexico remains the third-largest trading partner of the U.S. behind China and Canada, with $612 billion in total trade value in 2018,[24] accounting for 14.5 percent of total U.S. foreign trade,[25] an increase of one percent since 2014. Mexico is also the largest market for exports of goods made in California, accounting for approximately $31 billion (or 17 percent) of California's overall exports in 2018, as well as $44 billion in imports (or 10 percent).[26]

International POEs in the SCAG region were responsible for 38 percent of all California trade with Mexico in 2018. Most of the merchandise flows in the region are made by truck, supporting manufacturing and factories that lie on both the Mexican and U.S. sides of the border.

International trade value at the Calexico East commercial border crossing

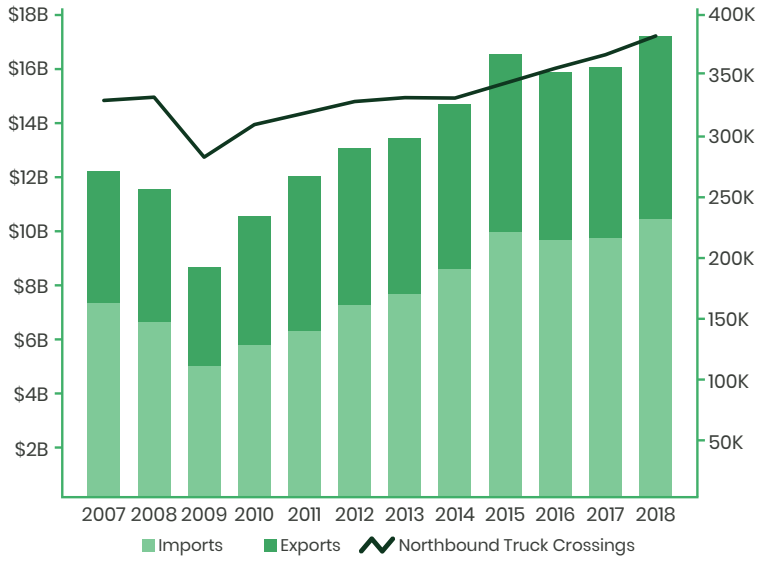
24 Source: U.S. DOT, Bureau of Transportation Statistics.
25 Branch, F. (2019). Foreign Trade - U.S. Trade with World, Seasonally Adjusted.
26 Source: U.S. Census Bureau. Foreign Trade. USA Trade Online.

FIGURE 9 Crossborder Trade in the SCAG Region (Selected Years) All Modes



Source: U.S. Census Bureau, Foreign Trade

FIGURE 10 Calexico East Trade Value and Truck Crossings



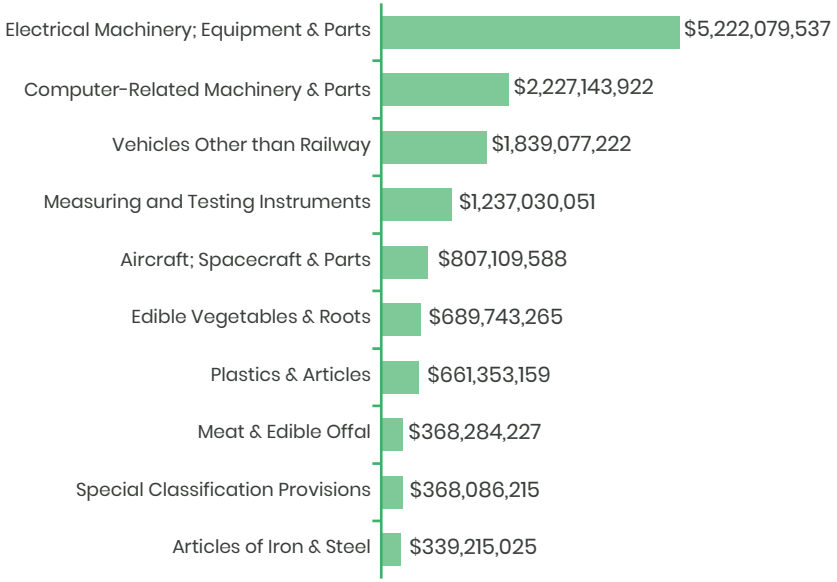
Source: U.S. Census Bureau, Foreign Trade, Bureau of Transportation Statistics

increased from $12 billion in 2007 to $17 billion in 2018. This included import value growth from $7 billion to over $10 billion, and export value growth from $5 billion to nearly $7 billion, generating a $3 billion trade deficit between imports and exports.[27] Northbound truck crossings into the U.S. have recovered well from the recession, but have only averaged a little over one percent growth per year since 2007. Import trade value growth has averaged annual growth of over three percent per year during the same period, a 250 percent increase, suggesting that commodity mix and pricing have been heavier influencers for growth.

Increased trade across the border has been bolstered by the existence of multiple free trade zones (FTZs). As a result of the associated tax savings and lower wages in Mexico, FTZs have been used by U.S. companies to export raw materials into Mexican manufacturing firms where goods are processed or assembled, and then exported back in their finished state to the U.S.[28] The ability to transfer goods from one FTZ to another within Mexican territory without losing any of the fiscal incentives (tax savings) is slowly creating a logistics and manufacturing network of FTZs that is expected to boost Mexican foreign trade with the U.S. As more businesses try to capitalize on the benefits of sourcing and manufacturing in Mexico, substantial impacts are expected on the transportation systems that service the border region and provide network connections to the Inland Empire and the San Pedro Bay Ports. In order to assess the mobility of commerce at the Imperial County-Mexicali border and to develop freight planning strategies that address long term trade and transportation infrastructure needs in this border region, SCAG continues efforts to analyze the patterns and improve the efficiency of goods that move across the border.

27 Ibid.

FIGURE 11 Top 10 Commodities Traded Through SCAG Regional POEs 2018



Source: U.S. Census Bureau, Foreign Trade

Shifting federal trade policies have the potential to have a significant impact on trade between the SCAG region and Mexico, and subsequently the regional goods movement system. Over the past few years, there have been several impacts on trade with Mexico, namely Section 232 tariffs on aluminum and steel, and more recently, the United States – Mexico – Canada Agreement (USMCA). The U.S. has reached an agreement with Mexico and Canada in the renegotiation of the North America Free Trade Agreement (NAFTA), which triggered the 10 and 25 percent tariffs on aluminum and steel being rescinded.[29] All three countries will need to pass the USMCA for it to take effect. The new agreement offers very few changes and appears unlikely to have meaningful impacts on trade through POEs in the SCAG region.

Additional tariffs on Mexico were recently averted, as the U.S. threatened to impose tariffs[30] on all goods from Mexico starting as a means to pressure Mexico to curb the influx of migrants across the southern border. Despite the

28 Originally these FTZs were located primarily along the border, but recent changes to the Mexican Customs Law now allow them to operate anywhere in the Mexican territory and several FTZs have opened in mainland Mexico, creating logistic hubs such as San Luis Potosí and Guanajuato.
29 Source: U.S. Customs and Border Protection. Section 232 Tariffs on Aluminum and Steel.
30 Tariffs are taxes on imported goods paid by an importer paid to the local country (e.g., U.S. importers pay tariffs to the U.S. government on goods from China that are have tariffs levied upon them).

agreement, it remains unclear whether tariffs may be used again to further other national policy objectives. The use of tariffs could decrease trade or shift commodity flows to other geographies and getaways. Tariffs paid by importers may be addressed in numerous ways, and generally include passing costs along to consumers and/or finding suppliers from countries without U.S. tariffs.

The impacts of current federal policies are unknown, particularly as a clear strategy has yet to be defined. Even anticipated actions have uncertain outcomes, and there is a significant risk of undermining long-term trade national trade and economic interests. The U.S. has traditionally sought to exert influence by investing in "soft power", the ability to convince other countries that their interests align with those of the U.S. However, an uneven set of changing trade strategies has pushed a number of U.S. allies to diversify their interests away from America. This may have far-reaching impacts on GRP, employment, and the transportation network.

HIGHLIGHT AREA: TRADE IN THE SCAG REGION

International trade has become a focal point for national policies in the U.S. The current Administration has sought to renegotiate trade agreements, and has implemented tariffs, leading to retaliatory actions from various countries, namely China, Mexico and Canada. This has complicated how businesses plan and invest for the future, especially in the case of global supply chain needs. The following trade highlights provide insights into the cotton, cellphone and the automotive industries to highlight key issues and relationships to the regional goods movement transportation system.

Cotton Industry: The U.S. is the third-largest cotton growing country in the world, behind India and China, producing 17 percent of the world total's 29.6 million tons of cotton in 2018. In trade, the U.S. ranked second behind China for raw and intermediary cotton exported products at $7.6 billion. Over 75 percent of U.S. cotton exports were shipped in bales, giving the U.S. a leading 43 percent market share of the world total's $15.4 billion for raw cotton exports.

The majority of U.S. produced cotton is grown within Texas. Closer crop areas include California's Central Valley, Arizona, and New Mexico. The majority of cotton bales are railed directly to the San Pedro Bay Ports from facilities within Texas, other U.S. states and Mexico.

The industry has remained resilient throughout recent U.S. trade policy changes. Through late 2018, bales of cotton exported from the U.S. increased by 15 percent with the San Pedro Bay Ports achieving similar results. Historically, China has been the largest market for cotton exports from the San Pedro Bay Ports; over the last decade, a new market has emerged in Vietnam, which accounted for 30 percent of exports in 2018. Concurrently, the Chinese market has declined by 43 percent over the past ten years. This has been a result of rising labor costs in China, as intermediary manufacturing has shifted to Vietnam for China's consumption needs. While Southeast Asian countries reflect today's lower cost intermediary labor, monitoring these trends for the region is important as labor may shift to another part of the world in the future, potentially impacting San Pedro Bay Ports export volumes. Other competitive port areas exporting significant amounts of cotton bales include the Ports of Houston and Savannah.

Cell Phone Market: The United States is the largest cell phone importer in the world, accounting for nearly 20 percent of the world total's $294 billion in cell phone imports in 2018. The U.S. also ranks fifth in exports behind China, Hong Kong, Vietnam and the Netherlands. Cell phone imports and exports to and from the United States totaled 204 million units and 57 million units in 2018, respectively. The Customs District of Los Angeles was responsible for roughly 10 million of these imports, and 3 million of the exports. A diverse range of countries hold a share of the total U.S. cell phone market. However, the Customs District of Los Angeles relies mainly on China and South Korea. China held a 97-percent share of Los Angeles' $2.7 billion market for cell phone imports in 2017, while South Korea held an 86-percent share of Los Angeles' $1.1 billion market for cell phone exports. Many, if not all cell phones, exported from the U.S. are re-exported imports from outside of the country. The majority of cell phones are transported to and from the U.S. by air, while a small number move via container ships. Through late 2018, 94 percent of the U.S.'s cell phone imports and exports relied on air transport. After entering the Customs District of Los Angeles by air or container ship, most cell phones travel by truck to warehouse and distribution centers, especially within the Inland Empire. These

truck moves to initial distribution facilities rely heavily on I-710, SR-60, and I-10.

The cell phone industry remains in a state of growth but recent performance places some uncertainty on growth estimates moving forward. Nonetheless, smartphones will continue to be the primary driver for the cell phone industry. Within the U.S., the top port districts for trade activity include Chicago and Miami.

Automotive Industry: The U.S. continues to be the leading light-duty vehicle manufacturer with close to 65 percent of the market share in North America, and 11 million units produced in 2017. The U.S. ranked first globally for light-duty vehicles with nearly $180 billion (7.9 million units), imported in 2018. For global exports, the U.S. ranked third with over $51 billion (2.4 million units). Of the 10.3 million imports and exports into the U.S., the Customs District of Los Angeles, including the San Pedro Bay Ports and the Port of Hueneme, held a market share of nearly 9 percent for imports and 2 percent for exports. Over the past decade, imported units at the San Pedro Bay Ports have declined by 13 percent, largely driven by a reduction in imports from Japan and Germany. NAFTA has been a primary driver of this decline as auto manufacturers from these countries have established production facilities in Mexico with significant imports shifting from Asia and moving through Texas. The total number of units imported from Mexico to the U.S. have increased by nearly 90 percent over the past decade. Exports through the San Pedro Bay Ports, have witnessed increasing growth driven by demand from South Korea, Australia, and Germany, among others, leading to a doubling of market share.

Despite having a lower volume of imported units than registered vehicles in Southern California, it cannot be assumed that every vehicle imported to the region is consumed within it. For example, light-duty vehicles imported through San Diego from Mexico via the Otay Mesa POE are move eastward out of Southern California on rail. There is also a westbound relationship as a substantial majority of auto manufacturing in the U.S. is east of the Rockies. The SCAG region has two substantial automotive facilities operated by BNSF and UPRR that serve both local and national needs. Units are also trucked to a number of dealers throughout Southern California, utilizing nearly all major regional roadway and local arterial networks.

The current state of the industry remains in flux for Southern California. Previous trade agreement trends have led to near-shoring of U.S., Asian and European production facilities to Canada and Mexico. With the new USMCA and the use of tariffs, the current U.S. Administration has made it a point to re-shore production activities to the U.S. as much as possible.

Summary: As can be seen from these highlights, the San Pedro Bay Ports and LAX are involved in complicated and diverse trade-related commodity movements that involve multiple modes of transport and provide opportunities to maximize efficiencies targeting economic and air quality goals. Future investments in the SCAG region's interstates and highways, last-mile connectors, mainline, on-dock and near-dock rail facilities will continue to play a critical role in improving the region's quality of life, and balancing economic growth needs and objectives.

DOMESTIC TRADE FLOWS AND GOODS MOVEMENT DEPENDENT INDUSTRIES

A substantial amount of the region's goods movement activity is associated with local pickup and delivery activity, construction, utilities and other service activities. The local goods movement-dependent industries involved in these activities rely on all modes of transportation as a key part of their business models, and generally utilize a more geographically dispersed transportation network than international markets. While much of the region's international trade system supports the global supply chains of national and multinational companies, approximately 35 percent of the imports moving through the San Pedro Bay ports are destined for final consumption within the greater Southwest U.S., especially the SCAG region. While less than the volume moving to other domestic markets, these imports represent six million TEUs, nearly all of which use the region's highway system. A substantial amount of this local activity takes place via trucks. According to the U.S. Department of Transportation (U.S. DOT), in 2016, 65 percent of domestic truck flows by tonnage in the Los Angeles Metropolitan Statistics Area (MSA) were associated

with intra-regional goods movement,[31] with the remaining 35 percent serving or coming from other local markets and destinations within the U.S.

Domestic manufacturers, wholesalers and retailers also use regional rail and the air freight systems, with the latter seeing increasing shipment growth stemming from strengthening e-commerce trends and international supply chains. Since 2014, domestic air freight trends have increased substantially, growing at an annual rate of six percent per year, largely outpacing flat performance over prior years. The primary driver for this growth domestically has been ONT as recent annual growth has increased by 13.5 percent per year. Market share for ONT has risen as well, to over 45 percent, a 20 percent increase from 2007. ONT serves as a key domestic air freight hub with major services provided by FedEx, UPS and Amazon. All three service providers continue to partner with the airport, and expand their facilities and throughput. Much of the containerized cargo imported through the San Pedro Bay Ports is domestically shipped from the Inland Empire to eastward destinations, with a share of the cargo being moved from ONT.

Domestic industries including industrial and residential construction, automotive and many industrial warehouse and distribution facilities also rely on regional rail infrastructure. Bulk items including wood products, steel, gravel, roofing, chemicals, finished automobiles and automotive parts, among others, are transported via railroads for domestic consumption within the region. Bulk items are transported via unit trains, tank cars and auto carriers. Rail traffic for bulk items weakened recently, with automotive and chemical products being the exception. The housing market, which often drives construction product needs, has also softened, but demand has remained positive for new build and renovation-related material uses.

MANUFACTURING

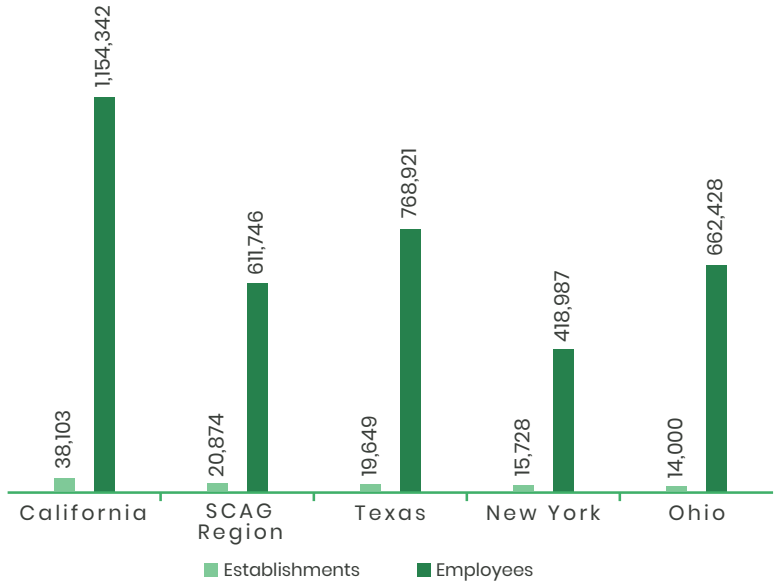
Southern California is the leading manufacturing center in the U.S., and regional manufacturers reach a mix of international, domestic and local customers and suppliers through the region's goods movement transportation system. As such, the goods movement system is a lifeline between the region's export base and markets. Even at the height of the 2007-2009 recession, the U.S. remained the world's largest manufacturing economy and Southern California continued to be a critical manufacturing hub. In 2016, the SCAG region was the second-largest manufacturing center in the country[32] by number of establishments, trailing only the state of California itself. The SCAG region also had more employees in the manufacturing industry than all other states except California, Ohio, and Texas.[33] It remains one of the leading manufacturing centers in the U.S., with total direct employment of nearly 612,000.

In 2016, manufacturing activities contributed approximately $112 billion of

31 Source: U.S. Department of Transportation. Federal Highway Administration Freight Management and Operations. Freight Analysis Framework, FAF Data Tabulation Tool.

32 Source: US. Census Bureau, American FactFinder.
33 Ibid.

FIGURE 12 Manufacturing Sector by Number of Establishments and Employees 2018



Source: U.S. Census Bureau, American FactFinder

the region's GRP and served both international and domestic markets. The region's trade and transportation system underpins this important component of the regional economy by providing connections to local, national and global suppliers and markets. In contrast to much of the discussion about the decline of domestic manufacturing and the outsourcing of manufacturing-related jobs to lower-wage countries, the United States' share of total global manufacturing output has held relatively constant over the last 30 years.[34]

The SCAG region remains one of the leading manufacturing centers in the U.S. However, the number of manufacturing employees has consistently declined since 2005 despite significant increases in regional population. Between 2012 and 2016, the number of employees declined by 1.3 percent. This was much less than the decline of 26.5 percent between 2005 and 2016.[35] Going forward, manufacturing is expected to add 30,040 jobs. It's worth noting that California's manufacturing sector shed 166,700 jobs in the period from 2007 through 2017, so while higher jobs counts over the next two years are welcome, it remains unlikely they foretell a return to prerecession employment levels.

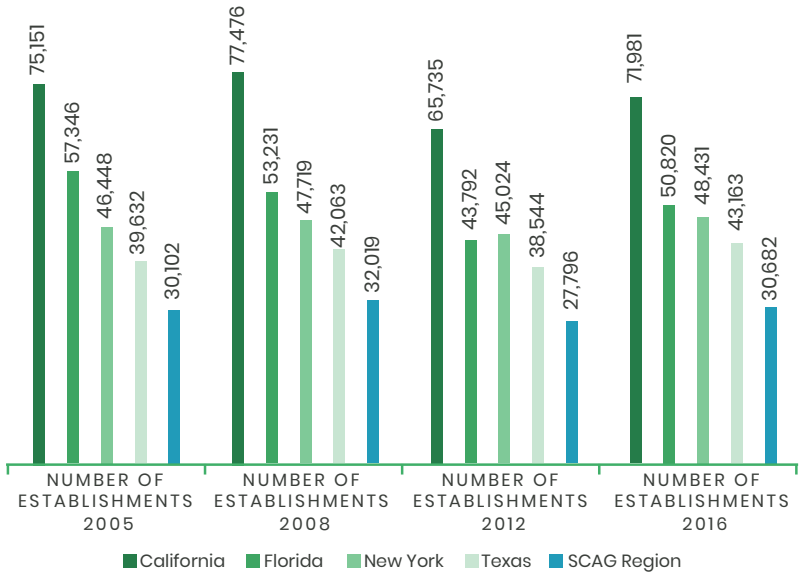
CONSTRUCTION

Construction-related activity also is an important element of the regional economy and a significant contributor to overall transportation demand. In

34 Manufacturing output has increased due to many factors including increased manufacturing efficiencies and technology which may require less workers and explain some of corresponding decreases in employment for some sectors.

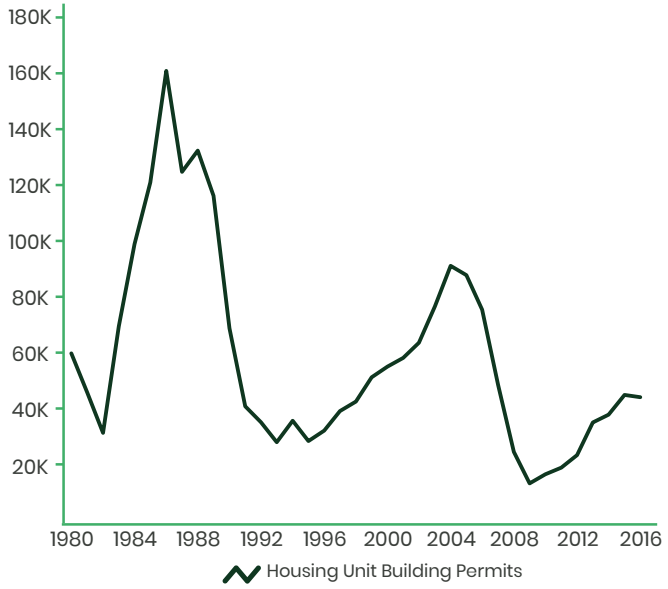
35 Between 2005 and 2016 manufacturing employment in the U.S. declined by 15.2 percent. Between 2012 and 2016, it increased 3.6 percent. There could be a number of reasons for the divergent trends at the regional and national level including more efficient manufacturing techniques, automation, outsourcing, and the mix of commodities and products.

FIGURE 13 Construction Sector by Number of Establishments and Employees 2018



Source: U.S Department of Housing and Urban Development

FIGURE 14 SCAG Region Housing Unit Building Permits Issued 1980–2016



Source: U.S Department of Housing and Urban Development

2016, the construction industry employed nearly 324,000[36] people in the region and contributed nearly $43 billion to SCAG's GRP. The construction industry also had almost 31,000 establishments in 2016, which was the fifth most among all U.S. states.[37]

Overall improvements in the regional economy generally drive increased investment in homes, business and infrastructure, and subsequently the goods necessary to meet that demand. These goods move across the regional transportation network and depend on its efficiency. The number of new housing building permits serves as one of many indicators of the overall health of the economy and the construction industry, and helps to drive the movement of goods both intra-regionally and to and from locations outside the region. While Southern California was severely damaged by the housing market collapse during the last recession, there has been a significant turnaround coinciding with the overall upward trajectory of the economy. At the lowest point of the recession in 2009, the region issued 14,164 housing unit building permits. In 2016, the region issued 44,859, an increase of 217 percent, and constituted 48.3 percent of all housing building permits issued in the state.[38]

Construction-related activity is primarily dependent on trucks, and household and construction-related land uses generate approximately 60 percent of the region's intra-regional truck traffic.[39] While light-heavy trucks account for a larger percentage of the truck trips involving these economic sectors than they do for total truck trips, household (i.e., consumer and service-related) and construction-related activities still generate a significant amount of heavy-heavy duty truck activity within the region.

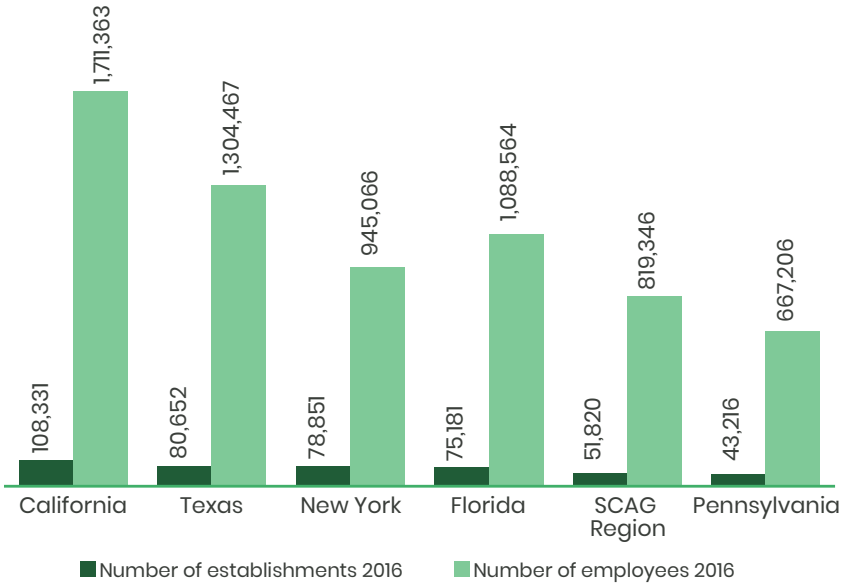
36 Source: US. Census Bureau, American FactFinder.
37 The SCAG region is has a larger number of construction sector establishments and employees than all states except California, Texas, Florida, and New York.
38 Source: U.S Department of Housing and Urban Development.
39 While agricultural trucking is not considered urban goods movement, most of the trucking related to these land uses comes from construction and quarry activity (which supports construction) and is driven by growth in housing and employment.

RETAIL

Retail trade is the sale of goods for personal and household use. The industry is heavily focused on serving the local and regional market with about 86 percent of its sales conducted regionally. Much of the demand for goods and services is related to activity in the consumer economy. As the number of households and the level of disposable incomes rise, the demand for retail goods and services rise commensurately. The SCAG region already is home to just 19 million people, or about 48 percent of the entire population of the State of California.[40] That number is expected to rise to over 22.5 million by 2045. Between 1996 and 2016, the median per capita personal income[41] in the SCAG region rose by 116

40 Source: US. Census Bureau, American FactFinder.
41 Source: U.S. Department of Commerce, Bureau of Economic Analysis (BEA).

FIGURE 15 Retail Sector by Number of Establishments and Employees 2018



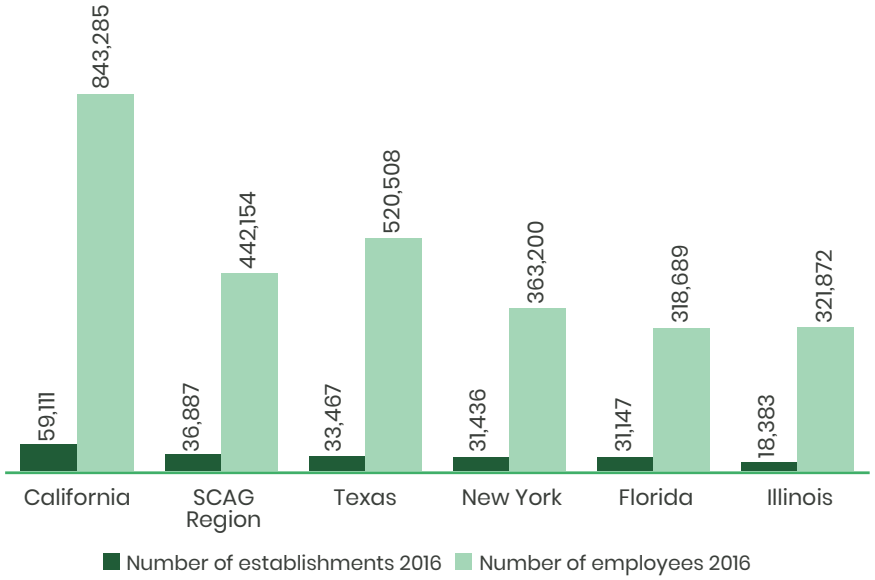
Source: U.S. Census Bureau, American FactFinder

percent.[42] Median per capita personal incomes in 2016 ranged from $36,206 in Imperial County to $65,400 in Orange County, and every county saw an increase ranging from 86 percent (Riverside County) to 128 percent (Los Angeles County) from 1996 to 2016.

Retail trade is the final step in the production and distribution of goods, and logistics services are often required to manage inventory, provide final packaging and distribute goods to retail outlets. Retail trade activities accounted over 819,000 jobs and nearly 52,000 retail establishments in the region in 2016. If the region were a state, it would rank fifth nationally for both the number of retail establishments and employees.

42 Per capita personal income was computed using Census Bureau midyear population estimates. Estimates for 2010-2017 reflect county population estimates available as of March 2018. Note: All dollar estimates are in thousands of current dollars (not adjusted for inflation). Statistics presented in thousands of dollars do not indicate more precision than statistics presented in millions of dollars.

FIGURE 16 Wholesale Sector by Number of Establishments and Employees 2018



Source: U.S. Census Bureau, American FactFinder

The retail sector also provided $69 billion in total GRP. Retail trade is heavily dependent on trucking, spending approximately 65 percent of its total transportation expenditures on trucking services. Trucking (as opposed to rail or air cargo modes) allows "door-to-door" service that is important for the retail industry, and is often the choice for local distribution services. Growth in e-commerce has been a considerable driver for these services as well.

WHOLESALE TRADE

Wholesale trade is the sale of large amounts of goods to industrial, commercial or institutional users (i.e., not consumers). Wholesale trade in the region is focused locally with the 75 percent of sales to local markets, 16 percent for international locations, and the remaining 9 percent for other U.S. locations. The regional logistics industry supports wholesale trade by providing repacking, redistribution and sorting services. These movements often involve raw materials or inputs to larger manufacturing activities. The wholesale trade sector was responsible for over 442,000 jobs in the region in 2016, and home to nearly 37,000 wholesale trade establishments. Nationally, the SCAG region ranked second (behind California) in number of wholesale trade establishments and third in jobs (behind California and Texas). It also accounted for $76 billion of total GRP.

The global reach of wholesale trade supply chains, as well as local and domestic delivery needs, is reflected in the modal expenditures of the wholesale industry. This industry is a heavier user of ocean containers and airfreight compared to the retail trade industry, reflecting the more global nature of wholesale trade activities. At the same time, this industry makes use of local and national trucking services, as well as truck and small package services.

TRANSPORTATION AND LOGISTICS

Transportation and warehousing provides transportation, storage, and inventory control services. The transportation and warehousing Industry in the SCAG region reflects a diverse set of markets/customers based locally, nationally, and globally. Thirty-one percent of the sales output from

this industry is local, 48 percent is in other U.S. regions, and 21 percent is international. The transportation and warehousing sector relies on the regional transportation system to connect to local markets, but also for connections to other U.S. and international markets. Transportation and warehousing activities provide over 284,000 jobs in the region and hosted more than 12,700 establishments, ranking it sixth in number of establishments and third in the number of employees nationwide. It also accounted for nearly $35 billion of total GRP.

Companies in the transportation and warehousing sector have high dependence upon highways, railroads, and water/marine services, and some dependence upon air to deliver service to customers. The transportation and warehousing sector spent 43 percent of its 2010 transportation expenditures on truck, with 23 percent spent on air, 20 percent on courier, and 6 percent on rail.

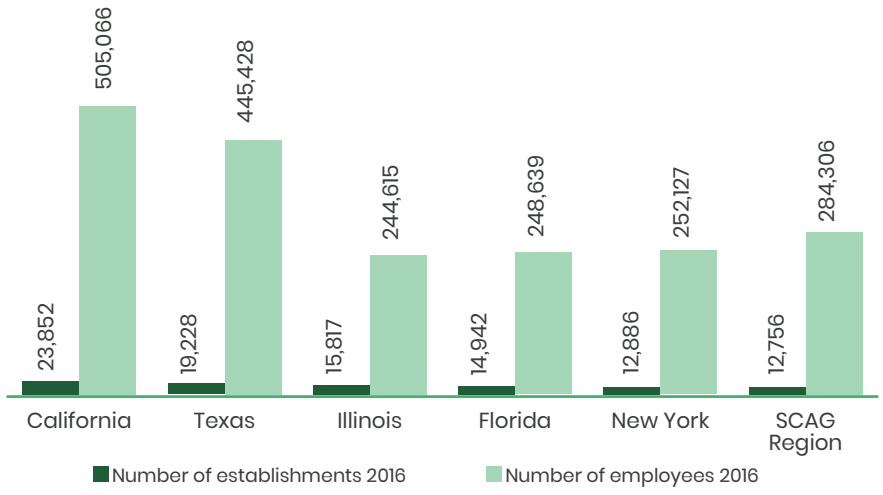
SUPPLY CHAIN TRENDS AND GOODS MOVEMENT DRIVERS

A number of key trends and drivers are expected to impact our region's goods movement system. These include:

POPULATION AND EMPLOYMENT

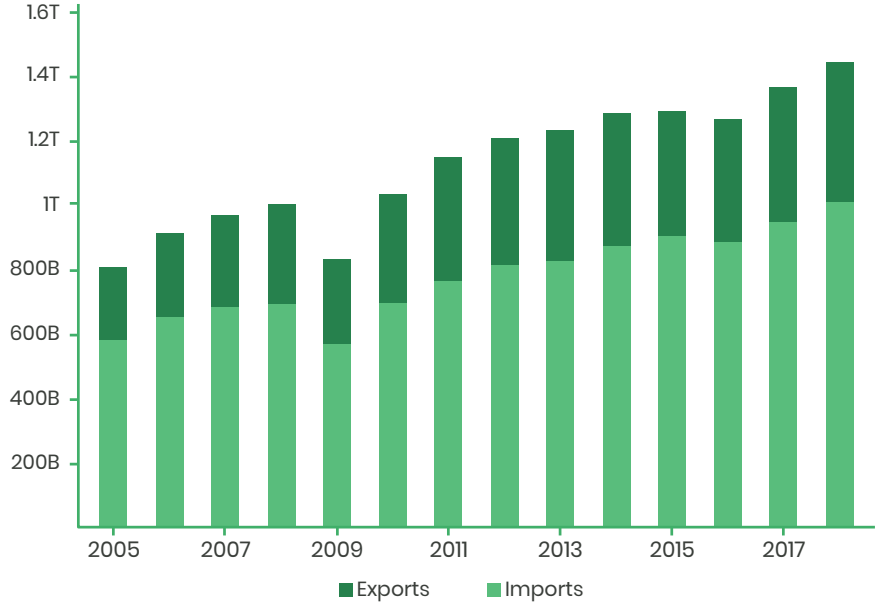
The regional population and rate of employment in the region are key indicators of economic health, and both are projected to grow rapidly over the next two decades. By 2045, the region's population is expected to grow by about 19.5 percent and employment is expected to grow by 19.8 percent. This growth is expected to fuel consumer demand for products and in turn, the goods movement services that provide them. Increased demand will drive stronger growth in freight traffic on already constrained highways and rail lines.

FIGURE 17 Transportation and Warehouse Sector by Number of Establishments and Employees 2018



Source: U.S. Census Bureau, American FactFinder

FIGURE 18 U.S. Trade by Value (SCAG Region Pacific Rim Trade Partners) 2005 - 2016



Source: U.S. Census Bureau, Foreign Trade

CONTINUED GROWTH IN TRADE

Since 2009, U.S. trade with the world has generally increased annually growing by approximately 15 percent.[43] International trade with Pacific Rim countries, which comprise an outsize portion of trade with the SCAG region, grew by nearly 75[44],[45] percent over the same period, outpacing overall U.S. trade with the world by 21.3 percent. The U.S. is currently expected to continue to see growth in Pacific Rim trade and the San Pedro Bay Ports anticipate cargo volumes to grow to over 34 million containers by 2040.[46]The Port of Hueneme in Ventura County is also positioned to grow as a preferred port for specialized cargo such as automobiles, break bulk fruit and military cargo.

In response to this trade growth, regional truck Vehicle Miles Traveled (VMT) are anticipated to grow by more than 80 percent and the region's major truck corridors will experience increasing delays if no action is taken. Freight train volumes are expected to more than double and intermodal lift volumes will grow by more than 140 percent. Air cargo growth is also expected to grow by over 140 percent by 2045. If the SCAG region can accommodate this growth it can reap significant economic benefits. This growth will place further demands on marine terminal facilities, highway connections, and rail intermodal terminals. The consequence of not planning for this growth will mean businesses will waste time and money dealing with congestion, logistics businesses that provide good jobs will look to other goods movement hubs that can provide more efficient infrastructure, and there will be growing conflicts between goods movement users and passenger traffic. Mitigating the impacts of increased train traffic in communities will continue to be a challenge.

COMPETITION WITH OTHER GATEWAYS

There is fierce national competition for import and export maritime trade with East and Gulf Coast ports as those ports try to recapture market share previously lost to the West Coast. The Canadian Federal Government has been working with ports and provincial governments to increase its market share of Pacific Rim trade and there are several potentially significant projects in Mexico. Prince Rupert, the closest direct deep-water seaport to Asia, has witnessed TEU growth of over 450 percent since 2008 (first year of full containerized operation) to over one million TEUs as of 2018[47]. During this same time, Port Metro Vancouver has grown its TEU demand by 40 percent to 3.4 million.[48] Prince Rupert is looking to double its TEU capacity by 2020, and over the longer term reach capacities as high as six to seven million TEUs. Vancouver is looking to add another three million TEU capacity within the next decade.

The recently opened, semi-automated Lazaro Cardenas Terminal 2 project, operated by APM Terminals, has become Latin America's most technologically advanced container terminal. Today the project capacity is 1.2 million TEUs (2.2 million TEU total capacity for Lazaro Cardenas), and by the late 2020s, capacity is expected to reach over 4 million TEUs, operated by 15 cranes and 10 rail tracks providing intermodal access. The Port of Manzanillo is looking to expand the waterfront of its TEC I terminal to provide capacity to simultaneously handle three vessels of up to 340 meters in length. Collectively, these Mexico seaports have witnessed TEU demand growth of 90 percent since 2010 to 4.4 million TEUs. Canadian and Mexican West Coast seaports are looking at expanding TEU capacity by around 10 million TEUs over the next decade. The UPRR and BNSF both consider the Southern California rail system to be a critical part of their respective networks and they will invest and price to keep market share in the face of these competitive pressures. These railroads have already made significant investments in the Southern California rail system. However, the railroads will prioritize their investments to ensure that all needs (e.g., domestic intermodal, carload, and passenger rail terminal and mainline throughput requirements and grade crossing improvements) are met. Advancing safety and environmental objectives will require broad regional partnerships. The Rail Strategy section of this chapter describes the types of investments that could

43 Source: U.S. Census Bureau. Foreign Trade. USA Trade Online.
44 Please note that countries included as "Pacific Rim" for this analysis were Australia, China, Hong Kong, Indonesia, Japan, Malaysia, New Zealand, Philippines, Singapore, South Korea, Taiwan, Thailand, and Vietnam.
45 Source: U.S. Census Bureau. Foreign Trade. USA Trade Online.
46 Source: Ports of Los Angeles and Long Beach.
47 Source: Port of Prince Rupert.
48 Source: Port of Vancouver.

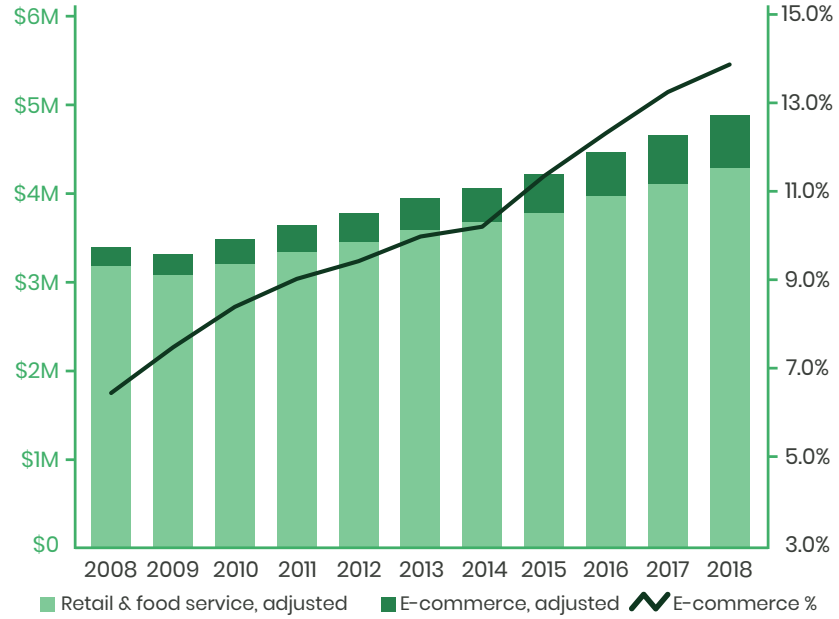
constitute a package of improvements that would maximize the benefits of the Southern California rail system for the public and private sectors.

E-COMMERCE

One of the most influential changes for the goods movement industry is the rapid rise in e-commerce. E-commerce sales for U.S. retailers were approximately $515 billion in 2018, more than double e-commerce sales in 2012. Total U.S. retail sales increased by 24.7 percent during the same period percent hitting $3.6 trillion in 2018.[49] Between 2012 and 2018, the proportion of e-commerce retail sales to total retail sales grew greater than 75 percent from 8.1 percent to 14.4 percent.

49 Retail sales have been adjusted to exclude sales from motor vehicles and parts dealers, gasoline stations and food services and drinking places. Source: U.S. Census Bureau.

FIGURE 19 Retail Sales in 2005 - 2018 in $ Millions



Source: U.S. Census Bureau, Monthly Retail Trade

The majority of e-commerce retail sales come from the Electronic Shopping and Mail-Order Houses industry classification, which is from the North America Industry Classification System (NAICS). This category is defined as "establishments primarily engaged in retailing all types of merchandise using means, such as catalogs, toll free telephone numbers, or electronic media, such as interactive television or the Internet".[50] During 2017, e-commerce reflected over 70 percent of the total for Electronic Shopping and Mail-Order Houses, while nearly 90 percent of all e-commerce sales were derived from this industry.

Amazon which falls under the this NAICS category, continues to be a major driver of e-commerce growth as it is estimated that the company accounted for a nearly 41 percent market share of total U.S. online retail sales in 2018, compared to 27 percent in 2015.[51] Amazon also contributed north of 50 percent of e-commerce sales within the Electronic Shopping and Mail-Order Houses industry. The distinction between this industry is important, as other traditional retail companies such as discount warehouse clubs like Costco and Wal-Mart, department stores like Macy's, or grocery stores like Kroger fall within the roughly 10 percent minority portion of e-commerce retail sales. Despite this, growth for certain traditional retailors has been robust as omni-channel services have emerged and taken hold.

E-commerce provides consumers with a broad range of shopping options as they compare product prices instantaneously from their mobile devices and decide how the purchased products will be acquired, known as omni-channel retailing. Omni-channel retailing offers shoppers multiple purchasing and receiving options, specifically allowing for online orders to be delivered to residences or businesses, or picked up via new programs. Target has recently witnessed 60 percent more items purchased through its online order pickup "Drive Up", where customers drive to designated delivery pickup points at Target locations after placing an order online. According to Invesp:

- Nearly 67 percent of shoppers in the U.S. have used Buy Online Pick Up Store (BOPIS) in the past six months

50 Source: North America Industry Classification System (NAICS).
51 Source: FTI Consulting. 2018 Online Retail Forecast.

- 10 percent of all sales will be fulfilled by click and collect by 2025
- 50 percent of respondents have decided where to shop online based on whether or not they could pick up in-store
- 90 percent of retailers plan to implement BOPIS by 2021

Simultaneously, e-commerce has generated a considerable force of change in terms of how traditional distribution centers and retail outlets operate to meet customer demands. Distribution centers in the past delivered bulk size goods to their customers or single vendors. Because e-commerce orders tend to be smaller in size than the traditional distribution center orders (i.e., a single item order as compared to a bulk-case order), many retailers and distribution center/warehouse operators are upgrading their facilities, or developing new facilities to meet surging e-commerce orders. This has included development and relocation closer to major metropolitan areas for fulfillment and sortation centers, as well as more local distribution facilities. This closer proximity and increased delivery frequency has had a profound impact on the last-mile leg of the supply chain. Since 2000, the average last-mile delivery trip length has declined by 37 percent, but concurrently, the number of truck trips and urban VMT has increased directly related to an increase in more regionalized retail supply chains and the proliferation of urban last-mile deliveries.

Further, consumers are increasingly demanding expedited fulfillment of their orders and same day-delivery options, and similar services for returns. Both the American Transportation Research Institute (ATRI) and Invesp have estimated that anywhere from 13 to upwards of 30 percent of all products ordered online are returned, as compared to a rate of between 8 to 9 percent for in-store purchases.

Additionally, Invesp states:

- Around 49 percent of retailers offer free return shipping now
- 92 percent of consumers will buy something again if returns are easy
- 79 percent of consumers want free return shipping
- 67 percent of shoppers check the returns page before making a purchase

To meet the same-day delivery promise, distribution or fulfillment center proximity to population centers has become an increasingly critical component. This is exemplified by the large-scale e-commerce fulfillment center developments in the periphery of urban population centers. The greater frequency of e-commerce deliveries also has significant community impacts as greater volumes of trucks in residential neighborhoods increase safety concerns, noise, and wear on local roads. This is especially the case in the densest urban areas where transit services, transportation network companies (TNCs), e-bikes and scooters, pedestrians and many other conflicting uses operate collectively. The last-mile leg for freight deliveries has become an important focal point as a result.

HIGHLIGHT AREA: LAST-MILE FREIGHT

E-commerce is at the forefront of the physical world of package and shipment deliveries, but the digital enabling of consumers has truly opened the floodgates of the explosive growth in e-commerce. The ubiquity of computers and mobile devices, data and social networks has provided consumers greater choice, faster information, and a lower cost of switching from traditional retail options. This has led to an expectation for lower prices, more convenience and a seamless experience, and has opened up logistics and last mile delivery as a new competitive playing field as consumer expectations of speed and reliability have increased. At the same time, this has presented retailers and deliverers of goods with more competition. Competition has led to better service aggregation and visibility into the supply chain, necessitating services meet consumer expectations for buying, receiving, paying and returning merchandise. This has naturally led to a sustained higher growth rate for e-commerce versus traditional retail.

These changes in consumer behavior and expectations have had a profound impact on the first mile/last mile delivery leg of supply chains. Warehouses and distribution centers have been the traditional inventory point prior to inventory being stocked at retail outlets. However, a transformation has taken place with fulfillment and sortation centers, smaller holding facilities and/or 3PL facilities looking to provide e-commerce services and added value. At the same time, the move from storage/value add facilities to retail establishments, consumer

businesses and/or residences has exponentially increased the complexity of how final deliveries may occur, including omni-channel orders made online or via mobile devices with customers then picking up the goods from retail stores.

The difficulties of last mile delivery have increased in concert with the growth in e-commerce. This growth has occurred in conjunction with land use trends of urban densification and multi-modality where new development has been directed to transit stations where job centers and transportation options, such as bikes, scooters, buses, and TNCs have expanded. Curb space is at a premium and must be shared with competing uses including transit, privately owned autos, TNCs, taxis and shuttles, bicycles and pedestrians. A wide range of delivery companies also contribute to this complexity, including electrified bike or scooter delivery, parcel and package delivery, foodservice, utility or other services, and Class 8 tractor and trailer trucks. This involves many of the largest shippers and delivery companies in the U.S., as well as many fragmented smaller businesses.

Key challenges in this environment are driven by the fact that recipients dictate delivery orders and timing. This necessitates delivery companies having to meet these time frames regardless of congestion, parking availability, parking restrictions, safety issues, and many other concerns. In many cases, ticket violations are an accepted norm as companies on their delivery routes attempt to maximize operating efficiencies in prioritizing customer needs. This also relates to safety concerns as deliverers are tasked with choosing between double parking and/or parking in medians in the event other options are not available.

SCAG has taken a comprehensive look at these challenges as they relate to last-mile freight deliveries through the Last Mile Freight Study (LMFS). Under this effort, key place types and typologies were identified, public and private stakeholders were interviewed soliciting expert feedback and guidance, an initial data collection process and method was established, and a toolbox of strategies was developed. Important findings from the effort included:

- Over 40 percent of freight deliveries were made by package/parcel delivery companies (FedEx, UPS, USPS)
- 25 percent of freight deliveries were made by a personal vehicle
- 10 percent of all passenger loadings were made by a TNC
- Excluding buses, over 20 percent of passenger loadings were made by a TNC

Strategies include modifications such as extending a yellow curb designation where appropriate to creating permitted parking zones, including pricing options. Permitted parking could allow for supply and demand management, data collection, and a potential revenue source. Other strategies include flexible parking spaces where restrictions would vary depending on need, off-peak programs, consolidation centers, building improvements, and better enforcement and driver education. Continued efforts remain underway with the objective of developing and implementing pilot project concepts to further determine which strategies may be suitable for generating operating efficiencies, zero- and near-zero emission benefits, and local agency monetization opportunities through pricing of the curb, among other strategies and policy considerations.

SCAG has compiled findings of this study as a toolbox, where solutions have been developed to match the problems of specific place types. Though the study was based in the City of Los Angeles, a diversity of place types was studied that would likely match other regional conditions.

CONNECT SOCAL – ACHIEVING THE REGIONAL GOODS MOVEMENT VISION

By 2045, the SCAG region will grow by more than four million people, placing increased demands on the region's ability to provide improved mobility, greater economic opportunity, and a higher quality of life. Connect SoCal serves as the principal planning document for the regional transportation network and balances Southern California's future mobility needs with economic, environmental and public health goals. In such a large and complex region, closely integrating strategies for land use and transportation is a significant challenge.

Connect SoCal identifies some broad approaches to accomplish the regional vision for goods movement by encouraging and supporting investments that target key industries to support the economy. The Plan ensures that local and regional businesses have access to transportation services and facilities necessary to support growth through investments in corridors where these industries are located. In so doing, it promotes system improvements that will help contain the rising costs of goods and services. Connect SoCal positions Southern California to continue to be a leading trade gateway serving the Pacific Rim and Mexico by supporting improvements in the marine terminals, intermodal terminals, railroad mainlines and roadway access routes to the seaports, airports, and international land border crossings that make up the region's trade transportation system.

Connect SoCal also addresses growth through multimodal solutions to enhance the freight system efficiencies, and provide safety and operational improvements. It includes projects and strategies to promote the fluid movement of goods and people consistent with user expectations for a world-class transportation system. For example, the Plan ensures that the regional rail system can accommodate the projected doubling of volumes without increasing delay and includes investments in highway improvements to significantly reduce truck vehicle-hours-traveled each year.

Finally, Connect SoCal provides strategies to expand the goods movement system while providing for a healthy environment and livable communities. It includes a strong commitment to reduce dangerous emissions from transportation sources by identifying strategies for the broad deployment of zero- and near-zero emission technologies. The development of a world-class zero- or near-zero emission freight transportation system is necessary to maintain economic growth in the region, sustain quality of life and meet federal and state air quality requirements.

By 2045, the goods movement system in the SCAG region is anticipated to include bold new freight enhancements, including new and expanded railyards, additional main line railroad tracks, improved and modernized port terminals and the completion of the replacement Gerald Desmond Bridge in 2020. The new system will also include critical bottleneck relief projects on major freeways and operational improvements such as traveler information systems and Global Positioning System (GPS) technology to reduce truck delays. Multiple grade separations on railroad mainlines will provide considerable traffic congestion relief throughout the region. The system will also show significant progress in reducing emissions from goods movement sources, including the introduction of near-zero and zero emission vehicles. The region will continue to lead the nation and the world in the application of innovative strategies for goods movement that realize the vision. The following section provides a more detailed discussion of Connect SoCal's regional goods movement strategies.

SEAPORT STRATEGIES

SAN PEDRO BAY PORTS TRUCK ACCESS PROJECTS

The San Pedro Bay Ports have long worked with regional and state transportation planning organizations to identify and promote projects that will mitigate vehicle delay to and from port areas, improve regional air quality and reduce collisions at rail-roadway crossings. The enhancement of critical freight corridors that connect the San Pedro Bay Ports, the Inland Empire, and outlying areas through multiple multimodal transfers are key components of access projects. Major projects to improve direct access from and to the San Pedro Bay Ports and within the port terminals and piers are already underway, including:

- The Pier B Street Freight Corridor Reconstruction Project: This project is a crucial component to the success and full utilization of the Pier B ODRSF. The project includes the realignment and closure of several local roadways, widening of the rail-bridge over the channel, reconstruction of several intersections, removal of the local freeway off-ramp, and reconfiguration of the existing Pier B Facility to a more efficient circulation. In addition to the realignment of Pier B Street and Pico Avenue, the project will also enhance the roadway by adding additional lanes and railcar storages to the Pier B Street, which would accommodate projected future cargo demand and will ease roadway traffic congestion. This project will also provide safety enhancements

for both motorists and pedestrians by constructing a new sidewalk on the south side (eastbound) of Pier B Street for pedestrian travel which involves the removal of 9th street and Pico Avenue at-grade railroad crossing.

- The Gerald Desmond Bridge replacement Project: This bridge, which has been designated as a National Highway System Intermodal Connector Route and part of the Strategic Highway Network, carries nearly 15 percent of the nation's waterborne cargo and is a critical access route for the San Pedro Bay Ports, downtown Long Beach and surrounding communities. The new bridge will provide three travel lanes in each direction for improved traffic flow including the emergency lanes on both inner and outer shoulders to reduce traffic delay and safety hazards from accidents and vehicle breakdowns. The bridge also includes a Class I bicycle facility and pedestrian path along the south side of the bridge, connecting Pico Avenue and Terminal Island and also includes pedestrian path with three scenic overlooks. The new bridge will be built with a second tallest cable-stayed design and will be high enough to accommodate the newest generation of the most efficient cargo ships. Currently, the bridge is the last stage of construction and is expected to be completed by 2020.
- SR-47 (Seaside Avenue)/Navy Way Interchange Project: This project is a construction of interchange at SR-47/Navy Way to eliminate traffic signal and movement conflicts. It removes the last signal on SR-47, an NHS Intermodal Connector Route, between General Desmond Bridge and Vincent Thomas Bridge.
- SR-47/ Vincent Thomas Bridge/Front St Interchange Project: This project entails removal of the existing westbound SR-47/Vincent Thomas Bridge off-ramp (south of the Vincent Thomas Bridge) with Harbor Boulevard, and construction of new WB SR-47/Vincent Thomas Bridge off-ramp (north of the Vincent Thomas Bridge) with Front Street. This project will eliminate the existing non-standard ramp connection to the Harbor Boulevard off-ramp. The project also includes realigned eastbound and westbound SR-47 on-ramps. Front Street is an NHS Intermodal Connector Route and the Vincent Thomas Bridge is a state-owned bridge that is on the PFN.
- Alameda Corridor South Terminus/Henry Ford Ave. Rail Crossing Advanced Warning System: The Alameda Corridor Terminus/SR 47 Rail Crossing Advance Warning System will be installed for three rail line crossings on Henry Ford Avenue (SR 47), near the southern terminus of the Alameda Corridor and also includes 4-5 Changeable Message Signs on Henry Ford Avenue, Anaheim Street, and Alameda Street. This project will reduces vehicle delay and emissions by diverting traffic to unblocked routes.
- Harbor Boulevard Improvements Project: As part of the San Pedro Waterfront Development project, Harbor Boulevard will be restriped, and the median is removed/reconstructed as needed to provide three northbound through and southbound through lanes between the reconstructed Sampson Way/Harbor Boulevard Intersection and the westbound SR-47 on-ramp/Front Street intersection. This will result in the removal of parking and the bike lane on the northbound side. The parking and bike lane on the southbound side will be preserved. North of O'Farrell Street, parking areas and the parking lane on the southbound side will be removed to accommodate the northbound dual left-turn lane. The innermost northbound through lane at the eastbound on-ramp intersection would become a forced left-turn lane at the SR-47 westbound on-ramp. This improvement is projected to be completed by 2027.
- Realign and Expand Harbor Boulevard Project: This project will start at the new intersection at Miner Street and end at 22nd Street. It will improve public access throughout the waterfront area to better connect with downtown San Pedro and the surrounding community. The reconfigured Harbor Boulevard will include two travel lanes in each direction and improvement related to utilities, street work, grading, paving, striping, lighting, street trees and landscaping.
- Zero Emission (ZE)/Truck Trip Reduction/Freight Efficiency Program: This project includes multiple in-port projects such as a second lead track and rail expansion at Pier 400; rail expansion at Pier 300 (addition of two new loading tracks); the New Terminal Island on-dock railyard

and support yard; railyard expansion at Berth 200 (additional storage/working tracks) and WBCT and Everport Wharf improvements.

- San Pedro Bay Ports Clean Air Action Plan (CAAP): In 2017, the Port of Long Beach and Port of Los Angeles adopted the Clean Air Action Plan (CAAP) Update, which outlines strategies to reduce pollution from port-related sources. One of the strategies outlined in the CAAP is to reduce pollution from on-road drayage trucks by registering trucks which are compliant with the California Air Resources Board's (CARB) Drayage Truck Regulation and Truck and Bus Regulation.Pier D Street Realignment Project: This project includes realignment of Pier D Street between the Middle Harbor out-gate and Pico Avenue and Broadway between old Port of Long Beach maintenance yard (Western Terminus of the roadway) and Pico Avenue.
- Pico Avenue Realignment project (roadway widening and realignment): This project will widen and rebuild Pico Avenue from Pier D Avenue to Pier E Street. Pier G Avenue Rehabilitation Project: This project includes roadway improvements and utility enhancements for water, stormwater, sewer, and street pavement. Utility improvements are combined with the roadway improvements for preventative maintenance and cost efficiency.

PORT OF HUENEME ACCESS PROJECTS

While the Port of Hueneme is smaller than the San Pedro Bay Ports, two-way trade activities through the Port were valued at $10 billion and generated nearly $1.7 billion in economic activities in the immediate region providing over 15 thousand direct and indirect jobs. The Port of Hueneme primarily imports and exports refrigerated goods and produce, automobiles, bulk cargo and fuels. The Port of Hueneme 2020 Strategic Plan highlights key strategies including focuses on business retention and growth, new business opportunities, waterside investments, project funding and fiscal planning, terminal efficiency, agency coordination, the environment, land use and logistical efficiencies, safety and resiliency.

Under the provisions of the 2020 Strategic Plan, the Port also emphasizes Port modernization projects that include:

- Innovative building design for the future.
- Adopting a state-of-the-art ecu (ecological compliance unit) to treat fresh goods.
- Improving traffic flow and space utilization for the competitiveness of the port.
- Improvement on intermodal yard and facilities for better efficiency to improve freight mobility.
- Embracing larger cargo ships through on-going dredging projects
- Improving terminal connectivity to upscale efficiency and quality of working.

In addition to the 2020 Strategic Plan, the following projects and strategies are among those anticipated to reduce truck congestion and improve space utilization and other impacts:

- Complete grade separations at Vineyard Avenue, Rose Avenue, Gonzales Road, and Los Angeles Avenue.
- Reconstruction of Rice Avenue from State Route 1 (SR-1/Pacific Coast Highway (Route 1) to US Highway 101.
- Maintenance of Port Hueneme Road/Hueneme Road and Rice Avenue as the primary truck access corridor to the Port of Hueneme and encouraging trucks to use this route through additional signage.
- Completion of a three story tall parking like structure for a last/first point of rest for automobiles exports and imports which will increase port capacity by 33 percent and efficiency through technology and electrical upgrades using solar power.
- An intermodal improvement project (wharf & berth improvements) with repaving of the terminal surfaces at each of the berths and cargo facilities including deepening the water depth from the channel to vessel berths and extending rail for on-terminal access.
- Dredging of the harbor channel from 35 feet to 40 feet deep to accommodate heavier ships with more cargo, and modernization of

cargo facilities and on-dock rail extending for on-terminal access.

- The LEAP project which includes solar panel installation and clean energy storage, 3 UTRS (Utility Tractor Rigs) and infrastructure for new clean energy charging stations for port ZEVS.
- The Port corridor optimization and efficiency project includes reconfiguration of terminal traffic circulation, ITS, electrical system upgrades for refrigerated containers and a solar power component to progress zero emission (ZE) initiatives.

RAIL STRATEGIES

EXISTING AND PROJECTED CONDITIONS

Regional rail traffic is expected to grow significantly over the next 25 years. Rail plays an important role in providing efficient long-haul movements (both in terms of energy efficiency and emissions) for a number of key markets at lower costs than truck. Generally, a mainline track can accommodate approximately 50 trains per day. For example, the Alameda Corridor with three tracks has an estimated throughput of about 150 trains per day. Intermodal trains (containers and trailers on flatcars) typically vary in length from between 6,000 feet and 10,000 feet; however, the trend in the future is toward longer trains up to about 12,000 feet. Unit bulk, unit auto, and carload trains are typically 5,000, 6,500, and 6,000 feet in length, respectively.

The BNSF San Bernardino Subdivision has at least two main tracks. There are segments of triple track between Hobart and Fullerton. The BNSF recently completed a third main track from San Bernardino to the summit of the Cajon Pass. The UPRR Alhambra Subdivision is mostly single-track, while the UPRR Los Angeles Subdivision has two main tracks west of Pomona and a mixture of one and two tracks east of Pomona. North from West Colton, UPRR operates the single-track Mojave Subdivision to Northern California and Pacific Northwest points. This line closely parallels the BNSF Cajon Subdivision as the two lines climb the south slope of the Cajon Pass.

Connections are afforded at Keenbrook and Silverwood to enable UPRR trains to enter/exit the main tracks of the BNSF Cajon Subdivision. Beyond Silverwood to Palmdale, the UPRR Mojave Subdivision has very little train traffic. East from Colton Crossing, UPRR operates its transcontinental Sunset Route main line, also known as the UPRR Yuma Subdivision. The line now has two main tracks the entire distance to East Indio.

Due to the substantial amount of goods imported and exported through the San Pedro Bay Ports which are transported beyond the SCAG region, there is a direct connection between railroads and moving these goods to their destinations. Railroads provide two core container services for the movement of goods nationally: direct transfer of international containers (IPI), and transloaded goods using 53-foot domestic intermodal container units and/or trailers, typically preferred by shippers with larger scale. Because of this relationship, there is a correlation between the San Pedro Bay Ports TEU volumes, and total railroad traffic performance, as intermodal-related train cargo is the largest driver of overall rail volumes in the region.

The years 2015 and 2016 were challenging for rail container traffic performance resulting from a confluence of events including labor contract negotiations, energy and industrial sector weakness, and lower consumer demand in the U.S., among other factors. These pressures led to negative intermodal unit performance of two and one percent for BNSF and UPRR respectively. Volatility increased during these years as labor contract holdouts from late 2014 and early 2015 led to abrupt shifts in container volume, and slower U.S. economic growth weighed throughout most of 2016.

From late 2016 through 2018, the opposite has been the case as 27 of the previous 28 months during the period witnessed positive year-over-year performance. During 2017 and 2018, railroad container traffic grew by greater than 3.5 percent each year, leading to a new peak, in line with the San Pedro Bay Ports record cargo levels in 2018.[52,53] Much of this stemmed from an uptick in economic activity within the U.S. and globally. In 2019, container rail traffic has been weaker, while the San Pedro Bay Ports finished the year down just below

52 Source: Association of American Railroads (AAR) and Surface Transportation Board.
53 Source: BNSF.

6 percent for laden TEUs.[54] Much of 2019's performance has been impacted by surges in import activity in 2018 and uncertainties generated by recent trade and tariff events.

Since the late 1990s, average annual TEU growth for the San Pedro Bay Ports has remained at above four percent. With TEU volumes projected to increase to 34 million TEUs by 2040, long term demand is anticipated to remain near historic levels. Domestically, there continues to be a healthy increase in intermodal container capacity as intermodal marketing companies and railroads have invested heavily in both container units and chassis. These capacity investments are a direct indication of recent demand, and further illustrate the correlation with TEU volumes as a continued driver for increased rail traffic for the region.

Significant growth in passenger and freight rail traffic is expected on most segments of the SCAG regional rail system by 2045. As freight rail volumes are anticipated to double over the long-term, passenger trains are projected to increase from 80 daily round trips in 2016 to over 290 by 2045. The rate of direct intermodal volumes from near or off-dock facilities has sustained a gradual decline over the past 15 years as on-dock rail investments have increased. In line with this shift, the share of transloaded domestic intermodal containers and/or trailers has increased to over 40 percent of the rail intermodal volume total, nearly doubling from the 2008 share. In addition to intermodal container trains providing international and domestic services, other non-intermodal freight train volumes are derived from unit automobile trains, unit oil trains, unit bulk, and carload trains. Passenger trains include Amtrak and Metrolink service. Increases in railroad traffic will require ongoing infrastructure investment to maintain current levels of service. Increased rail traffic also has an impact on roadway traffic and congestion, as more trains will result in increased wait times for vehicles at at-grade crossings.

54 Source: Ports of Los Angeles and Long Beach.

REGIONAL RAIL STRATEGIES

The proposed regional rail package in Connect SoCal has several components. These include mainline rail improvements (rail-to-rail grade separations, double or triple tracking, new signal systems, universal crossovers, new sidings, etc.) that would benefit both freight rail and passenger rail service depending on their location, rail yard improvements (upgrades to existing yards as well as construction of new yards), rail operation safety improvements, road-rail grade separations and emissions reduction strategies (See **TABLE 3**). Connect SoCal includes numerous rail improvements such as installation of a third main track and fourth main track on specific segments of the BNSF Cajon Subdivision, and exceptional earthmoving, crossovers and bridges across multiple culverts. Improvements to the BNSF San Bernardino Subdivision include a third main track, as well as a fourth main track along the Hobart to Fullerton segment. Caltrans has provided $121.8 million for the triple tracking from Serapis (MP 151.1) to Valley View (MP 158.7). Key investments on the UPRR Mojave Subdivision include a second main track over a key segment and a "flying junction" at Rancho (West Colton). The UPRR Alhambra Subdivision will include double tracking key segments and route connections to Pomona.

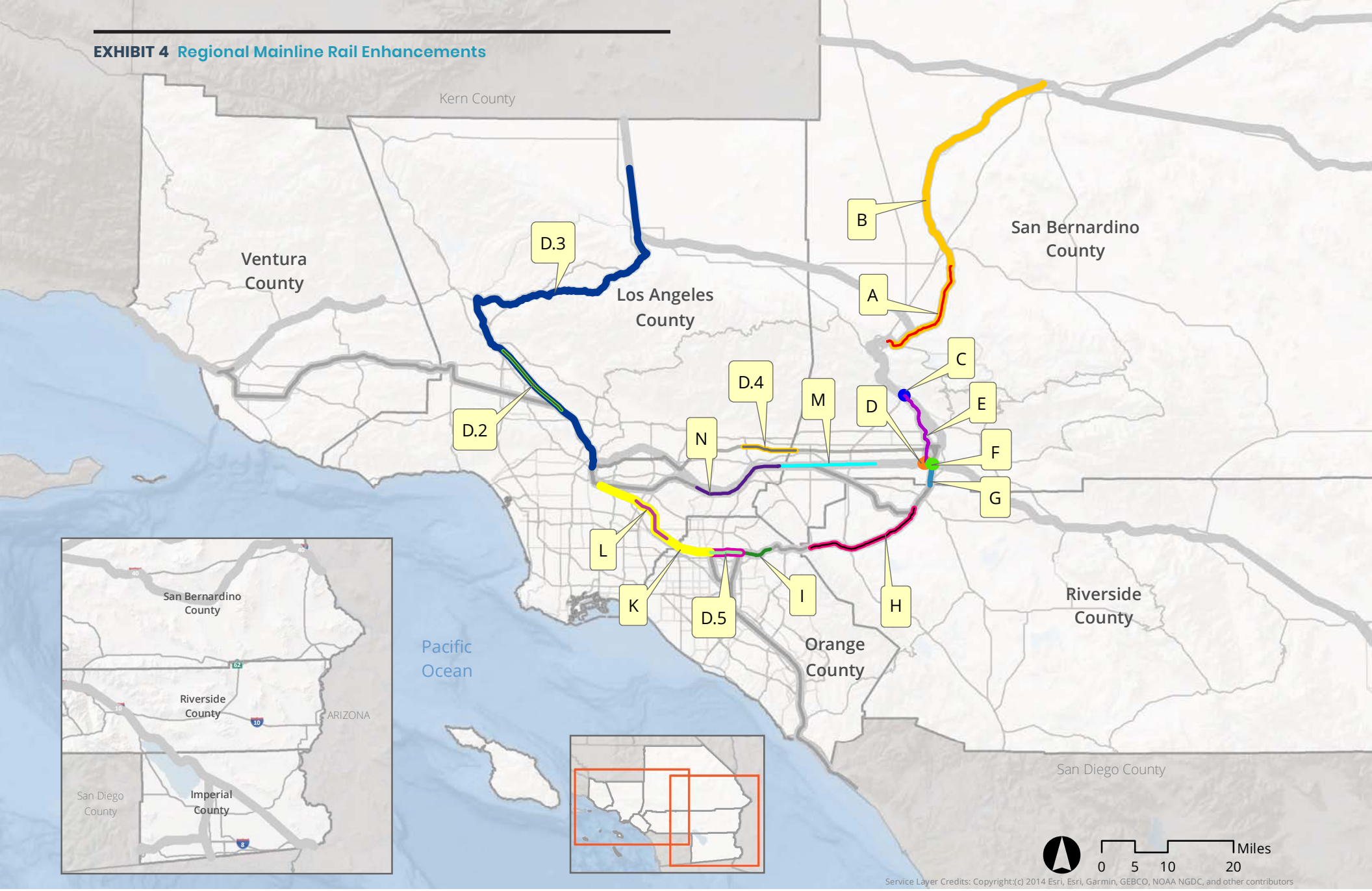
There has been significant progress for the installation, interoperability and crew training for Positive Train Control (PTC) since the 2016 RTP/SCS. PTC

TABLE 3 Estimated Cost of the Proposed Package of Rail Projects, by Major Category (Millions of Nominal Dollars)

Category	Estimated Costs
Mainline Rail Improvements	$4,386.75
Port Area Rail Improvements	$2,337.18
Intermodal Railyard Improvements	$1,799.62
Rail-Highway Grade Separations	$5,900.57
Total	$14,424.11

Source: SCAG

EXHIBIT 4 Regional Mainline Rail Enhancements



A - Fourth Main Track from Silverwood to Frost
B - Third Main Track Martinez to Barstow
C - Devore Rd Crossovers
D - Flying Junction at Rancho
E - Second Main Track Devore to Rancho
F - Colton Crossing Grade Separation
G - Third Main Track MP 2.9 to Highgrove MP 6.1
H - Third Main Track West Riverside to Prado Dam
I - Third Main Track Esperanza to Atwood
J - Third Main Track Atwood to Fullerton Jct.
K - Fourth Main Track Fullerton Jct. to Hobart
L - Third Main Track Valley View to Serapis
M - Second Main Track South Fontana to Reservoir
N - Second Main Track Pomona to City of Industry
D.2 - Brighton To Roxford Double Track
D.3 - Antelope Valley Line Capacity Improvement Project
D.4 - Lone Hill Ave To CP White Double Track
D.5 - Fullerton Jct. To Orange/Riverside County Line
Main Rail Line
Commuter Rail

Source: SCAG, 2019

is a radio or GPS-based system designed to automatically prevent train-to-train collisions, derailments cause by excessive speeds, unauthorized train movements in work zones, and the movement of trains through switches left in the wrong position. Congress mandated the installation of PTC through the Rail Safety Improvement Act of 2008 on lines where certain hazardous materials are carried and any line on which passenger or commuter rail services operate.

Per UPRR, PTC equipment has been installed on 100 percent of required route miles and implemented on all required passenger train routes, including the Los Angeles and Alhambra subdivisions.[55] UPRR's PTC operations are running on more than 13,000 miles across its national system, including main lines within the state of California. Implementation efforts continue to ensure PTC interoperability with other freight and passenger railroads operating on UPRR tracks by 2020, per federal law. BNSF has installed PTC infrastructure on all 88 required subdivisions covering more than 11,500 route miles and 80 percent of the company's freight volume, including the San Bernardino Subdivision.[56] All required BNSF employees in the region have been trained and PTC interoperability was completed with Metrolink, UPRR, the North County Transit District (NCTD) in San Diego, and Amtrak in 2018.

55 Source: Union Pacific. (February 2019). "Union Pacific Reports Positive Train Control Progress: Installation Completed and Passenger Routes Implemented".

TABLE 4 List of Recently Completed Grade Separation Projects

County	Locations
Los Angeles	Fullerton Rd
Los Angeles	Durfee Ave
Orange	Lakeview Ave
Orange	Raymond Ave
Orange	State College
Orange	Orangethorpe Ave
San Bernardino	Lenwood Rd
San Bernardino	N. Vineyard Ave
San Bernardino	S. Milliken Ave
San Bernardino	S. Archibald Ave
San Bernardino	Monte Vista

Source: SCAG

GRADE SEPARATIONS

With increasing railroad and highway traffic, vehicle delays at grade crossings are expected to increase considerably by 2045. Allowing two intersecting axes of traffic to move concurrently, grade separations of at-grade crossings reduce traffic congestion and delays and emissions from idling vehicles and address other critical rail crossing related concerns such as emergency vehicle access and mobility, noise and safety.

Sixty grade crossings throughout the SCAG region were identified for inclusion in the financially constrained Connect SoCal. To date, 11 regional grade separations have been completed and opened to traffic. One separation project is currently under construction and anticipated to be open to traffic in 2020. Further, additional grade separation projects have been identified for inclusion in Connect SoCal, for a total of 48 grade separation projects (excluding complete and under construction projects), as shown in shown in **TABLE 4.**

Financially Constrained and Strategic Plan (unfunded) grade separation projects are included at the end of this report, along with grade separation maps by county. The estimated costs of the grade separation projects in the financially constrained plan total approximately $6 billion.

56 Source: BNSF Railway. (June 2019). "Leading the Way in PTC.".

ON-DOCK/NEAR-DOCK/OFF-DOCK RAIL IMPROVEMENTS

In 2018, approximately 29.5 percent of the San Pedro Bay Ports' containers were shipped by rail "intact" (direct intermodal), meaning the cargo was moved by rail in marine containers without being transloaded or deconsolidated first. Containers that are neither shipped by rail intact nor transloaded are trucked directly to and from local warehouses or distribution facilities.

Containers moved using on-dock rail do not have to be trucked to and from more distant rail yards. In 2018, 24.3 percent of direct intermodal cargo was handled using on-dock rail. In that same year, 5.1 percent of containers were handled at off-dock yards (e.g., Hobart, East Los Angeles) or existing near-dock yards (e.g., ICTF). These containers must be trucked between port terminals and these yards.

ON DOCK RAIL SUPPORT FACILITY AT PIER B STREET (PIER B ODRSF)

Pier B ODRSF is a $720 million project that will expand the existing Pier B Rail Yard. The project will allow trains up to 10,000 feet long to be loaded and unloaded at on-dock rail facilities at marine terminals to streamline rail operations, remove bottlenecks, and reduce the need for local truck trips, resulting in a more efficient and sustainable transfer of cargo. The Pier B ODRSF project proposes to:

- Improve roadway traffic flow to enhance motorist and rail safety by eliminating the existing railroad crossing at the 9th Street and Pico Avenue intersection.
- Reconfigure existing tracks and add additional tracks to allow trains up to 10,000 feet long to directly connect to the on-dock rail facilities and the Alameda Corridor railway.
- Potentially acquire additional land to the north of the Pier B rail facility (as far as 12th Street, but south of Anaheim Street in West Long Beach) to provide for additional rail car storage and staging. Other small parcels located in the vicinity of the Alameda Corridor to Ocean Boulevard may also be acquired.
- Potentially remove the ramps connecting 9th Street and the Shoemaker Bridge.

PORT AREA RAIL INFRASTRUCTURE IMPROVEMENTS

The Ports of Los Angeles and Long Beach have about $2.3 billion in rail improvements within the harbor area **(TABLE 5)**. These projects are designed to support increased on-dock rail service, to reduce railroad delay associated with train meets and passes and to reduce conflicts with highway traffic. By allowing more on-dock rail, truck traffic between the San Pedro Bay Ports and distant rail yards can be reduced. Use of on-dock rail eliminates truck VMT and associated emissions by allowing trains to be loaded and unloaded inside marine terminals.

With the proposed investments, it is estimated that on-dock rail will account

TABLE 5 Estimated Cost of Port-Area Rail Improvement (Millions of Nominal Dollars)

Port Area Rail Improvements (Excluding SCIG and ICTF)	Estimated Costs
Port of Long Beach	$1,223.86
Port of Los Angeles	$1,113.33
Total Port Area	**$2,337.19**

Source: Ports of Los Angeles and Long Beach

for the movement of approximately 25 percent (8 percent off dock) of all San Pedro Bay Ports' TEUs by 2045. On-dock rail will not be able to accommodate 100 percent of direct intermodal moves. It is limited by factors such as shipper/steamship line logistics (transloading, transportation costs, etc.), railroad operations (equipment availability, the need to generate destination-specific unit trains, train schedules and steamship line contracts/arrangements) and terminal operations and congestion. Projects include:

- Port of Long Beach
  - Pier G South Working Yard Rehabilitation
  - Middle Harbor Terminal Rail Yard (three phases)
  - Pier A On-Dock Rail Yard Expansion to Carrack
  - Pier A On-Dock Rail Yard East of Carrack
  - Pier G Metro Track Improvements
  - Pier B Street Freight Corridor Reconstruction
  - Double Track Access from Pier G to Pier J
  - Track Realignment at Ocean Boulevard (currently under operation)
  - Terminal Island Wye Track Realignment
  - Reconfiguration of Control Point (CP) Mole
  - Navy Mole Road Storage Yard
  - Pier B Rail Yard (Phase III-12th Street Alternative)
- Port of Los Angeles
  - West Basin Container Terminal Railyard Modernization – Expanded Railyard; Improved Wharf and Backland
  - Pier 300 : Expanded Railyard; Improved Wharf and Backland
  - Pier 400: Expanded Railyard (including Pier 400 Storage Yard)
  - Terminal Island Railyard Expansion
  - Alameda Corridor Southern Terminus Gap Closure
  - Terminal Island Railyard Enhancement Phase II – Pier 400 Second Lead Track
  - Alameda Corridor Southern Terminus Enhancement – B200 Railyard Connection Expansion
  - Alameda Corridor Terminus/Terminal Way Grade Separation
  - Port of Los Angeles and Long Beach Joint Projects
  - Alameda Corridor Terminus Enhancement – New Cerritos Channel Rail Bridge
  - Alameda Corridor Enhancement – Triple Track S/O Thenard Junction

EXPANSION OF NEAR-DOCK RAIL

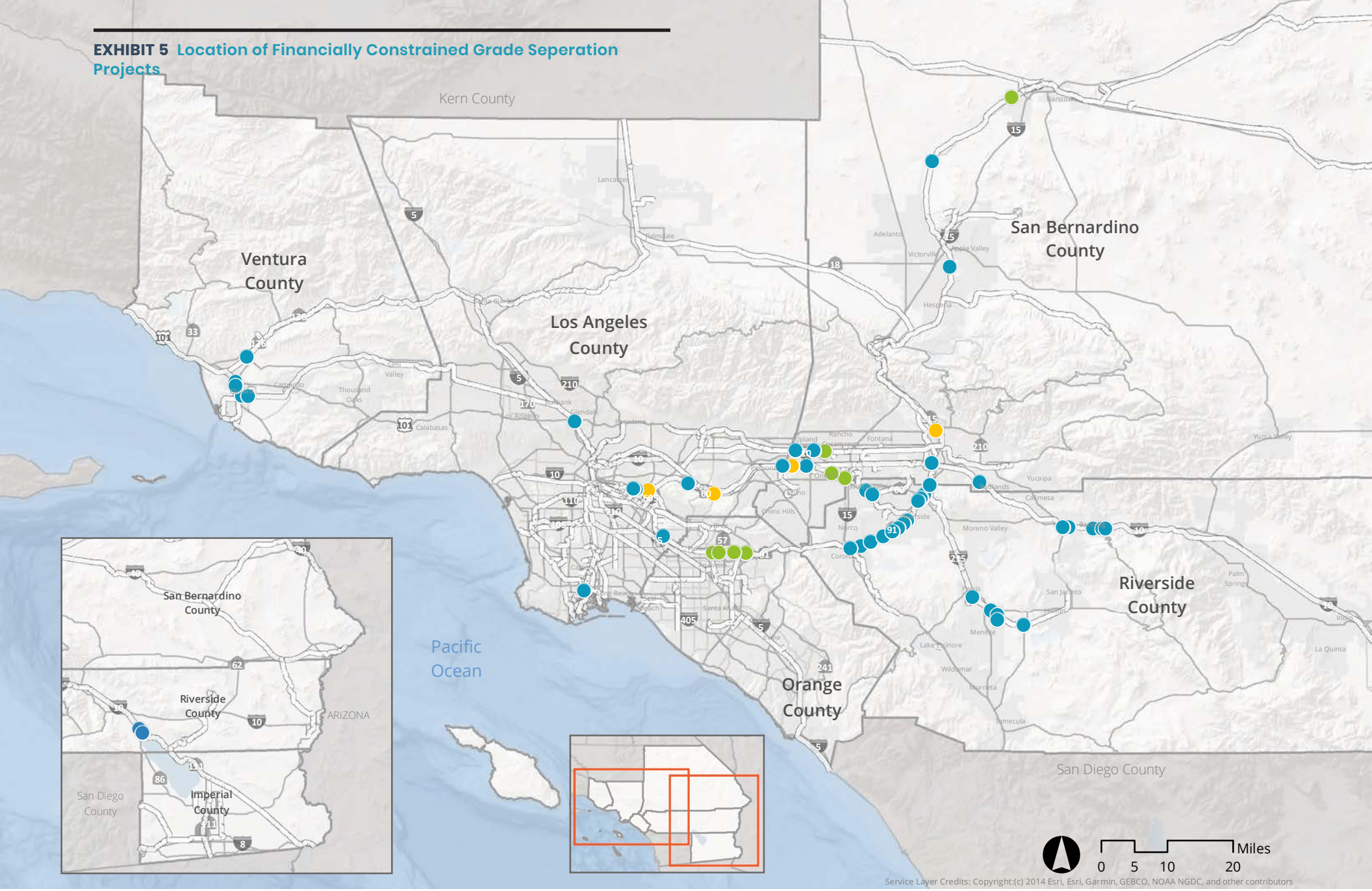
Enhancements at near-dock railyards is needed to accommodate projected demand and reduce the number of truck trips to off-dock yards. Near-dock rail terminals provide rail accessibility to import and export cargo, using drayage trucks for the connection to and from port terminals. Expansion of near-dock rail will reduce truck VMT and emissions by eliminating the need to access more distant off-dock fail facilities.

Two near-dock rail projects are currently undergoing environmental review: BNSF's Southern California International Gateway (SCIG) and modernization of UPRR's Intermodal Container Transfer Facility (ICTF). Without the SCIG and ICTF expansion projects, it is estimated that the growth in direct intermodal container volumes would require that at least 1.5 million containers lifts would have to be handled at different yards throughout the SCAG region. While the number of truck trips would not change significantly, VMT would be reduced due to the shorter distance from the Ports to the SCIG terminal (about 3 to 4 miles), compared to the distance to Hobart and East Los Angeles yards terminals (about 20 miles). The Alameda Corridor has sufficient throughput to handle the projected increase in railroad traffic from the ICTF and SCIG.

INTERMODAL TRANSFER CONTAINER FACILITY (ICTF)

The UPRR has proposed to invest $500 million in a modernization project that

EXHIBIT 5 Location of Financially Constrained Grade Seperation Projects



Complete Planned Under construction Regional Rail Lines

Source: SCAG, 2019

will increase the throughput at the ICTF, from the current maximum of 725,000 containers (1.4 million TEUs) to 1.5 million containers (2.8 million TEUs). The project will include the replacement of diesel cranes and yard hostlers with electric ones as well as the addition of six new railroad tracks totaling 50,000 ft. Clean technologies will be utilized to cut facility emissions by 74 percent. An EIR is currently being prepared for this project.

SOUTHERN CALIFORNIA INTERNATIONAL GATEWAY (SCIG)

SCIG is a $500 million project looking to build a new, state of the art intermodal "near dock" railyard facility located within four miles of the San Pedro Bay Ports (SPBPs) and connected to the Alameda Corridor. The proposed project would be located on an approximately 185-acre site comprised of 117 acres of Harbor Department land and 68 acres required from private parties.

RAIL PACKAGE SUMMARY

The combined rail package has been estimated to cost approximately $14.4 billion, including main line rail improvements, port area rail improvements, near-dock railyard improvements and rail-highway grade separations.

HIGHWAY STRATEGIES

Trucks carry the largest fraction of goods moved, both in terms of ton-miles and cargo value, of all goods movement modes on a roadway system that also carries growing passenger traffic. To better understand the locations that will demand greater truck efficiency and operational improvements, Connect SoCal considers current and future truck traffic volumes on the key roadway corridors. Truck traffic in the region is expected to grow at a very high rate, much higher than auto traffic, and will use an increasing share of the region's highway facilities. The most heavily used routes are already extremely congested and will continue to be in the future. This will cause increasing delay for the trucking industry, increasing costs to shippers and ultimately to consumers.

EXISTING AND PROJECTED CONDITIONS

With continued growth in freight demand, regional truck-related activities will increase over Connect SoCal's horizon. SCAG's Heavy Duty Truck (HDT) model is the primary analysis tool used to evaluate the impacts of truck traffic and highway goods movement strategies on the regional transportation network. Major sources of truck traffic are grouped into the following categories in SCAG's HDT model:

- Internal Truck Trips: These are intraregional truck trips that have both an origin and a destination within the SCAG region and are generated by local industries, construction sites, domestic warehouses and manufacturing sites and distribution centers and truck terminals and residences.
- External Truck Trips: These are interregional truck trips that reflect trade between the SCAG region and the rest of the U.S. based on the firm synthesis model which reflects business establishments and employment growth factors in the SCAG region.
- Port Truck Trips: These are truck trips with an origin and destination at the San Pedro Bay Ports
- Secondary Port Truck Trips: These are truck trips with an initial origin or destination at the San Pedro Bay Ports and IMX that are moved a second time after the first trip to or from the San Pedro Bay Ports. Transloading trips are in this category.
- Intermodal (IMX) Truck Trips: These are domestic intermodal truck trips that have origins or destinations at regional intermodal facilities in the SCAG region. These truck trips do not include those that have either an origin or destination at the San Pedro Bay Ports as they were modeled by Port HDT Model.

In 2016, the San Pedro Bay Ports were responsible for approximately 56,558 direct daily regional truck trips. As shown in **TABLE 6**, this constitutes only about 5 percent of regional truck trips. That number is expected to grow to approximately 116,628 daily regional truck trips, an increase to nearly 8 percent, by 2045.

Internal truck trips accounted for the vast majority (87.6 percent) of truck trips in 2016. Over 60 percent of these trips were made by light-heavy and medium-heavy trucks, whereas all of the other categories are dominated by heavy-heavy trucks. Internal truck trips in Los Angeles County amounted to 583,074 trips per day, or 54.6 percent of all internal trips, and 57.3 percent of all truck trips in the region. Although there is a general public perception that port-related truck trips are the dominant causes of congestion, pollution, and accident-related issues associated with goods movement, the Ports generated only 4.6 percent of all truck trips in the region in 2016. External trips make up a larger share of the trips that have origins or destinations in Imperial, Riverside and San Bernardino Counties. Port trips make up a larger share of truck trips in Los Angeles County than the overall regional share of these types of truck trips.

All key regional highway corridors used to move goods are expected to see an increase in overall truck volumes by 2045. The succeeding tables show existing truck speeds on the regional highway network during the AM and PM Peak periods, respectively. The expected speeds on the regional highway network during the PM Peak period in 2045, if no action is taken, is also included. Exhibit 6 illustrates truck volume trends for the 2016 baseline and 2045 plan on the major truck corridors in the region. Most of the corridors show significantly increased truck volumes in the no-plan scenario while minor improvements are shown in the plan scenario map.

EXHIBITS 11 and **12** show PM and AM peak exiting period truck speeds on regional highways. **EXHIBITS 13** and **14** show PM and AM peak period of truck speeds in 2045 with SoCal Connect constrained projects. **EXHIBITS 15** and **16** show PM and AM peak period of truck speed on highways in 2045 with SoCal Connect strategic plan projects.

CLEAN FREIGHT CORRIDOR SYSTEM

The 2016 RTP/SCS included a system of truck-only lanes connecting key trade gateways at the San Pedro Bay Ports and industrial cluster areas in Los Angeles and the Inland Empire. Today's vision remains the same. However, in March 2018, the Metro Board of Directors selected Alternative 5C as the Locally Preferred Alternative (LPA) for the I-710 Corridor Project.[57] This alternative reduced the extent of the truck-only lanes of the project, terminating at Del Amo Boulevard, south of SR-91. The region remains focused on developing innovative strategies and solutions towards project concepts which can address growing truck traffic and safety issues on core highways throughout the region, serving key goods movement industries. This includes a continued focus with developments related to near-zero and zero emission technologies.

EAST-WEST FREIGHT CORRIDOR

Connect SoCal continues to identify a corridor concept along the SR-60 known as the East-West Freight Corridor (EWFC). As a result of the LPA for I-710, further analysis will need to be performed to revisit the EWFC concept. Other work efforts may involve more direct stakeholder involvement regarding existing versus future operating environments of supply chains, and financial analysis considering newer asset monetization opportunities such as the monetization of right-of-way (ROW) for fiber and other communications equipment infrastructure as related to 5G, the Internet of Things (IoT) and blockchain. The EWFC may also consider pilot projects for the use of near-zero and zero emission truck technologies, with the goal of improving air quality for communities near the corridor and throughout the region.

BOTTLENECK RELIEF STRATEGY

The SCAG 2013 Comprehensive Regional Goods Movement Plan and Implementation Strategy included a ranked list of 48 regional HDT bottlenecks using 2008 data from several sources, public and private. In 2015, SCAG refreshed the list to reflect 2012 data to identify changes that occurred following the recession of 2008-2009. That update was done at a high-level by estimating congestion growth rates for each corridor. Caltrans' Performance Management System (PeMS) was used to develop the growth rates as well as to identify other potential new HDT bottlenecks that may have emerged since

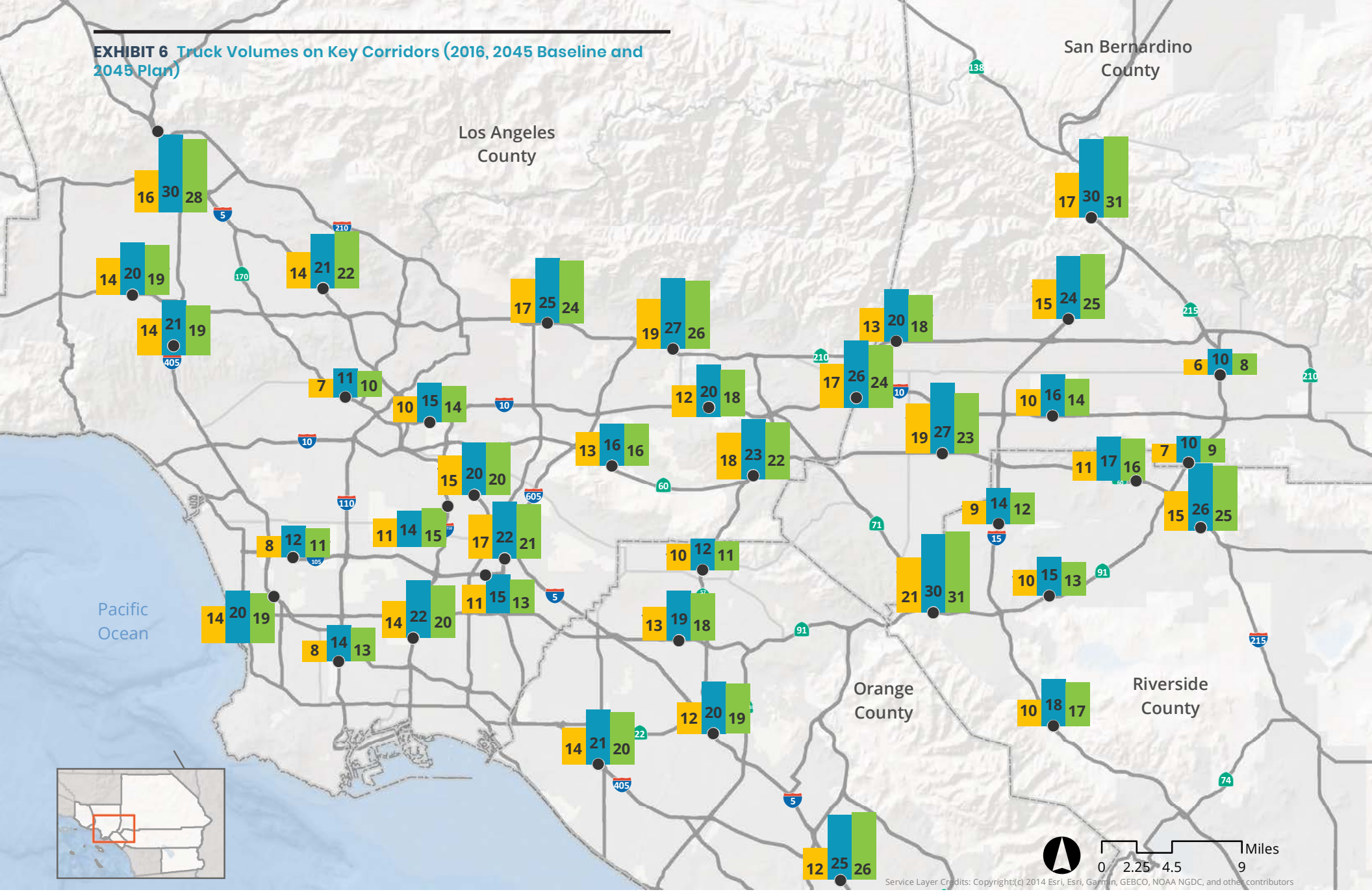
57 Source: Los Angeles County Metropolitan Transportation Authority.

TABLE 6 Daily Regional Truck Trips by Catergory by County

Type of Truck Trip	Imperial County	Los Angeles County	Orange County	Riverside County	San Bernardino County	Ventura County	Total	Percent
Internal	10,664	583,074	182,824	110,592	137,188	42,937	1,067,280	87.6%
External	2,145	50,479	7,842	5,627	8,894	2,025	77,012	6.3%
Port	16	51,794	1,694	759	2,167	128	56,558	4.6%
Intermodal (IMX)	6	5,904	309	214	1,749	48	8,229	0.7%
Secondary	2	6,974	440	176	1,428	27	9,047	0.7%
Total	12,834	698,225	193,108	117,369	151,425	45,164	1,218,125	100.0%
Percent	1%	57%	16%	10%	12%	4%	100%	

Source: SCAG

EXHIBIT 6 Truck Volumes on Key Corridors (2016, 2045 Baseline and 2045 Plan)



Daily Truck Volumes (Bidirectional)
Numbers in thousands (rounded)

2016 2045 Baseline 2045 Plan

Source: SCAG, 2019

economic recovery began. In 2016, a subsequent update was performed to reflect traffic conditions in 2014. That analysis involved a revised methodology using speed data from INRIX.[58] and Caltrans Average Annual Daily Truck Traffic (AADTT) volumes to estimate HDT Annual Vehicle Hours of Delay (AVHD).

Connect SoCal uses that same methodology to update the bottleneck analysis using 2016 INRIX data and 2016 Caltrans AADTT data to refresh the 2014 findings. As was done in the previous update, key SCAG region truck corridors that had at least one count location reporting at least 5,000 5+ axle daily trucks were included. Weekday, hourly HDT delay was estimated for each available INRIX segment, and this delay was then aggregated to the AM, Midday, PM, and Off-Peak time periods for each segment. The total annual vehicle hours of delay (AVHD) was summarized by bottleneck location, and total regional HDT delay was estimated. Any bottleneck exceeding 20,000 HDT AVHD was considered a significant regional bottleneck location.

EXHIBIT 7 shows the high-priority HDT bottleneck locations color-coded by severity. **TABLE 7** reports the regional priority bottleneck locations with estimated queue length of specific bottlenecks which include those that had the highest truck-related annual delay according to the quantitative bottleneck assessment. Table 8 also report the prioritized list of the bottlenecks ranked in descending order of severity as measured by AVHD. In 2016, heavy-duty trucks experienced more 3.2 million AVHD on key goods movement highways, which is around 6 percent higher than AVHD measured using 2014 data. The analysis also identified 42 HDT bottlenecks that accounted for 57 percent of total regional AVHD.

Other key findings from this analysis included:

- In general, the HDT congestion at major bottlenecks was significantly higher than was reported in the 2016 RTP/SCS.
- The most congested bottleneck is at the interchange of eastbound SR-60 and northbound State Route (SR-57). The location experienced more than 190,000 AVHD in 2016 accounting for 6 percent of total regional HDT delay. This bottleneck was reported as the most congested "Freight Significant Highway Location" in California by the American Transportation Research (ATRI) in 2018, a position it has held since ATRI began reporting on truck bottlenecks in the United States.
- Southbound I-605 at Florence Boulevard, just south of the I-5 interchange with around 107,000 AVHD, was the second most congested bottleneck in 2016, and was the top bottleneck in the 2014 analysis.
- The third most congested bottleneck is on southbound I-5 just north of the I-605 interchange with nearly 89,000 AVHD.
- Eastbound I-210 at South Cerritos and Citrus Avenues in Asuza has the fourth highest AVHD with just over 66,000 AVHD.
- Northbound I-5 at the SR-2 interchange in Los Angeles is the fifth most congested bottleneck with just under 63,000 AVHD and was the 15th ranked bottleneck in 2014.

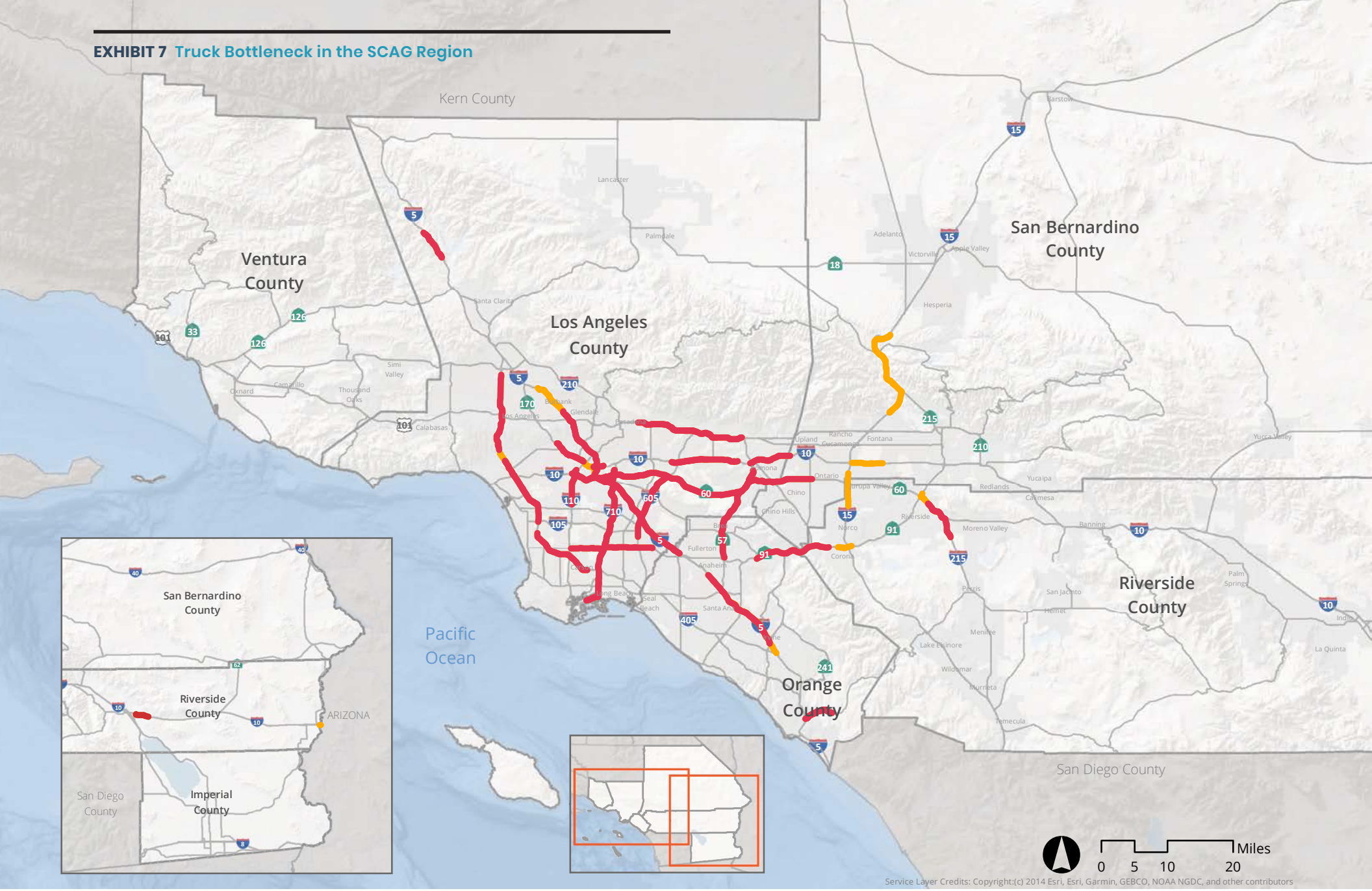
Combined, these five bottlenecks account for around 17 percent of all HDT AVHD in the region, and ten bottlenecks account for nearly 25 percent of all truck congestion. I-5 has around than 612,600 AVHD, which is more than twice the congestion reported on SR-60 – the next most congested freeway. In total, more than 3 million HDT delay was estimated for the year 2014.

TRUCK CLIMBING LANES

Additional highway projects that would facilitate goods movement activities in the region include truck climbing lanes. Examples of corridors identified as suitable for truck climbing lanes and currently programmed with funding and/or under construction include I-5, I-10, I-15, SR-57 and SR-60. Truck climbing lanes are additional lanes located outside mixed-flow lanes, which permit slower-moving trucks to operate at their own pace. This enables other vehicles to move at a faster pace, thereby reducing congestion. These lanes are typically placed where slow-moving trucks would cause an obstruction to other vehicles, such as hillsides or other areas with significant grade increases.

58 INRIX is a private data vendor.

EXHIBIT 7 Truck Bottleneck in the SCAG Region



Annual Vehicle Hours of Delay (AVHD)

15,000 - 20,000 Above 20,000

Source: SCAG

TABLE 7 2016 SCAG Region Heavy-Duty Truck High Priority Highway Bottlenecks

Route	Direction	Distance (miles)	County
SR-60	Eastbound	10.7	Los Angeles
SR-57	Northbound	10.2	Los Angeles/Orange
SR-605	Southbound	8	Los Angeles
I-5	Southbound	8.9	Los Angeles
SR-210	Eastbound	7	Los Angeles
I-5	Northbound	5.2	Los Angeles
SR-710	Southbound	9.2	Los Angeles
I-10	Eastbound	7.6	Los Angeles
SR-60	Westbound	10.7	Los Angeles/San Bernardino
SR-57	Southbound	2.9	Los Angeles
SR-60	Westbound	12.6	Los Angeles
SR-91	Eastbound	12.5	Los Angeles
I-5	Northbound	4.3	Los Angeles
I-10	Eastbound	3.9	Los Angeles
SR-60	Eastbound	7.5	Los Angeles
SR-710	Northbound	6	Los Angeles
SR-91	Eastbound	11.8	Orange/Riverside
I-5	Northbound	7.5	Los Angeles/Orange
SR-710	Northbound	8.4	Los Angeles
SR-605	Northbound	3	Los Angeles

TABLE 7 2016 SCAG Region Heavy-Duty Truck High Priority Highway Bottlenecks - Continued

Route	Direction	Distance (miles)	County
I-5	Southbound	5.2	Los Angeles
SR-210	Eastbound	5.7	Los Angeles
I-215	Northbound	7	Riverside
SR-74	Eastbound	4.7	Orange
I-405	Northbound	7.8	Los Angeles
SR-210	Westbound	7.1	Los Angeles
I-405	Southbound	11.9	Los Angeles
SR-57	Southbound	10.8	Los Angeles/Orange
I-405	Southbound	8.4	Los Angeles
I-10	Westbound	5.8	Los Angeles
SR-60	Westbound	4.8	Los Angeles
SR-110	Northbound	5.5	Los Angeles
I-405	Southbound	10.3	Los Angeles
SR-710	Southbound	8.2	Los Angeles
U.S. 101	Southbound	5.1	Los Angeles
SR-605	Northbound	7	Los Angeles
SR-710	Southbound	5	Los Angeles
SR-74	Westbound	4	Orange
SR-210	Westbound	6.4	Los Angeles
I-5	Northbound	5.5	Los Angeles

TABLE 7 2016 SCAG Region Heavy-Duty Truck High Priority Highway Bottlenecks - Continued

Route	Direction	Distance (miles)	County
I-10	Westbound	9.0	Los Angeles
I-10	Eastbound	6.4	Los Angeles/San Bernardino
I-5	Northbound	6.5	Los Angeles
I-5	Southbound	14.4	Orange
I-10	Eastbound	6.5	Riverside
I-5	Northbound	4.8	Los Angeles
I-5	Northbound	8.3	Orange
I-5	Northbound	3.8	Orange
I-15	Northbound	16.0	San Bernardino
I-5	Southbound	7.4	Los Angeles
SR-91	Westbound	2.3	Riverside
I-405	Northbound	4.7	Los Angeles
U.S. 101	Northbound	3.8	Los Angeles
I-10	Eastbound	4.7	San Bernardino
I-215	Southbound	5.1	Riverside
I-15	Northbound	5.0	Riverside/San Bernardino
I-10	Westbound	0.5	Riverside

Source: SCAG

TABLE 8 SCAG Region Heavy-Duty Truck Annual Vehicle-Hours of Delay on Key Corridors 2016

Route	HDT Annual Vehicle-Hours of Delay (AVHD)
I-5	529,840
SR-60	387,300
I-10	295,080
I-405	235,150
SR-210	234,890
I-710	228,120
SR-91	207,600
SR-605	198,340
I-15	138,970
U.S. 101	119,790
SR-57	94,140
I-105	86,890
I-110	73,690
I-215	71,530
SR-74	61,730
SR-118	46,480
SR-40	45,550
SR-23	44,610
SR-58	42,300
SR-86	27,760
I-8	14,130

Source: SCAG

INTERNATIONAL POE STRATEGIES

International border crossings between the U.S. and Mexico in Imperial County are critical components of the freight transportation system in Southern California. Within Imperial County, the three ports of entry (POEs)–Calexico West-Mexicali I, Calexico East-Mexicali II and Andrade-Los Algodones–accounted for $17.3 billion in international trade in 2018. The value of goods moving through the SCAG international POEs was double the value during the Great Recession in 2009, and 45 percent higher than the pre-Recession high of 2007.

Driven by dramatic increases in cross-border trade, Imperial County worked to improve local connections to the interstate highway system. While Imperial County has seen economic development benefits as a result of the growth of the maquiladora industry, it may also realize economic benefits from by supporting Baja California which has positioned itself as a global competitor in business recruitment. The County's development area surrounding this border crossing is known as "Gateway of the Americas". The Gateways of the Americas is located on the new port of entry where industries located in this area perform the following activities:

- Supplying of raw material and components
- Warehousing and distribution
- Transportation services
- Brokerage services

While most goods in Imperial County move by truck, the border areas are also served by the UPRR and Carrizo Gorge Railway (CGR). The Calexico East border crossing is the only international rail crossing in the SCAG region and provides the only rail connection from California into Central Mexico. There are a number of challenges in Imperial County that could constrain future economic development. A lack of adequate transportation infrastructure, at the U.S. - Mexico border is a significant concern, but there are also operational issues that have to be addressed. Some of the most noticeable challenges include:

- The lack of direct freeway connections to railyards and intermodal facilities.

- The lack of dedicated truck lanes, passing lanes and truck bypass routes.
- High truck traffic through urban areas .
- The impacts of empty trucks returning to Mexico after unloading their cargo in Calexico.

These statements are consistent with findings of recent SCAG goods movement border crossing studies, which found that costs of delays at the border are high. Other major findings were that:

- Border-crossing times in Imperial County's land port of entries (LPOEs) are among the highest along the U.S.-Mexico border.
- Southbound commercial border-crossing times are higher than commonly anticipated, occasionally attaining levels comparable to those of northbound commercial trips.
- Future volumes of goods crossing the border are anticipated to generate significant pressure on current LPOE infrastructure, potentially increasing commercial truck wait times at the border.
- LPOE users are willing to pay to improve border-crossing times and reliability on northbound trips.

Key transportation strategies identified to improve the flow of goods in the area include:

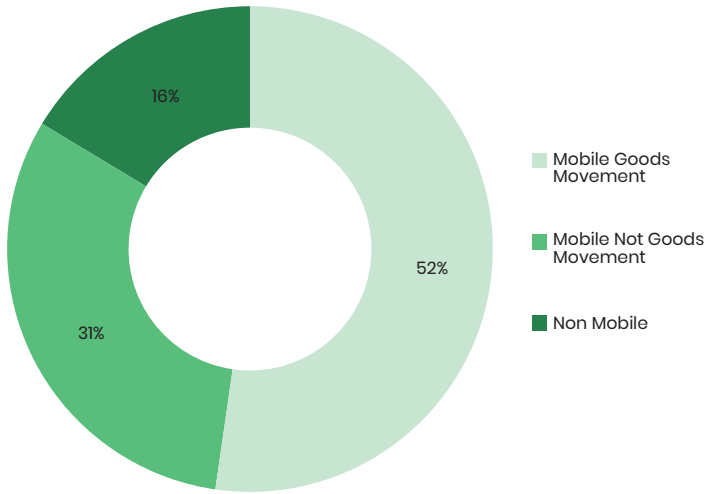
- Improving interchanges and developing bypasses to appropriate regional roadways;
- Reconstruction of the I-8/Imperial Avenue interchange and Imperial Avenue Extension projects in the City of El Centro which expand to the Calexico East Port of Entry. The proposed projects would increase the number of commercial vehicle inspection lanes and booths from the existing three to six lanes and booths, while widening the bridge over the All-American Canal (Canal serves as U.S./Mexico Border);
- Construction of cold storage facilities in Imperial County to perform pre-inspections and allow streamlined crossing of trucks across the LPOEs; and
- Development at air cargo and intermodal facility in the region.

GOODS MOVEMENT ENVIRONMENTAL CONDITIONS AND TECHNOLOGY ADVANCEMENT STRATEGIES

EXISTING AND PROJECTED ENVIRONMENTAL CONDITIONS

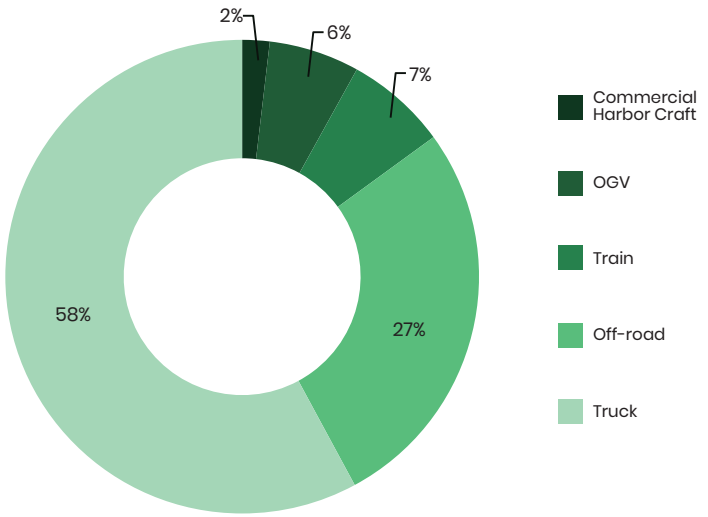
Ships, trucks, trains and other goods movement equipment are among the largest contributors to regional air pollution, which must be reduced to comply with federal law and improve quality of life. Criteria pollutants such as nitrogen oxides (NOx), particulate matter ($PM_{2.5}$ and PM_{10}), sulfur oxides (SO_x) and carbon monoxide (CO) can have significant public health impacts. Goods movement is also a major producer of GHG emissions and user of energy in the form of diesel fuel. Though the environmental impacts of goods movement are far-

FIGURE 20 Goods Movement Sources as a Percent of NOx Emissions, South Coast Air Basin, 2016



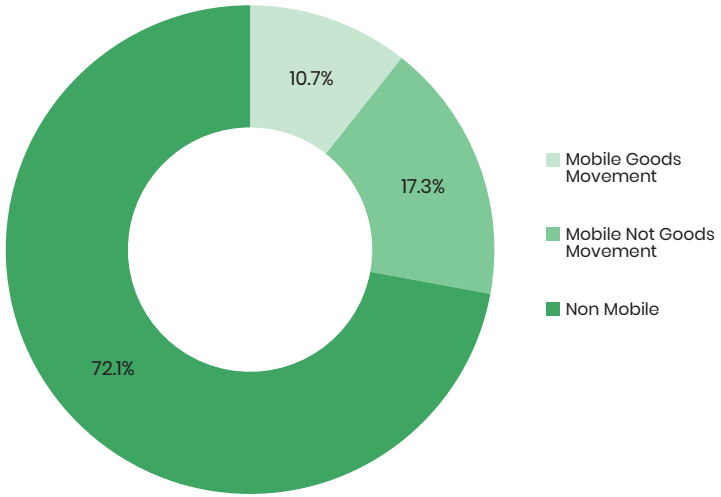
Source: CARB CEPAM 2016 Standard Emission Tool

FIGURE 21 Distribution of NOx Emissions from Goods Movement Sources, South Coast Air Basin, 2016



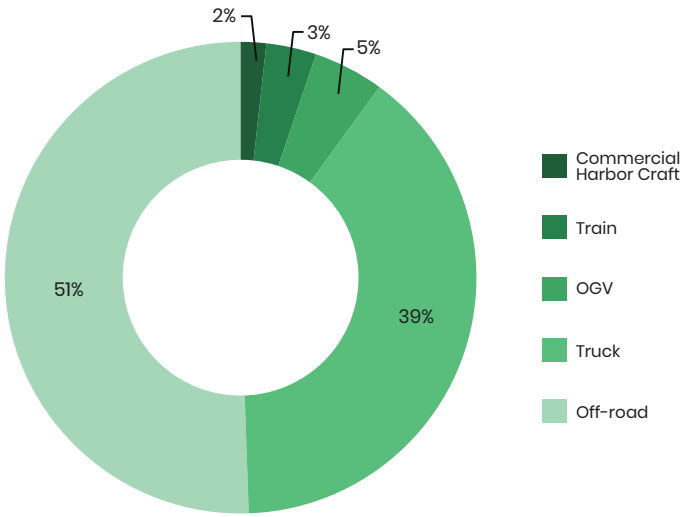
Source: CARB CEPAM 2016 Standard Emission Tool

FIGURE 22 Goods Movement Sources as a Percent of $PM_{2.5}$ Emissions, South Coast Air Basin, 2016



Source: CARB CEPAM 2016 Standard Emission Tool

FIGURE 23 Distribution of $PM_{2.5}$ Emissions from Goods Movement Sources, South Coast Air Basin, 2016



Source: CARB CEPAM 2016 Standard Emission Tool

reaching, Connect SoCal's goods movement action plan focuses on air quality. Improving air quality is the priority for better public health, meeting federal and state requirements and reducing the region's contribution to climate change.

There are several ways that emissions from goods movement sources could be reduced. Integrated land use and infrastructure planning may encourage facility development that leads to reduced VMT. Infrastructure improvements that create greater system efficiency may reduce emissions. This section focuses on addressing air quality through cleaner and more efficient operation of vehicles, largely by modifying or replacing the existing regional fleet of goods movement equipment with cleaner technologies or efficiency improvements.

Goods movement sources include trucks, locomotives, cargo handling equipment, ocean going vessels and commercial harbor craft.[59] For the

59 Aircraft when transporting commercial goods would also be a portion of this calculation, though for this document, data was not available to distinguish between passenger and commercial air emissions

South Coast Air Basin (SCAB) in 2016,[60] mobile sources were estimated to be responsible for 83 percent of NOx emissions, and emissions from goods movement sources were estimated to be 52 percent of the total. In 2016, heavy-duty trucks were responsible for 58 percent of goods movement related NOx emissions, or 30 percent of total NOx emissions.[61] Locomotives were responsible for 7 percent of goods movement NOx emissions and 3.6 percent of total NOx emissions. Emissions from goods movement related sources constitute a smaller percentage of all $PM_{2.5}$ emissions than NOx emissions. In 2016, mobile sources were estimated to be 28 percent of total $PM_{2.5}$ emissions, and emissions from goods movement sources were estimated to be 11 percent of total $PM_{2.5}$ emissions. In 2016, heavy-duty trucks contributed 39 percent and off-road equipment contributed 51 percent to goods movement related $PM_{2.5}$ emissions, or 9.5 percent of total $PM_{2.5}$ emissions.[62] Locomotives contributed 3 percent, of $PM_{2.5}$ emissions from goods movement related sources, and less than 1 percent of $PM_{2.5}$ emissions from all sources. **FIGURE 21** shows the distribution of NOx emissions from various goods movement sources.

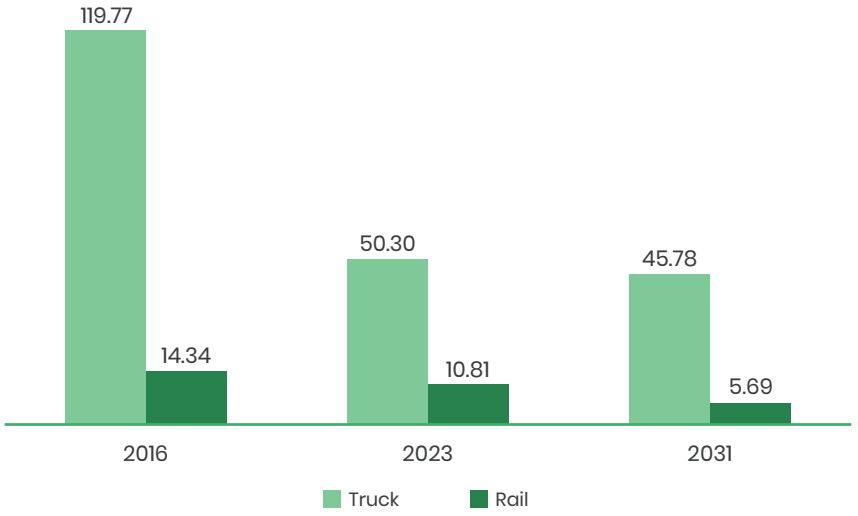
FIGURE 23 shows the distribution of $PM_{2.5}$ emissions from various goods movement sources.

Currently, much of the SCAG region fails to meet federal ozone and fine particulate air quality standards as mandated by the federal Clean Air Act. The SCAB which includes Orange County and portions of Riverside, Los Angeles and San Bernardino Counties, is designated as an extreme nonattainment area for the 1997, 2008, and 2015 8-hour ozone standards. NOx is a precursor to ozone formation, and therefore a key pollutant to control. The target attainment dates to meet these standards are June 2024, July 2032, and August 2038, and by those years, the region must reduce ozone concentrations to 80 parts per billion (ppb), 75 ppb and 70 ppb, respectively.[63] To meet these deadlines, the South Coast Air Basin, covering much of the SCAG region, must reduce NO_x emissions by 45 percent above and beyond the existing regulations by 2023, and 55 percent by 2031, to attain the 1997 and 2008 federal ozone standards required by the statutory attainment deadlines.[64]

Additionally, the region is a serious nonattainment area for the 2012 Annual $PM_{2.5}$ standard of 12 micrograms per cubic meter of air (ug/m^3), with an attainment deadline of December 2025.[65] However, the SCAB has already attained the 1997 Annual PM2.5 Standard of 15ug/m^3.[66] In scenarios run by the South Coast Air Quality Management District (SCAQMD), the basin is expected to attain the annual $PM_{2.5}$ standard by 2025.[67]

60 2016 emissions are a projection from 2012 baseline using data from the CARB CEPAM 2016 Standard Emissions Tool.
61 Calculated by author using data from the CARB CEPAM 2016 Standard Emissions Tool; The parameters of the emissions query included: Annual Average, Oxides of Nitrogen, Grown and Controlled, All sources except natural, and South Coast Air Basin. Due to the data format, off Road equipment may include equipment from non-goods movement related activities.
62 Ibid.
63 AQMD. (n.d.). National Ambient Air Quality Standards (NAAQS) and California Ambient Air Quality Standards (CAAQS) Attainment Status for South Coast Air Basin; Fact Sheet
64 AQMD. (2016). 2016 Air Quality Management Plan
65 Ibid.
66 Ibid.
67 Ibid.

FIGURE 24 NOx Emissions Baseline and Forecast (Tons per Day)



Source: CARB CEPAM 2016 Standard Emission Tool.

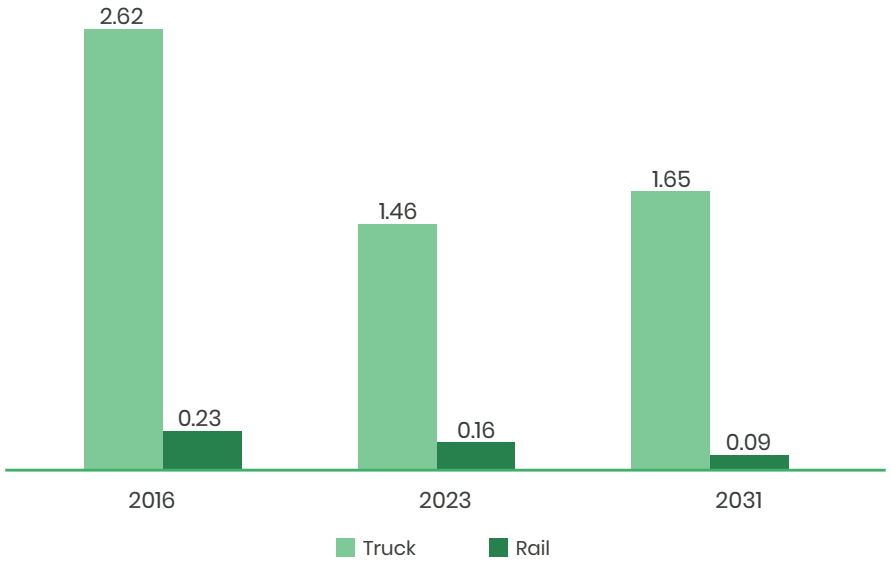
As shown in **FIGURES 24** and **FIGURE 25**, NOx emissions from trucks are projected to decrease as the region approaches target deadlines. $PM_{2.5}$ emissions are projected to decrease, then increase again, between 2023 and 2031.

If the EPA Administrator determines that requirements under the Clean Air Act have not been carried out by the state to meet federal standards, federal sanctions may be imposed, jeopardizing transportation funds and the permitting of stationary facilities may become substantially more burdensome. The federal government may also take over air local air quality regulation if state plans are not adequate to meet federal standards.

RELATED REGULATORY INITIATIVES

The South Coast Air Quality Management District (SCAQMD) is the agency most responsible (with SCAG sharing responsibility through its transportation strategies) for developing the Air Quality Management Plan (AQMP) that provides the blueprint for meeting federal air quality standards at the regional level. Connect SoCal supports this effort by including transportation strategies that reduce emissions. Although most of the emissions contributing to poor air quality come from sources of emissions that are primarily regulated either by EPA or by CARB, the SCAQMD has committed to assisting these agencies in reducing goods movement related emissions through the development of five Facility Based Mobile Source Measures (FBMSM) and through the implementation and development of incentive programs.

FIGURE 25 $PM_{2.5}$ **Emissions Baseline and Forecast (Tons per Day)**



Source: CARB CEPAM 2016 Standard Emission Tool.

The FBMSM process includes a combination of regulations and voluntary, contract-based measures or agreements to reduce emissions in a way that are quantifiable and could generate credit towards State Implementation Plan (SIP) requirements. For instance, a voluntary Memorandum of Understanding (MOU) between the ports and SCAQMD is under development for the ports that will largely be based on the 2017 San Pedro Bay Ports 2017 Clean Air Action Plan Update. The air district is developing an indirect source rule for warehouses and is pursuing an indirect source rule for rail yards as well as exploring if an update to previous MOUs in 1998 and 2005 with the railroads is possible.

At the state level, the California Sustainable Freight Action Plan was released in July 2016 and includes a Zero Emission Technology Target, a System Efficiency Target, and a Competiveness and Economic Target. Under this initiative, the California Air Resources Board (CARB) has a vision for fully zero emission (ZE) transportation where possible, and near-zero everywhere else. The first target is to deploy over 100,000 freight vehicles and equipment capable of zero or near-zero emission operation by 2030.[68] The System Efficiency target is to improve freight system efficiency 25 percent by increasing the value of goods and services produced from the freight sector, relative to the amount of carbon that it produces, by 2030. Targets for competitiveness and future economic growth have not yet been established. CARB is working closely with other state agencies, including Caltrans and the Governor's Office of Business and Economic Development ("GO Biz"), to realize the goals of this plan.

68 CARB. (March 2018). 2017-2018 Grant Solicitation, Zero and Near-Zero Emission Freight Facilities Project

The overall CARB strategy includes development and adoption of several new regulations; an emphasis on strategic development of freight infrastructure with the California Public Utilities Commission (CPUC), the California Energy Commission (CEC) and utilities; continued incentives for zero emissions demonstration and deployment (equipment and infrastructure); and guidance to developers, local jurisdictions and environmental advocates on the development, siting and inclusion of zero emission operations at new freight facilities. In addition to developing regulations for all sources under their purview, CARB will also pursue stricter federal and international standards, support local facility based measures and port initiatives and coordinate and expand incentives. It also has plans to develop a series of freight handbooks, to assist local jurisdictions in guiding the development of freight facilities, and empower environmental justice (EJ) groups to participate in the decision making. The first module of the freight handbook will be focused on warehouses, will likely be released in 2020.

To achieve sustainable freight goals, accelerate the introduction of cleaner technology and protect local communities, several important regulations have been developed, and additional regulations are underway. For instance, the Heavy Truck and Bus rule, passed in 2008, implemented in 2012 and amended in 2014, requires that by 2023 nearly all heavy duty vehicles (HDVs) have engines that are model year 2010 or newer. Drayage trucks must also meet the requirement of having 2010 or newer model year engines under the Drayage Truck Regulation. In 2013, CARB created an optional low NO_x standard to allow certification of lower NO_x engines for use in an incentive program. Additionally, various incentive programs have since funded the deployment of electric, hybrid-electric and near-zero emission trucks, and an updated funding plan is under development. The proposed 2019-2020 Funding Plan expends Clean Transportation Incentive Funds, and is expected to include $447 million in the Low Carbon Transportation Program funded by Cap and Trade Auction Proceeds, and $48 million for the Air Quality Improvement Program.

Some additional CARB initiatives under development include:

- The low NOx emission package (Heavy-duty Low NOx Omnibus Rulemaking), which will include new standards for low NOx engines, with a 90 percent reduction compared to today's engines and in-use requirements that ensure that vehicles perform as intended. To keep these standards aligned with federal standards, CARB is working with the U.S. Environmental Protection Agency (U.S. EPA) to establish a new national low - NOx standard for heavy-duty trucks.
- Advanced clean truck regulation, formerly known as last mile delivery, expected to be finalized by 2020, will include manufacturing and reporting requirements. This will establish a requirement for a certain percentage of a manufacturer's sales to be ZE, with those percentages increasing over time. Though the regulation has not been finalized, it is expected to begin in 2024 with 3 percent of Class 2-3B and Class 7-8 tractors, and 7 percent of Class 4-8 vocational truck sales to be zero emissions. By 2030, manufacturer's sales requirement are expected to be 15 percent for class 2B-3 and Class 7-8 tractors and 50 percent for Class 4-8 vocational trucks. The regulation also includes reporting requirements to help inform future development of fleet purchase requirements. In 2025, the sales percentages will be revisited to set requirements beyond 2030.
- A Transportation Refrigeration Unit (TRU) regulation to set operating time limits and facilitate a transition to zero emission units at warehouses and other facilities that support TRUs.
- Regulations are also being developed for forklifts, cargo handling equipment, commercial harbor craft and ships while at berth.

Since the 2016 RTP/SCS, federal regulations have also been advanced to address NOx emissions from heavy duty vehicles, and create standards that improve efficiency. CARB estimates that 60 percent of total heavy-duty truck VMT in the SCAB on any given day are accrued by trucks that were newly purchased outside of California.[69] The Cleaner Truck Initiative was announced by the US EPA on November 13, 2018, and regulations to further reduce NOx emissions from on-road heavy-duty trucks and engines are expected in the

69 CARB. (April 23, 2019). Email Subject: CARB Staff Current Assessment of the Technical Feasibility of Lower NOx Standards

2020/2021 timeframe. The Cleaner Truck Initiative includes strategies to ensure better in-use operation such as extended warranties and protocols for maintenance on diesel after treatment systems.[70]

Building on the 2011 Phase 1 standards for medium and heavy duty vehicles, stricter Phase 2 fuel efficiency standards were finalized in 2016, and incrementally tighten standards on vehicles through model year 2027. The Phase 2 standards are expected to lower CO_2 emissions by approximately 1.1 billion metric tons, and save vehicle owners about $170 billion in fuel costs nationwide.[71] Despite these increases, discussions are underway to roll back fleetwide fuel efficiency standards, threatening an increase in GHGs and fuel consumed compared to current standards. This has caused a great deal of controversy between the U.S. EPA, California and 16 other states with more advanced standards, and has not yet been finalized.

Additional policies are in place at the state level to reduce per capita GHG emissions and combat the effects of climate change. California Executive Order S-3-05 called for a coordinated approach to address the detrimental air quality effects of greenhouse gases (GHGs). More recently, California Executive Order B16-12 set a 2050 GHG emissions reduction goal for the transportation sector to achieve 80 percent less emissions than 1990 levels. In addition, Executive Order B-30-15 established an interim statewide GHG emission reduction target to reduce GHG emissions to 40 percent below 1990 levels by 2030 to ensure California meets its GHG reduction goals by 2050.

It is also a regional priority to reduce rail pollutants and work toward the objective of a zero-and near-zero emission freight rail system. At the federal level, regulations to regulate rail emissions were last updated in 2008 including the U.S. EPA Locomotive Engine Standards, 2008 rulemaking to reduce locomotive idling and non-road locomotive and marine (NRLM) fuel sulfur rule. CARB has petitioned the U.S. EPA to update the standard to Tier 5 engines for newly manufactured locomotives. Tier 5 engines are expected to reduce NOx emissions by 99 percent compared to pre-Tier 0 engines, while Tier 4 engines have a 90 percent reduction. The majority of locomotives in the air basin are currently Tier 3 or lower, which only reduce emissions by 59 percent.[72] The U.S. EPA Tier 4 locomotive standards also became effective for all new engines in 2015, and Tier 4 are now available from General Electric (GE). GE estimates that these engines will reduce emissions by 70 percent as compared to a Tier 3 engine without the use of selective catalytic reaction (SCR) or other complex aftertreatment.[73] Under an agreement between CARB and the BNSF and UPRR railroads in 1998, both railroads must ensure that their fleet meets the Tier 2 standard on average every year between 2010 and 2030. While the railroads have complied with this agreement, the transition to Tier 4 engines has been slow, with only about 4 percent of locomotive activity meeting that standard in 2017.[74]

In the SCAB, attaining the national ozone standards will require reductions in emissions of NOx well beyond reductions resulting from current rules, programs and commercially-available technologies. Previous regulations and incentive programs have improved vehicle emissions performance, but as the region grows, existing measures are not enough to realize attainment of the ozone standards in the 2023 and 2031 time frames. With the projected changes in both truck and rail emissions, greater advancements in technology are needed to meet regional attainment objectives.

The 2016 RTP/SCS Goods Movement Environmental Strategy was developed to address community health concerns, federal attainment requirements and climate change issues while supporting regional economic goals. The strategy emphasizes coordinated solutions for mobility, economy, energy and the environment so that investments provide multiple benefits. Connect SoCal perpetuates the same vision. This includes a focus on the long-term goal of a zero emission goods movement system where technically feasible and economically viable, while also integrating near-zero emissions technologies that serve as bridging options to continue to reduce emissions below current

70 Johnson, Dennis (May 2019) Diesel Emission Controls and Fuel Saving Technologies, Talking Freight Webinar
71 EPA. (n.d.). Regulations for Greenhouse Gas Emissions from Commercial Trucks & Buses
72 Green Car Congress. (April 2017). California ARB petitions US EPA for Tier 5 stricter locomotive emissions standards.
73 General Electric. (2014). "Fact Sheet on Evolution Tier 4 Locomotive".
74 CARB.(n.d.) 1998 Locomotive NOx Fleet Average Emissions Agreement

levels. It is important to note that the term "zero emission" as used throughout this document refers to technologies that are zero tailpipe emissions, meaning emissions are not released at the location of the vehicle, but may still be produced off-site through the production of energy needed to power the vehicle. For instance, electric vehicles may be zero tailpipe emissions while in use, but emissions are still being generated at the location of the power plant that is producing energy to power or charge the vehicle. Similarly, emissions may be generated in the production and transportation of fuels used to power the vehicle. It is encouraged that a life cycle approach is taken in consideration of new technologies, looking at the materials made to manufacture them, and how they may eventually be disposed of, reused or recycled.

Though Connect SoCal supports accelerated deployment of existing proven technologies that will serve to improve the region's air quality, immediate opportunities must be balanced with investment to achieve the long-term goal of a zero and near-zero emission freight system. Compared to previous RTPs, Connect SoCal includes an expanded focus on opportunities to develop the charging and fueling infrastructure needed to support a transition to zero emission goods movement. Continued innovation, partnerships with the private sector and building on lessons learned will help the region achieve the goal of a robust zero-and near-zero emission freight system.

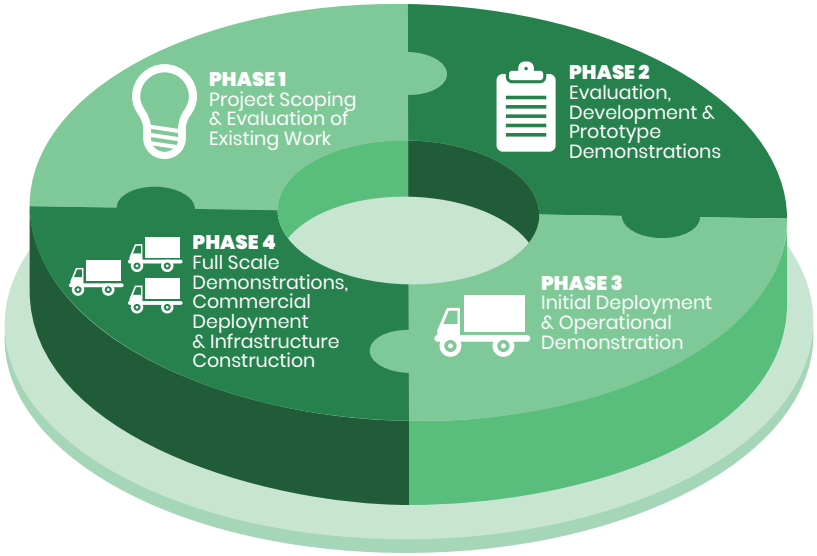
GOODS MOVEMENT ENVIRONMENTAL STRATEGY AND TECHNOLOGY ADVANCEMENT PLAN

ACTION PLAN FOR ADVANCEMENT OF ZERO EMISSION TECHNOLOGY

The 2012 RTP/SCS included a Technology Advancement Plan to develop and deploy a fully zero emission goods movement system in the 2035 timeframe. The 2016 RTP/SCS detailed progress and new action steps. Connect SoCal builds on these previous plans using lessons learned. The overall structure which traces the four stages of technology development and deployment, remains the same. Additionally, Connect SoCal discusses in greater depth the need for infrastructure to support the region's zero emissions goals, and includes renewed commitments and goals from regional partners, and action steps needed to achieve them. Moreover, the Plan advocates a lifecycle approach be taken to evaluate new technology development.

As new vehicle prototypes are developed and tested, early consideration can be given to the design to minimize the use of new resources and the disposal of hazardous waste, and to maximize opportunities for reuse and recycling. For instance, many electric vehicle applications are powered by lithium ion batteries, which require the extraction of new materials, and may offer challenges for recycling and disposal. However, there is potential to design them for easier reuse and recycling. Producer responsibility mandates already exist in China and the European Union (EU), and there may be a role for public agencies, such as the California Department of Toxic Substances Control (DTSC) and CalRecycle, to facilitate the development of batteries to reduce end of life impacts. Lithium ion batteries that are used for other applications like

FIGURE 26 Phases of Technology of Development and Deployment



Source: SCAG

cell phones and laptops are only collected and recycled at a rate of less than 5 percent.[75] This low rate of reuse and recycling is something to avoid now in the early prototype development stage of new vehicles.

The technology development and deployment plan is inclusive of all stages of technology development and deployment beginning from an initial definition of key operational parameters, moving through prototype development to initial demonstration and evaluation, and eventually a staged roll-out. This start-to-finish framework is useful as there are many potential technologies available, each at different stages of readiness.

The four phases of the action plan applicable to technology solutions are shown in **FIGURE 26** below:

- Phase 1: Project Scoping and Evaluation of Existing Work
- Phase 2: Development and Prototype Demonstrations
- Phase 3: Initial Deployment and Operational Demonstration
- Phase 4: Full-Scale Demonstrations and Commercial Deployment

PHASE 1: PROJECT SCOPING AND EVALUATION OF EXISTING WORK

The project scoping stage of technology development is intended to define the needs that the new technology must provide. In addition to meeting the overriding goal of zero emissions, new technologies must have adequate range, power and charging capability to serve business needs. Scoping must be done on the infrastructure side to better understand the amount of energy or fuel required, and how to generate and distribute the fuels needed for the new vehicles. Standards may also be set for the development of new batteries to ensure that they are built with as few extractive, nonrenewable resources as possible, and that key components are recyclable and/or can be disposed of safely.

This stage of exploring market needs and potential applications that could meet those needs has already begun. Industry needs are better understood, as are the operational challenges of integrating zero and near-zero emission technologies into daily business operations. Recently, the 2018 Feasibility Assessment for Drayage Trucks released by the San Pedro Bay Ports includes operational requirements for drayage trucks, though they acknowledge that even within the category of drayage trucks there are different operational parameters. However, they were able to define a broadly applicable truck (BAT) with Minimum Operational Capabilities.[76] Defining these characteristics creates a way of evaluating potential technologies and informs original equipment manufacturers (OEMS) of necessary criteria.

Additionally, CARB has conducted a Total Cost of Ownership study, comparing the full cost of battery electric vehicles (BEVs) and hydrogen vehicles to diesel trucks. The results show that by 2024, BEVs and hydrogen vehicles are expected to have total cost of ownership parity with diesel, though much is dependent on the ability to install appropriate infrastructure for hydrogen vehicles. These studies are critical to define the operational characteristics of new vehicles, and assess cost parameters to ensure that new technologies are competitive.

Since 2012, the region has also gained insights into the infrastructure needs for powering and providing fuel to zero and near-zero emissions vehicles, though many questions still remain. For instance, electricity distribution and transmission centers may need upgrades in order to provide adequate power at the site of new charging stations. The extent of the upgrade needed depends on many things, including existing infrastructure, the expected aggregated power demand of the vehicles and equipment, and the schedule that they will be charging. Larger heavy duty vehicles require more power and therefore the scale of the upgrades required depends on the vehicle type.

Ongoing work is needed in this area, particularly to learn how industry could best incorporate new technologies into their daily operations. These questions will in part be answered by demonstrations in Phases 2 and 3. As

75 US Department of Energy. (February, 2019) Energy Department Announces Opening of Battery Recycling Center at Argonne National Lab

76 Port of Los Angeles and Port of Long Beach. (April 2019). 2018 Feasibility Assessment for Drayage Trucks

the region learns more about new technologies, new questions arise. As part of the scoping phase, regional partners may continue to define parameters related to operating, powering and disposing of new vehicles to make sure that their design supports an environmentally sound cradle to grave lifecycle for the product.

PHASE 2: EVALUATION, DEVELOPMENT, AND PROTOTYPE DEMONSTRATIONS

As technology development progresses, Phase 2 includes the development, design validation, and initial demonstration of several types of advanced prototype vehicles and testing of the initial prototype. Phase 2 includes performance assessment of new technologies, including addressing market risks/uncertainties. As prototypes are developed and demonstrated, significant evaluation will also occur.

Developing and testing zero emission prototypes requires considerable investment from both public and private sector partners. It is the OEMs that must invest in research and development, with the assurance that there will be a market for their product when it becomes commercially viable. Both large companies and smaller startups have invested in new technology development and smaller companies in particular, may benefit from additional public financial support for prototype development. Several successful partnerships already exist where public funding combines with private sector investment to develop technology prototypes.

Once prototypes are available, it is beneficial for them to be tested in operational service with industry operators. Existing partnerships allow for trucking companies and terminal operators to integrate and experiment with new technologies in their everyday business operations. As prototypes are developed, early testing will answer questions about key parameters like range, battery life, truck residual value, and total cost of ownership.

Since the 2012 RTP, several prototype heavy duty trucks have been built and tested. In 2012, the SCAQMD received a U.S. Department of Energy (DOE) grant of $4.2 million to develop and test 13 zero emission drayage trucks using various technologies. In 2014, a second DOE grant of $9.5 million was awarded to SCAQMD for the development and demonstration of zero emission fuel cell range extended electric drayage trucks and hybrid electric drayage trucks.

The Technology Advancement Program (TAP) funded by the San Pedro Bay Ports is also a good example of resources to test new technologies in ongoing operations. The Ports partner with industry and provide $3 million annually to develop and test new clean air technologies at their terminals. The TAP addresses clean air technologies for rail, truck, ship, cargo handling equipment, and harbor craft. By mid-2018, there were at least 20 different major projects (recently completed, underway or soon to start) focused on testing ZE and/or NZE Class 8 truck platforms in drayage duty at the San Pedro Bay Ports. These demonstration projects involve nearly all of the major existing Class 8 truck OEMs, as well as several start-up OEMs and technology providers. Approximately 120 individual drayage trucks are now being (or will soon be) demonstrated in and around the San Pedro Bay Ports. These test tractors roughly break-out as follows:[77]

- 65 zero emission battery electric
- 16 zero emission fuel cell
- 12 near-zero emission natural gas ICE / hybrid electric
- 20 near-zero emission natural gas ICE
- 7 near-zero emission diesel ICE / hybrid electric

While designing and funding early demonstration projects, it must be understood that the purpose is to learn more about the technology, iterate where possible and move on from lessons learned. This process may have risks as not all technologies tested will be advanced to full deployment. For example, the 2012 and 2016 RTP/SCS discuss the concept of inroad charging via an overhead catenary system. To realize this concept, several partners including AQMD, the China Shipping Fund, the (CEC), the Port of Long Beach and Metro, with in-kind contributions from Siemens Inc., funded the construction of a

77 Ibid.

one mile test track on Alameda Street in the City of Carson. Three truck types including a serial hybrid with compressed natural gas (CNG) range extender, a full battery electric truck and a parallel hybrid with diesel combustion engine were retrofit with an overhead pantograph and tested for 6 months starting in July 2017.

Though important lessons were learned about this technology, the system was decommissioned at the end of the demonstration. This was due to the inability to identify an owner operator for the system. Six potential agencies were identified, then three including Southern California Edison (SCE), LA Metro and Cofiroute USA, were surveyed for ownership potential. The other 3 entities considered were the Gateway Cities Council of Governments (COG), Edison International and Caltrans. However, these parties were unable to commit to extending the test track to a larger 5 mile loop as originally envisioned in 2012. The primary concerns were the adoption of catenary enabled trucks and the competitiveness of the system with other technologies, especially given the long timeframe for construction and the ability of other technologies to potentially commercialize faster during that timeframe.

The technology was deemed viable and areas for improvement were identified. The technology had an ability to operate in different traffic conditions on the test track and beyond in zero emissions mode, depending on the energy storage potential of the vehicle. However, technologies not tied to wayside power are more versatile and flexible in their application for multiple duty cycles. Having two propulsion technologies on one vehicle increased costs and it was suggested that early cooperation is needed with OEMs to integrate the pantograph into the design of the truck and to optimize electric hybrid drivetrains.[78]

Although these findings suggest that utilization of this system is not immediate for the SCAG region, a similar ehighway has gone live in Germany in a rural location. A six-mile stretch of the A5 Autobahn will be tested through 2022.[79]

78 SCAQMD and Siemens. (March 12, 2018). eHighway SoCal Final Report; Construction of a 1 Mile Catenary System and Develop & Demonstrate Catenary Electric Truck

79 Business Insider, (May 2019). Germany opens first electric highway that lets trucks draw power from overhead cables.

This shows that although investments in technology demonstrations would ideally lead to advanced deployments, the region must also be willing to take risks and learn and build on lessons on what does not work well.

Evaluation of technologies, has begun throughout the course of several demonstration projects. As technologies evolve and more is learned about them, SCAG maintains a technology neutral position. However, lessons learned will be communicated and shared by users so that OEMS can advance the most applicable products to the next phase. It is important to keep in mind that a variety of technologies might be helpful to serve a variety of applications.

PHASE 3: INITIAL DEPLOYMENT AND OPERATIONAL DEMONSTRATION

Phase 3 is an opportunity to scale up research and development efforts to evaluate not just a prototype, but the performance of a larger fleet of vehicles. In this phase, industry partners are critical to test and evaluate larger vehicle fleets in everyday business operations. In addition, these tests may serve in part as initial deployment of cleaner vehicles. Assuming a successful demonstration, the industry partner may opt to continue to use these emergent technologies. These demonstrations will generally require public funding, where all, or a portion of, the incremental cost of the new technology is subsidized. This type of program provides an opportunity to see how new technologies work in practice, while at the same time hastening their placement into service. Many deployment demonstrations have been 10 or less vehicles with only one or two vehicles of the same type. Larger scale demonstrations that test larger fleets are the next step and several initiatives for this are underway.

The CARB Zero- and Near-Zero Emission Freight Facilities Project (ZANZEFF) Program, funded under Clean Transportation Incentives offers one source of funding for larger deployments. For instance, with a $41 million ZANZEFF grant, the Port of Los Angeles in partnership with Kenworth and Toyota will be testing 10 ZE Class 8 fuel cell tractors to be used to move cargo from Port's terminals to local distribution centers, and ultimately inland locations by partners including Toyota Logistics Services, UPS, and Total Transportation Services Inc. and Southern Counties Express. This project will be completed by 2021 and may

include development of two hydrogen fueling stations. The Port of Long Beach will demonstrate ZE trucks and equipment including 10 Class 8 battery-electric Peterbilt trucks as part of a larger Sustainable Terminals Accelerating Regional Transformation (START) Project. The Port of Hueneme also received a $3 million ZANZEFF grant to install equipment for and test two electric yard tractors, and to move cargo between the Port of Hueneme, the Port of Los Angeles and local produce processors using a hydrogen fuel cell truck.[80]

In mid-2018, Daimler Trucks North America (DTNA) and SCAQMD announced a $31.3 million heavy-duty electric truck project to put 20 Freightliner electric trucks into operation. Direct Current (DC) fast chargers will be installed at the identified fleet locations to test the feasibility and economics of pairing these charger stalls with energy storage systems, to reduce energy costs and demonstrate grid resiliency benefits.

The SCAQMD, Volvo and many others have also partnered to demonstrate 23 Volvo battery electric Class 8 trucks using a DC fast-charge technology at NFI, a third party logistics firm. The project also includes off road battery electric tractors and charging stations. This project is being funded by a $44 million grant from the CARB ZANZEFF program and additional matching funds. This project will demonstrate the clean transportation of cargo to destinations throughout the region.

Moving forward, there are plans to expand on these efforts by deploying larger fleets and demonstrating their progress. As described in the San Pedro Bay Ports 2018 Feasibility Assessment for Drayage Trucks, they intend to form a Large-Scale Zero emission Truck Demonstration Working Group in fall 2018, with the goal of issuing requests for proposals in 2019. The vision for the large scale demonstration is for projects of between 50-100 ZE emission drayage trucks to be operated in real service, however the solicitation will consider projects of at least 10 vehicles that are developed past the prototype stage.[81]

The examples cited in this section call attention to the high cost of accelerating zero emission technologies. OEMS will not invest unless they have certainty that a market for their products will exist and they will not invest unless they can make a reasonable return on their investment. The regulations described help send a signal that a market will in fact exist for these technologies as they will in fact be required. Subsidizing OEMs through the technology development and testing phase helps keep costs down so that they are not passed on to adopters of the new technology. Similarly, incentives for early deployment of new technologies keep costs lower for users and reduces the risk of trying something new. Existing regulatory efforts and technology investments help guide the development of new products to ensure a commercially viable product for use in the SCAG region.

PHASE 4: FULL SCALE DEMONSTRATIONS, COMMERCIAL DEPLOYMENT, AND INFRASTRUCTURE CONSTRUCTION

During Phase 4, technologies will be deployed as they meet the criteria for deployment established by regional stakeholders. As various technologies are currently in different stages of readiness, it is assumed that their deployment will be staggered throughout the 2020-2045 timeframe.

In this stage, there may be a greater role for planning agencies as it will be critical to provide infrastructure that supports the deployment of new technologies. If wayside power is deemed applicable, this may be incorporated into infrastructure planning. For all power types under development, fleets will require safe, convenient, and price competitive access to fuel. There are several models to develop charging/fueling stations as they may be on private lots, or public retail stations. In determining locations, there is a role for regional coordination to ensure that they are placed strategically where they will serve the most vehicles. Public private partnerships may also develop where land is public and infrastructure is private or vice versa. Though drayage trucks are a unique market, the San Pedro Bay Ports Feasibility Assessment reports that 28

80 Port of Hueneme. (n.d.), Port of Hueneme Environment webpage.
81 Port of Los Angeles and Port of Long Beach. (April 2019). 2018 Feasibility Assessment for Drayage Trucks

percent of truck operators do not have overnight parking.[82] Therefore, charging on site overnight would not be an option, and they would need additional space to charge. As vehicles are deployed, infrastructure must be done in parallel to support them, but must be done in a cost effective way, offering a return on investment for the provider.

The public sector may also have a role in facilitating a consistent set of standards for infrastructure development. Not only must stations be safe and accessible, but having consistent equipment will allow use by the maximum number of users. While many questions about infrastructure design, compatibility and the appropriate model will be addressed in earlier phases, it is in Phase 4 that infrastructure must be rolled out in proportion to the deployment of new vehicles.

AGENCY AND PARTNER ROLES AND RESPONSIBILITIES FOR ACTION

In addition to the phases described above, significant regional actions will be needed in order to realize this vision of a zero- and near-zero emission freight transportation system that meets regional objectives for long-term sustainability and can also meet the performance objectives required by industry. SCAG may act together with key partner agencies such as the San Pedro Bay Ports, SCAQMD and the region's county transportation commissions to update and implement this plan as needed. Stakeholders must work together to share and evaluate new information as it becomes available. SCAG and other regional partners must continue to advocate for additional funding for technology development, demonstration and deployment efforts as well as regulatory and market structures to deploy these technologies. In the past, the LA Zero Emission Trucks Collaborative has successfully advocated for additional technology investment and has served as a body to support technology advancement in the region. At the time of writing, there are discussions to expand the membership of this group to include additional regional partners.

Where possible, SCAG and partners will also continue to incorporate opportunities to incentivize zero emission technology as goods movement projects are programmed. As more zero and near-zero emission vehicle technologies are developed, SCAG and partners will also engage where possible in the parallel effort of providing charging and fueling infrastructure.

Roles for SCAG and regional partners:

- Convene stakeholders to collaboratively determine regional priorities and support a regional vision
  - In the past, the LA Zero Emission Trucks Collaborative has represented a cooperative body to advocate for funding, support regional grant applications and share information. In the future, this group may be expanded to include regional representatives, in particular representatives of the Inland Empire and Port of Hueneme.
- Convene stakeholders to proactively address concerns with battery development and disposal
- Program sound projects that improve the efficiency of the goods movement system and therefore reduce emissions
- Coordinate with utility providers and regulators on transportation electrification planning
- Program projects that reduce neighborhood and community impacts.
- Engage with providers to incorporate fueling and charging infrastructure into regional projects
- Incorporate incentives into infrastructure planning
  - These incentives may include reduced tolls for zero emission vehicles, expedited access to freight facilities, preferred access for last mile delivery, dedicated lanes for advanced clean technology trucks, or low emission zones.
- Work with statewide agencies to advocate that batteries be designed for reuse, recycling and safe disposal and potentially advocate for producer mandates. Partners may include DTSC, CalRecycle and the

82 Ibid.

Product Stewardship Council

- Identify and secure funding to support technology evaluation and demonstration efforts, lead these projects and share the results with partner agencies and private sector partners.
- Support the development of policies and regulatory efforts that accelerate technology development and deployment
- Work with and engage regional businesses to best support them in this transition
  - Continue to engage and collaborate with the private sector to continuously solicit feedback on operational parameters and real world operating conditions.
  - Encourage private sector partners to participate in operational demonstrations. Partners are needed to evaluate the performance of technologies in a real world setting.
  - Support partnerships with OEMS for technology development and send a consistent signal to OEMs that there will be market demand for the new technologies they are investing in and creating.

Ongoing and Potential Study Areas for SCAG:

- A component of the forthcoming Integrated Passenger and Freight Rail Forecast will focus on emission reduction strategies for rail operations
- A forthcoming study funded by a Caltrans Sustainable Communities Grant will further study how communities are impacted by goods movement and will make recommendations at the community level for environmental mitigations.
- Continued study of Last Mile Delivery conditions and curbside access will consider recommendations for dense urban areas such as low-emission zones or cargo bikes.
  - A study will be conducted by SCAG to determine new locations for the installation of charging/fueling infrastructure, and make recommendations on locations for large scale deployment pilot projects. Site screening criteria would be developed and applied to SCAGs existing knowledge of goods movement activity in the region.

Regional partners already have several ongoing and updated efforts to address the transition to a zero emission goods movement system. The San Pedro Bay Ports have updated their CAAPs, including aggressive equipment goals, and funding towards their TAP. They are also partners on several grants to deploy and test new technology. Both the SCAQMD and the CARB are working on regulatory initiatives that will accelerate adoption of zero emission technologies, and simultaneously manage funding programs to provide incentives. LA Metro is actively investigating how to include opportunities for zero emissions technologies in highway projects, with an initial focus on the I-710 South. The San Bernardino County Transportation Authority (SBCTA) has convened a study to identify actions to be taken at the county level to further these objectives.

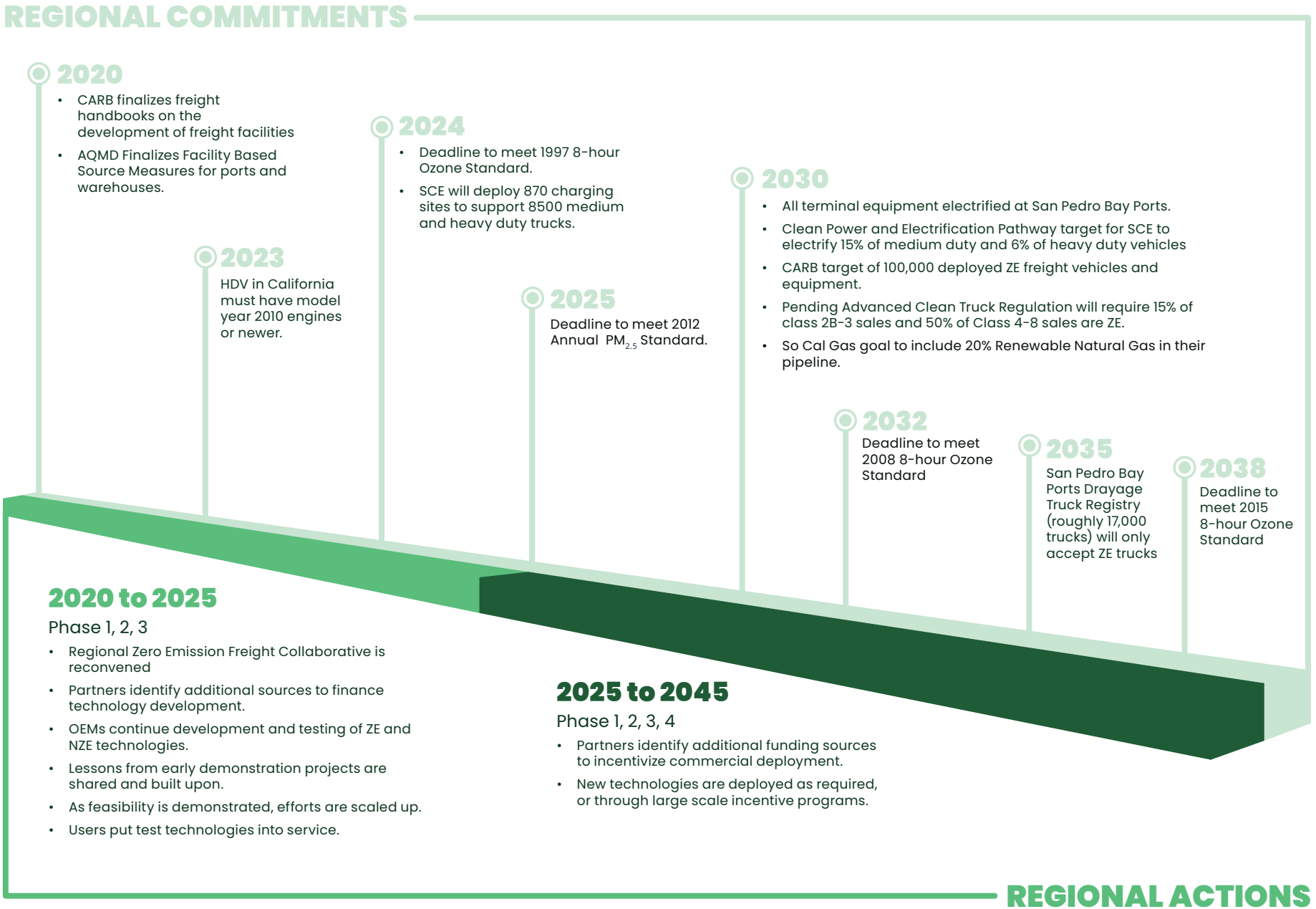
Private sector initiatives such as SCE's Charge Ready Program are also underway. Through this program, SCE plans to install infrastructure for at least 870 SCE customer sites by 2024. The program cost is estimated at $356 million and will expand charging for approximately 8,500 trucks, buses, forklifts and other industrial vehicles.[83]

REGIONAL COMMITMENTS AND TIMELINE

A review of previous automotive technologies done by the Victoria Transport Policy Institute[84] concludes that of the technologies reviewed, they often require 20-50 years from commercial availability to full market saturation, and without government mandates the length of time is longer. For instance, hybrid passenger vehicles, became commercially available in 1997 and over 20 years later, are estimated to currently be about 4 percent of the market. If these lessons could be carried over to the market for zero emission heavy duty vehicles, this suggests that full market saturation is still several decades away. First the products must advance to commercial viability, then vehicle fleets must turn over quicker than they ordinarily would. The expected term of use for a heavy duty truck is 18 years.[85]

83 Southern California Edison. (November, 2017) The Clean Power and Electrification Pathway
84 Litman, Todd. Victoria Transport Policy Institute. (September 2016). Autonomous Vehicle Implementation Predictions
85 Southern California Edison. (November, 2017) The Clean Power and Electrification Pathway

FIGURE 27 Timeline and Action Steps Towards Clean Technology Deployment



Source: SCAG

The timeline highlights the many goals for incorporating ZE Technology into the regional fleet and the commitments and roles of regional partners. Included are both required targets and voluntary commitments. The timeline also includes necessary regional action steps and shows that Phases 1, 2 and 3 are already underway in the region.

The timeframes suggested in this plan are broad and will likely capture a majority of technologies that can serve the region's needs. However, as innovation is continuous, these time frames may not catch all technologies, and the development of particular technologies may either exceed or lag behind proposed time frames. As the four phases described above allow for continuous innovation in new and improved products, we assume that project scoping and early phases of the development/deployment cycle will continue to occur as new products and technologies are considered. The ability to create partnerships and procure funding for research and development efforts will also influence the timeline for technology development. This plan of technology development, evaluation and eventual deployment will be undertaken in close cooperation with regional partners and industry stakeholders.

NEAR-TERM AND LONG-TERM TECHNOLOGIES FOR COMMERCIAL DEPLOYMENT

Connect SoCal recommends a two-pronged environmental strategy to be implemented in the four phases outlined in the previous section. SCAG recognizes that not all technologies have advanced to the stage where they can be implemented immediately. As the region works to advance and deploy current prototype technologies (i.e., those that are currently in Phase 2), focus should be placed on commercializing and implementing existing solutions as well (i.e., implementing those that are currently in Phases 3 & 4, or beyond).

Several, zero emission, near-zero emission clean-fuel trucks and hybrid trucks are currently available depending on the application and are currently incentivized through the California Hybrid and Zero emission Truck and bus Voucher Incentive Project (HVIP). To date this program has helped deploy over 4,000 medium to heavy duty vehicles, including buses, equipment and trucks, at a price tag of roughly $123 million.[86] The commercial availability of zero tail pipe emission vehicles varies depending on the vehicle class and use and additional work is still needed to advance many of these vehicles to full commercialization. In the short term, many small modifications exist where the conventional diesel trucks, as well as near-zero emission natural gas and propane trucks, can be made more efficient, but these modifications have not been fully implemented.

For rail, near -term technologies for switcher locomotives can reduce emissions at railyards. With cleaner Tier 4 locomotive engines currently available, accelerated replacements of locomotives with Tier 4 engines are also needed to reduce emissions. A longer-term objective of a zero emission rail system, or the ability to operate in zero emissions mode while in the region, can be reached through further technology development.

Additional detail about technologies that may assist in realizing the vision of a zero and near-zero emissions goods movement system are discussed as an appendix to this report.

IMPLEMENTING THE ENVIRONMENTAL STRATEGY

Broad deployment of zero- and near-zero emission transportation technologies is a significant undertaking with technological, cost and operational challenges. Connect SoCal describes a process to develop and deploy needed technologies, along with needed regional actions to accomplish that objective. Private sector participation will also be necessary including commercial technology developers/manufacturers, industry users who will test and eventually deploy new technologies, and infrastructure providers who will develop and deploy the needed infrastructure to generate, transport and convey power to new vehicles.

The functionality of zero and near-zero emission technologies has advanced since the last RTP with several prototypes available. Work is still needed to produce these vehicles at scale, and bring the costs down so that they are commercially viable. Critically, new infrastructure must be planned and built

86 CARB and CALSTART (n.d.). Hybrid and Zero emission Truck and Bus Voucher Incentive Project (HVIP) Program numbers

to support the energy and fueling needs of these technologies. Substantial investment will be needed to accelerate the deployment of clean technologies, and significant expenditure has already been made. Additionally, the project list includes over $3 billion for zero emission initiatives. In the near term, $100 million dollars are allocated to Terminal Island Container Transfer Facility Modernization at the Port of Los Angeles, which includes truck efficiency improvements and electrification of cargo handling equipment. While this plan focuses on getting cleaner vehicles on the road as soon as possible, this must be done will full life cycle consideration of production, use and disposal impacts. This plan reaffirms zero- and near-zero emission technologies as a priority, describes progress to date, and outlines a framework and key action steps to reach that goal.

GOODS MOVEMENT PROJECT LIST

TABLE 9 Goods Movement Project List

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
A. ROADWAY ACCESS TO MAJOR GOODS MOVEMENT FACILITIES				
A.1	LOS ANGELES	THE PROJECT WILL EXTEND THE HOV LANES ON I-5 FROM THE SR-14 INTERCHANGE TO JUST SOUTH OF THE PARKER ROAD INTERCHANGE, INCORPORATING AN ADDITIONAL NORTHBOUND TRUCK CLIMBING LANE FROM SR-14 TO CALGROVE BOULEVARD AND AN ADDITIONAL SOUTHBOUND TRUCK CLIMBING LANE FROM PICO CANYON ROAD/LYONS AVENUE TO SR-14.	$679,630	S
A.2	LOS ANGELES	SR-47 EXPRESSWAY: CONSTRUCT 4 LANE EXPRESSWAY AND 2-LANE FLYOVER TO SCHUYLER HEIM BRIDGE	$420,000	M
A.3	LOS ANGELES	BRIDGE NO. 53C0065, OCEAN BLVD, OVER ENTRANCE CHANNEL, UPRR, 1.0 MI E STATE ROUTE 47. REPLACE EXISTING 5 LANE GERALD DESMOND BRIDGE (GDB) WITH NEW 6 LANE BRIDGE.	$1,491,981	S
A.4	LOS ANGELES	COMMERCE GOODS MOVEMENT ATLANTIC BOULEVARD: WASHINGTON BOULEVARD TO COMO STREET : 1) IMPLEMENTS SOUTHBOUND RIGHT-TURN OVERLAP SIGNAL PHASING FROM ATLANTIC BL ONTO WASHINGTON BL TO IMPROVE MOBILITY FOR TRUCKS AND VEHICLES. 2) STREETSCAPE IMPROVEMINTS, SUCH AS RAISED MEDIANS, CROSSING IMPROVEMENTS, AND 3) SIDEWALK IMPROVEMENTS TO IMPROVE PEDESTRIAN SAFETY AND REDUCE PEDESTRIAN/ VEHICLE CONFLICT INCLUDE RAISED MEDIANS, HAWK INSTALLATION AT UNCONTROLLED CROSSWALKS, MISC SIDEWALK AND ADA IMPROVEMENTS A LITTLE OVER A 1/2 MILE STRETCH.	$1,172	S

TABLE 9 Goods Movement Project List - Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
A.5	LOS ANGELES	WB SR-60/SB SR-57 GRAND AVENUE OFF RAMP INTERCHANGE : ADD WB SR-60 AUXILIARY LANE FROM SB SR-57 TO GRAND AVENUE OFF-RAMP TO IMPROVE TRUCK MOBILITY AND REDUCE CONGESTION.	$21,303	S
	LOS ANGELES	ROUTE 57/60 CONFLUENCE CHOKEPOINT RELIEF PROGRAM. RECONSTRUCT GRAND AVENUE OVERCROSSING. RECONSTRUCT NORTHBOUND SR-57 CONNECTOR TO EASTBOUND SR-60. CONSTRUCT EASTBOUND SR-60 BYPASS OFF-RAMP TO GRAND AVENUE. CONSTRUCT SOUTHBOUND GRAND AVENUE LOOP ENTRANCE RAMP TO EASTBOUND SR-60. CONSTRUCT GRAND AVENUE TO EASTBOUND SR-60 ENTRANCE RAMP. RECONSTRUCT THE DIAMOND BAR GOLF COURSE TUNNEL AND GOLF COURSE. RECONSTRUCT DIAMOND BAR BOULEVARD ENTRANCE RAMP TO EASTBOUND SR-60.	$420,000	S
	LOS ANGELES	SR-57/SR-60 INTERCHANGE IMPROVEMENT	$300,000	M
A.6	LOS ANGELES	SR 47/NAVY WAY INTERCHANGE: CONSTRUCTION OF INTERCHANGE AT SR-47 / NAVY WAY TO ELIMINATE TRAFFIC SIGNAL AND MOVEMENT CONFLICTS; THIS PROJECT WAS A S.CA TRADE CORRIDOR TIER II TCIF PROJECT AS SUBMITTED TO THE CTC IN 2008; PROJECT REMOVES LAST SIGNAL ON SR 47 BETWEEN DESMOND AND V. THOMAS BRIDGES, NHS INTERMODEL CONNECTOR ROUTE.	$50,000	S
A.7	LOS ANGELES	SR 47-V. THOMAS BRIDGE/FRONT ST INTERCHANGE: NEW WESTBOUND SR-47 ON- AND OFF-RAMPS AT FRONT STREET JUST WEST OF THE VINCENT THOMAS BRIDGE AND ELIMINATE THE EXISTING NON-STANDARD RAMP CONNECTION TO THE HARBOR BOULEVARD OFF-RAMP; FRONT STREET IS AN NHS CONNECTOR. THE PROJECT ALSO INCLUDES REALIGNED EASTBOUND AND WESTBOUND SR47 ON-RAMPS.	$46,020	S
A.8	LOS ANGELES	ALAMEDA STREET DOWNTOWN LA: GOODS MOVEMENT, PHASE I. THIS PROJECT WILL PROVIDE CONGESTION RELIEF, IMPROVE MOBILITY/REDUCE CONFLICTS, AND IMPROVE SAFETY FOR BOTH AUTOS AND TRUCKS BY PROVIDING INTERSECTION IMPROVEMENTS. PROJECT WILL ALSO REMOVE ABANDONED RAIL LINES, REPAIR PAVEMENT, ADD NEW STREET LIGHTING, AND CONSTRUCT PEDESTRIAN IMRPOVEMENTS.	$7,132	S
A.9	LOS ANGELES	ALAMEDA STREET WIDENING FROM ANAHEIM STREET TO 300 FT. SOUTH OF PCH : (1) WIDENS ALAMEDA ST BETWEEN ANAHEIM ST AND 300 FT SOUTH OF PACIFIC COAST HIGHWAY FROM 2 TO 3 LANES IN EACH DIRECTION FOR CONGESTION RELIEF AND IMPROVE GOODS MOVEMENT MOBILITY.	$9,708	S

TABLE 9 Goods Movement Project List - Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
A.10	LOS ANGELES	ANAHEIM STREET WIDENING - FARRAGUT AVENUE TO DOMINGUEZ CHANNEL: WIDEN ANAHEIM ST BETWEEN FARRAGUT AV AND DOMINGUEZ CHANNEL FROM 2 TO 3 LANES IN EACH DIRECTION FOR CONGESTION RELIEF AND IMPROVE GOODS MOVEMENT MOBILITY. THIS UPGRADES THE ARTERIAL TO MAJOR HIGHWAY STANDARDS.	$6,566	S
A.11	LOS ANGELES	HARBOR BLVD IMPROVEMENTS - AS PART OF THE SAN PEDRO WATERFRONT DEVELOPMENT PROJECT, HARBOR BLVD WILL BE RESTRIPED, AND THE MEDIAN IS REMOVED/RECONSTRUCTED AS NEEDED TO PROVIDE THREE NBT AND SBT LANES BETWEEN THE RECONSTRUCTED SAMPSON WAY/HARBOR BLVD. INTERSECTION AND THE WB ON RAMP/FRONT STREET INTERSECTION. THIS WILL RESULT IN THE REMOVAL OF PARKING AND THE BIKE LANE ON THE NORTHBOUND SIDE. THE PARKING AND 5' BIKE LANE ON THE SOUTHBOUND SIDE, SOUTH OF O'FARRELL STREET WILL BE PRESERVED. NORTH OF O'FARRELL STREET, THE PARKING AND THE PARKING LANE ON THE SOUTHBOUND SIDE WOULD NEED TO BE REMOVED TO ACCOMMODATE THE NORTHBOUND DUAL LEFT-TURN LANE.	$5,000	M
A.12	LOS ANGELES	REALIGN AND EXPAND HARBOR BLVD. (FORMERLY KNOWN AS SAMPSON WAY) STARTING AT THE NEW INTERSECTION AT MINER ST. AND ENDING AT THE SP SLIP. THIS PROJECT WILL IMPROVE BULIC ACCESS THROUGHOUT THE WATERFRONT AREA TO BETTER CONNECT THE WATERFRONT WITH DOWNTOWN SAN PEDRO AND THE SURROUNDING COMMUNITY. THE RECONFIGURED HARBOR BLVD. WILL INCLUDE TWO TRAVEL LANES IN EACH DIRECTION FROM THE NEW HARBOR BLVD. INTERSECTION AT MINER STREET TO THE SP SLIP. WORK ALSO INCLUDES UTILITIES, STREET WORK, GRADING, PAVING, STRIPING, LIGHTING, STREET TREES, LANDSCAPING, AND OTHER STREET IMPROVEMENTS.	$30,000	S
A.13	LOS ANGELES	ALAMEDA CORRIDOR SOUTH TERMINUS/HENRY FORD AVE. RAIL CROSSING ADVANCED WARNING SYSTEM.	$15,000	S
A.14	LOS ANGELES	TERMINAL ACCESS IMPROVEMENT ON HARBOR SCENIC DRIVE, CONNECTING I-710 AND INTERMODAL CONTAINER FACILITIES: (1) ROADWAY IMPROVEMENTS AND REHABILITATION FROM HARBOR PLAZA TO GRADE SEPARATION TO THE SOUTH, (2) CHANGEABLE MESSAGE SIGN INSTALLATION.	$23,700	S
A.15	LOS ANGELES	FREIGHT CORRIDOR ENHANCEMENT PROJECT ALONG PIER B STREET, WHICH INVOLVES (1) REALIGNS PIER B ST. BETWEEN PICO AV. AND ANAHEIM ST. AND WIDENS TO 2 LANES IN EACH DIRECTION TO IMPROVE GOODS MOVEMENT MOBILITY; (2) REALIGNS PICO AVE TO THE WEST FROM PIER B ST/I-710 RAMPS TO PIER D ST.; (3) CONSTRUCTS NEW SIDEWALK ON THE SOUTH SIDE OF PIER B ST. AND ALONG THE WEST SIDE OF PICO AVE. FOR PEDESTRIAN SAFETY; AND (4) CLOSES THE AT-GRADE RAILROAD CROSSING AT 9TH STREET FOR RAIL EFFICIENCY	$150,000	S

TABLE 9 Goods Movement Project List - Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
A.16	LOS ANGELES	PIER D STREET REALIGNMENT PROJECT. ACCESS IMPROVEMENT PROJECT TO REALIGN PIER D STREET FOR SAFETY, CONGESTION REDUCTION, AND EFFICIENT CARGO MOVEMENT.	$32,000	S
A.17	LOS ANGELES	ENHANCE GOODS MOVEMENT BY INCREASING TURNING RADII, UPGRADING SIGNALS, ADDING LIGHTING & SIGNAGE, REMOVING OLD RAILROAD TRACKS, IMPROVING STORM DRAINS, & ELIMINATING HAZARDS.	$12,027	S
A.18	LOS ANGELES	TERMINAL ACCESS PROJECT ON PICO AVE SERVING MIDDLE HARBOR (FULLY MODERNIZED AND NATION'S GREENEST TERMINAL). WIDENS AND REBUILDS PICO AVE. FROM PIER D AVE. TO PIER E ST. PREPARE PS&E. WORK INCLUDES WIDENING, REPLACE EXISTING PAVEMENT POLB LEAD SIGNING/STRIPING ON AN NHS INTERMODAL CONNECTOR ROUTE.	$5,900	S
A.19	LOS ANGELES	TERMINAL ACCESS PROJECT ON PICO AVE SERVING MIDDLE HARBOR (FULLY MODERNIZED AND NATION'S GREENEST TERMINAL). WIDENS AND REBUILDS PICO AVE. FROM PIER D AVE. TO PIER E ST. PREPARE PS&E. WORK INCLUDES WIDENING, REPLACE EXISTING PAVEMENT POLB LEAD SIGNING/STRIPING ON AN NHS INTERMODAL CONNECTOR ROUTE.	$23,742	S
A.20	LOS ANGELES	TERMINAL ACCESS IMPROVEMENT PROJECT ON PIER G AVE., A HEAVILY UTILIZED ROUTE AND QUEUING LANE. INCLUDES ROADWAY IMPROVEMENTS AND UTILITY ENHANCEMENTS FOR WATER, STORMWATER, SEWER, AND STREET PAVEMENT.	$15,000	S
A.21	LOS ANGELES	EVERPORT TERMINAL BERTH EFFICIENCY AND EMISSION REDUCTION PROJECT: THE PROJECT ENTAILS A NEW WHARF AT THE EVERPORT TERMINAL TO ACCOMMODATE LARGER VESSELS AND MORE/LARGER ELECTRIFIED GRANTRY CRANES.	$65,164	S
A.22	LOS ANGELES	ZERO EMISSION (ZE)/TRUCK TRIP REDUCTION/FREIGHT EFFICIENCY PROGRAM: PIER 400 SECOND LEAD TRACK	$15,000	M
A.23	LOS ANGELES	SR-60/7TH AVENUE INTERCHANGE IMPROVEMENT PROJECT.	$23,075	S

TABLE 9 Goods Movement Project List - Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
A.24	LOS ANGELES	SR-91 ADD AUXILIARY LANE BETWEEN GORE POINTS, WESTBOUND FROM ACACIA AVENUE TO CENTRAL AVENUE	$90,000	S
A.25	LOS ANGELES	SB I-605 LOOP ON AND OFF RAMP REMOVAL AND RECONFIGURATION OF THE EXISTING INTERCHANGE AT BEVERLY BLVD. THE SOUTHBOUND I-605 COLLECTOR-DISTRIBUTOR ROAD WILL BE REMOVED FROM THE MAINLINE AND THE NEW RAMPS WILL MERGE/DIVERGE DIRECTLY FROM THE MAINLINE.	$25,607	S
A.26	LOS ANGELES	SR I-605 AT SOUTH STREET IMPROVEMENTS PROJECT; PROPOSED IMPROVEMENTS ON THE I-605 CONNECTOR SOUTH ST. OFF RAMP BY ADDING STORAGE CAPACITY.	$36,001	S
A.27	LOS ANGELES	EB SR-91 ATLANTIC AVE TO CHERRY AVE. ADD ONE EASTBOUND AUXILIARY LANE FROM I-710 RAMPS AT ATLANTIC AVENUE TO PAST CHERRY AVENUE UNDERCROSSING.	$90,000	S
A.28	LOS ANGELES	SR-91 CENTRAL AVE INTERCHANGE IMPROVEMENTS. PROPOSED IMPROVEMENTS WOULD RECONFIGURE CENTRAL AVE. INTERCHANGE TO A MODIFIED DDI (DIVERGING DIAMOND INTERCHANGE)	$49,000	S
A.29	LOS ANGELES	SR-91 WILMINGTON AVE. INTERCHANGE; PROPOSED IMPROVEMENTS WOULD RECONFIGURE WILMINGTON AVE. INTERCHANGE TO A MODIFIED DDI (DIVERGING DIAMOND INTERCHANGE)	$49,000	S
A.30	LOS ANGELES	I-605 VALLEY BLVD INTERCHANGE IMPROVEMENTS: THE PROJECT INVOLVES THE RECONFIGURATION OF SB I-605 RAMP BY REMOVING THE HORSESHOE ON-RAMP AND ADDING TWO LANES TO THE ON-RAMP. THE PROJECT WILL ALSO RECONSTRUCT THE SB I-605 LOOP OFF AND ON-RAMPS. LASTLY, THE PROJECT WILL ADD A WB THROUGH LANE ON VALLEY BLVD WEST OF TEMPLE AVE AND ADD A TWO LANE LEFT TURN POCKET FOR SB I-605 ON-RAMP ON WB VALLEY BLVD.	$21,000	S
A.31	LOS ANGELES	IMPROVEMENTS TO I-605, I-105 AND I-5 WHICH MAY INCLUDE ONE ADDITIONAL GENERAL PURPOSE, EXPRESS LANE, OR HOV LANE IN EACH DIRECTION. IMPROVEMENTS WILL BE INCORPORATED AT THE MAINLINE, RAMPS, FREEWAY-TO-FREEWAY AND LOCAL INTERCHANGES, AND ADDITION OF AUXILIARY LANES FOR EACH OF THE CORRIDORS.	$2,200,000	M

TABLE 9 Goods Movement Project List - Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
A.32	LOS ANGELES	IMPROVEMENTS TO I-605 AND SR-60 WHICH MAY INCLUDE ONE ADDITIONAL GENERAL PURPOSE, EXPRESS LANE, OR HOV LANE IN EACH DIRECTION. IMPROVEMENTS WILL BE INCORPORATED AT THE MAINLINE, RAMPS, FREEWAY-TO-FREEWAY AND LOCAL INTERCHANGES, AND ADDITION OF AUXILIARY LANES FOR EACH OF THE CORRIDORS.	$2,200,000	M
A.33	LOS ANGELES	IMPROVEMENTS TO THE WESTBOUND SR-91 IMPROVEMENTS PROJECT CONSIST OF ADDING AN ADDITIONAL GENERAL PURPOSE LANE, ADDING AUXILIARY LANES, AND ON/OFF RAMP IMPROVEMENTS.	$187,800	S
A.34	LOS ANGELES	ADD AUXILIARY LANES ALONG I-405 NORTHBOUND AND SOUTHBOUND BETWEEN ARTESIA BLVD AND EL SEGUNDO TO ALLEVIATE CONGESTION AND IMPROVE OPERATIONS.	$108,000	S
A.35	LOS ANGELES	I-710 IMPROVEMENTS/SHOEMAKER BRIDGE REPLACEMENT: REPLACE THE EXISTING SHOEMAKER BRIDGE WITH A NEW BRIDGE. THE NEW BRIDGE WILL BE REDUCED TO HAVE TWO MIXED-FLOW LANES IN THE NB AND IN THE SB DIRECTIONS TO TIE THE FLOW INTO I-710. THE NEW BRIDGE WILL ALSO INCLUDE PEDESTRIAN AND BICYCLE ACCESS. ADDITIONALLY, BICYCLE, PEDESTRIAN, AND STREET ENHANCEMENTS WILL BE PROVIDED ON ADJACENT THOROUGHFARES.	$302,336	S
A.36	LOS ANGELES	NORTHWEST 138 CORRIDOR IMPROVEMENT PROJECT – APPROXIMATELY 36 MILES, PROVIDING AN IMPROVED 4 TO 6-LANE FACILITY FROM I-5 TO SR-14.	$600,000	M
A.37	LOS ANGELES	I-5 NORTH CAPACITY ENHANCEMENT (TRUCK ONLY)	$373,100	L
A.38	LOS ANGELES	PREPARE CALTRANS PROJECT STUDY REPORT (PSR), PROJECT REPORT (PR), PRELIMINARY PLANS AND ENVIRONMENTAL DOCUMENTATION (ED) REPORTS TO OBTAIN CALTRANS APPROVAL AND ENVIRONMENTAL CLEARANCE; DESIGN (PLANS, SPECIFICATION AND ESTIMATE) AND CONSTRUCTION FOR THE SR 47/VINCENT THOMAS BRIDGE AND FRONT STREET/HARBOR BOULEVARD INTERCHANGE RECONFIGURATION PROJECT.	$28,107	S

TABLE 9 Goods Movement Project List - Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
A.39	LOS ANGELES	ROUTE 71: ROUTE 10 TO 0.14 MILE SOUTH SAN BERNARDINO COUNTY LINE - EXPRESSWAY TO FREEWAY CONVERSION - ADD 1 HOV LANE AND 1 MIXED FLOW LANE (2001 CFP 8349, TCRP #50) (EA# 210600, PPNO 2741) (TCRP #50)	$305,800	S
A.40	LOS ANGELES	CALL FOR PROJECTS GOODS MOVEMENT MODE	$765,026	M
A.41	ORANGE	SR-57 TRUCK CLIMBING AUX LANE FROM LAMBERT TO LA COUNTY LINE (PPNO 3847A))	$124,600	M
A.42	ORANGE	ADD 1 HOV LANE EACH DIRECTION (I-5 FROM SR-57 TO SR-91)	$305,924	L
A.43	ORANGE	I-405 FROM SR-73 TO I-605 ADD 1 MF LANE IN EACH DIRECTION, AND ADDITIONAL CAPITAL IMPROVEMENTS (BY 2022), CONVERT EXISTING HOV TO HOT. ADD 1 ADDITIONAL HOT LANE EACH DIRECTION.	$1,900,000	M
A.44	ORANGE	I-5 (I-405 TO SR-55) - IN THE CITIES OF IRVINE AND TUSTIN. ADD 1 MF LANE NB FROM TRUCK BYPASS ON RAMP TO SR-55, ADD 1 MF LANE SB FROM SR-55 TO ALTON AND 1 AUX LANE FROM ALTON TO TRUCK BYPASS. (PA&ED AND PS&E PHASE) PROJECT WILL UTILIZE TOLL CREDIT MATCH.	$457,000	M
A.45	ORANGE	SR-91 ADD 1 MF LANE EB FROM 55 TO 57, AND 1 MF LANE WB FROM KRAEMER TO STATE COLLEGE; IMPROVE INTERCHANGES; AND MERGE FROM LAKEVIEW TO RAYMOND	$456,190	M
A.46	ORANGE	SR-91 ADD 1 LANE EACH DIRECTION FROM SR 241 TO COUNTY LINE, AND OTHER OPERATIONAL IMPROVEMENTS. SEE RIVERSIDE COUNTY FOR ADDITIONAL DETAILS. (LINKED WITH RIV071250B)	$292,530	L

TABLE 9 Goods Movement Project List - Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
A.47	ORANGE	SR-57 - ADD 1 MF LANE NB BETWEEN ORANGEWOOD AND KATELLA	$47,690	M
A.48	ORANGE	ADD 1 MF LANE EACH DIRECTION FROM I-5 TO SR-55 AND ADD SB AUX LANES FROM SR-133 TO IRV CTR DR	$323,600	M
A.49	ORANGE	SR-55 WIDENING BETWEEN I-405 AND I-5 - ADD 1 MF AND 1 HOV LANE EACH DIRECTION AND FIX CHOKEPOINTS FROM I-405 TO I-5; ADD 1 AUX LANE EA DIR BTWN SELECT ON/OFF RAMP AND NON-CAPACITY OPERATIONAL IMPROVEMENTS THROUGH PROJECT LIMITS	$410,932	S
A.50	ORANGE	SR-74 ORTEGA HIGHWAY – IN SAN JUAN CAPISTRANO FROM CALLE ENTRADERO TO CITY/COUNTY LINE – WIDEN FROM 2 TO 4 LANES	$77,120	M
A.51	RIVERSIDE	ON I-10 NEAR BEAUMONT: ADD/CONSTRUCT NEW EASTBOUND TRUCK CLIMBING LANE FROM SAN BERNARDINO COUNTY LINE TO 1-10/SR60 JCT (EA: 35300)	$35,709	M
A.52	RIVERSIDE	I-10 CONSTRUCT NEW INTERCHANGE	$282,443	M
A.53	RIVERSIDE	CONSTRUCT NEW IC AND RAMPS AND WIDEN OC FROM 2 TO 6 LANES	$67,863	L
A.54	RIVERSIDE	CONSTRUCT NEW IC AND RAMPS AND WIDEN OC FROM 2 TO 6 LANES	$68,423	L

TABLE 9 Goods Movement Project List - Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
A.55	RIVERSIDE	IN WESTERN RIVERSIDE COUNTY ON SR-91/I-15: ON I-15 - ADD TOLL EXPRESS LANE MEDIAN DIRECT CONNECT FROM SB15 TO WB 91 & EB 91 TO NB 15, 1 TOLL EXPRESS LANE EACH DIRECTION FROM HIDDEN VALLEY TO SR-91 DIRECT CONNECTOR. CONSTRUCT OPERATIONAL IMPROVEMENT AND AUXILIARY LANE ALONG SR-91. CONSTRUCT ADDITIONAL SIGNAGE ALONG SR-91 AT PM R18.0 IN OR COUNTY.	$180,000	S
A.56	RIVERSIDE	AT SR86S/AVENUE 52: WIDEN AND CONSTRUCT NEW 6 THROUGH LANE IC FROM E/O COACHELLA STORMWATER CHANNEL BRIDGE TO E/O TYLER ST. IMPROVEMENTS INCLUDE: REALIGN POLK ST AND RELOCATE AVE 52 AND POLK ST INTERSECTION, EXTENDED RAMP ACCELERATION/DECELERATION LANES, BIKE LANES, SIDEWALKS, AND RECONSTRUCT TRAFFIC SIGNALS (EA: OC960).	$33,000	S
A.57	RIVERSIDE	AT SR86S/AVENUE 50: WIDEN AND CONSTRUCT NEW 6 THROUGH LANE IC FROM E/O COACHELLA STORMWATER CHANNEL BRIDGE TO E/O TYLER ST. IMPROVEMENTS INCLUDE: EXTENDED RAMP ACCELERATION/DECELERATION LANES, RELOCATE/REALIGN AVE 50 AND TYLER ST, BIKE LANES, SIDEWALKS, SIDEWALKS, AND RECONSTRUCT TRAFFIC SIGNALS (SAFETEA LU 1702, CA583, #2543)(EA:OC970)	$32,160	S
A.58	RIVERSIDE	IN WESTERN RIVERSIDE COUNTY IN THE CITY OF MORENO VALLEY ALONG SR 60 - WIDEN FROM TWO TO THREE LANES IN EACH DIRECTION IN THE EXISTING MEDIAN TO PROVIDE ONE ADDITIONAL GENERAL PURPOSE LANE IN EACH DIRECTION FROM REDLANDS BLVD. TO GILMAN SPRINGS RD.	$7,500	S
A.59	RIVERSIDE	IN WESTERN RIVERSIDE COUNTY IN MARCH IPA AREA - CONSTRUCT NEW EXTENSION OF VAN BUREN BLVD FROM MARCH FIELD AIR MUSEUM TO NANDINA AVE WITH 4 LANE ARTERIAL WITH CENTER TURN MEDIAN.	$8,800	S
A.60	RIVERSIDE	CONSTRUCT 1 LN WESTBOUND FROM GREEN RIVER ROAD TO SR-241	$50,000	S
A.61	RIVERSIDE	CONSTRUCT 4 LANE BRIDGE/INTERCHANGE AND RAMPS ACROSS SR-86S	$92,843	L

TABLE 9 Goods Movement Project List - Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
A.62	RIVERSIDE	RECONSTRUCT/WIDEN IC FROM 2 TO 4 LANES AND RECONSTRUCT/WIDEN RAMPS	$26,851	M
A.63	RIVERSIDE	AT SR91/71 JCT: REPLACE EB 91 TO NB 71 CONNECTOR W/DIRECT CONNECTOR AND RECONSTRUCT THE GREEN RIVER ROAD EB ON-RAMP (EA: 0F541) ($1,501/$639/$200 TOLL CREDITS WILL BE USED IN PS&E TO MATCH DEMO-SAFETEALU/DEMO-TEA21/STP, RESPECTIVELY. $159 TOLL CREDITS WILL BE USED IN R/W TO MATCH DEMO-SAFETEALU)	$127,000	S
A.64	RIVERSIDE	ON SR-60 IN UNINCORPORATED RIVERSIDE CO: CONSTRUCT NEW EASTBOUND CLIMBING AND WESTBOUND DESCENDING TRUCK LANES FROM GILMAN SPRINGS RD TO APPROX. 1.37 MILES W/O JACK RABBIT TRAIL AND UPGRADE EXISTING INSIDE AND OUTSIDE SHOULDERS TO STANDARD WIDTHS (10-FT INSIDE SHOULDER AND 12-FT OUTSIDE SHOULDER) (EA: 0N69U) - CMAQ PM2.5 BENEFITS PROJECT.	$138,375	S
A.65	SAN BERNARDINO	I-10 AT CEDAR AVE. BETWEEN SLOVER AND BLOOMINGTON- FROM BLOOMINGTON TO ORANGE, RECONSTRUCT I/C WIDEN FROM 4-6 LANES WITH LEFT AND RIGHT TURN LANES. ADD 1 LANE TO THE EB OFF RAMP WHICH GOES BEYOND THE GORE AREA; ADD 2 LANES ON THE WB OFF RAMP WITHIN THE GORE AREA; PAVEMENT REHAB FROM ORANGE TO SLOVER (REMAINS 4 LANES).	$79,209	S
A.66	SAN BERNARDINO	SR-210 LANE ADDITION - ADD 1 MIXED FLOW LANE IN EACH DIRECTION FROM HIGHLAND AVE(S/B). TO LUGONIA (REDLANDS) INCLUDES AUX. LANES BETWEEN BASE LINE AND 5TH STS AND AN ACCELERATION LANE AT 5TH ST. E/B ON RAMP AND DECELRATION LANE AT HIGHLAND AVE E/B OFF RAMP EXTENDING TO STERLING AVENUE, AND INCLUDES ROAD REHAB. (UNDER 1/4 MILES LENGTH)	$187,050	S
A.67	SAN BERNARDINO	I-10 AT GROVE AVE AND 4TH ST: CONSTRUCT NEW INTERCHANGE AT I-10 AND GROVE AVE; CLOSE EXISTING I-10/FOURTH ST INTERCHANGE; AND LOCAL STREET IMPROVEMENTS ALONG GROVE AVE (CHILD PROJECT IS 20171102).	$199,423	M
A.68	SAN BERNARDINO	SR-60 AT ARCHIBALD AVENUE; WIDEN WB AND EB ENTRY RAMPS (ADD 1 LANE), WIDEN WB AND EB EXIT RAMPS (ADD LEFT TURN LANE), ADD ADDITIONAL LEFT TURN LANE FROM ARCHIBALD AVE TO SR-60 ENTRY RAMPS. (NON-CAPACITY ENHANCING ALONG ARCHIBALD).	$14,563	S
A.69	SAN BERNARDINO	I-10 @ MT VERNON INTERCHANGE IMPROVEMENTS	$38,500	M

TABLE 9 Goods Movement Project List - Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
A.70	SAN BERNARDINO	COLTON: MT. VERNON AVE BRIDGE WIDENING OVER 1-10: WIDEN MT. VERNON BRIDGE STRUCTURE (3-4 LANES; 1 NEW SB LANE) TO ACCOMMODATE NEW DEDICATED TURN AND BIKE LANES, WIDEN MT. VERNON AVE (2-4 LANES) FROM I-10 EB OFF/ON-RAMPS TO APPROX. 300 FT SOUTH ALONG MT. VERNON; REALIGN MT. VERNON & E VALLEY BLVD INTERSECTION; RELOCATE WB ON-RAMP (REMAINS 1 LANE AT THE MAINLINE).	$53,869	S
A.71	SAN BERNARDINO	I-10/MOUNTAIN VIEW AVE INTERCHANGE IMPROVEMENTS	$37,800	L
A.72	SAN BERNARDINO	I-10 @ CALIFORNIA ST INTERCHANGE IMPROVEMENTS	$58,500	L
A.73	SAN BERNARDINO	I-10 EB TRUCK CLIMBING LANE: CONTINUE THE EXISTING EASTBOUND TRUCK CLIMBING LANE ON I-10 FROM THE 16TH ST BRIDGE IN THE CITY OF YUCAIPA FOR ABOUT 3 MILES TO JUST EAST OF THE COUNTY LINE ROAD UNDERCROSSING. THE PROJECT INCLUDES A TRANSITION LANE TO ALLOW TRUCKS TO MERGE WITH GENERAL TRAFFIC AND MAY INCLUDE MINOR STRUCTURAL IMPROVEMENTS TO ACCOMMODATE FOR LANE WIDENING (PPNO 3009Q)	$34,596	S
A.74	SAN BERNARDINO	US-395 (HESPERIA, VICTORVILLE, & ADELANTO) FROM CHAMBERLAINE WAY TO 1.8 MI S/O DESERT FLOWER ROAD -INTERIM WIDENING-WIDEN FROM 2-4 LANES AND ADD LEFT TURN CHANNELIZATION AT INTERSECTIONS (EA 0F632 | PHASE II | SEQ 9)	$24,000	M
A.75	SAN BERNARDINO	US-395 (HESPERIA, VICTORVILLE, & ADELANTO) FROM 0.16 MI N/O INTERSTATE ROUTE 15 JUNCTION TO SR18 - INTERIM WIDENING - WIDEN FROM 2-4 LANES AND ADD LEFT TURN CHANNELIZATION AT INTERSECTIONS (EA 0F633)	$58,000	S
A.76	SAN BERNARDINO	US-395 (HESPERIA, VICTORVILLE, & ADELANTO) FROM SR18 TO CHAMBERLAINE WAY -INTERIM WIDENING-WIDEN FROM 2-4 LANES AND ADD LEFT TURN CHANNELIZATION AT INTERSECTIONS(EA OF631)	$55,054	S

TABLE 9 Goods Movement Project List - Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
A.77	SAN BERNARDINO	SR-210/5TH ST IC IMPROVEMENTS: WIDEN & RESTRIPE 5TH ST (4-6 LANES) FROM EAST EDGE OF CITY CREEK BRDG TO THE EB SR-210 RAMPS W/ADD'L TURN POCKETS PLUS 2 TRUCK ACCESS LANES; WIDEN & RESTRIPE 5TH ST (6-8 LANES) UNDER SR-210 B/W EB & WB RAMPS, INCL. ADD'L THRU & TURN LANES; WIDEN THE EB & WB ON-RAMPS 2-3 LANES, WIDEN THE EB & WB OFF-RAMPS 1-2 LANES, ALL RAMPS REMAIN 1 LN AT THE MAINLINE. (COMBINES PRIOR PROJS 2011153 & 2011154)	$9,661	S
A.78	SAN BERNARDINO	I-10 CORRIDOR EXPRESS LANE WIDENING (CONTRACT 1): FROM SAN ANTONIO AVE TO I-10/I-15 IC; IMPLEMENT 2 EXPRESS LNS IN EACH DIRECTION FOR A TOTAL OF 4 GENERAL PURPOSE AND 2 EXPRESS LNS IN EACH DIRECTION AND AUX LANE WIDENING, UNDERCROSSINGS, OVERCROSSINGS, AND RECONSTRUCTION OF RAMPS AND LANE TRANSITIONS WHERE NEEDED.	$690,623	S
A.79	SAN BERNARDINO	I-10 CORRIDOR EXPRESS LANE WIDENING (CONTRACT 2): IMPLEMENT 2 EXPRESS LANES IN EACH DIRECTION FROM I-10/I-15 INTERCHANGE TO CALIFORNIA ST; IMPLEMENT 1 EXPRESS LANE IN EACH DIRECTION FROM CALIFORNIA ST TO FORD STREET IN REDLANDS FOR A TOTAL OF 10-12 LANES, AND AUX LANES, UNDERCROSSINGS, OVERCROSSINGS, RAMP RECONSTRUCTION AND LANE TRANSITIONS WHERE NEEDED. (PPNO 0314K)	$1,214,607	S
A.80	SAN BERNARDINO	I-15 EXPRESS LANES: CONST 2 NEW EX LNS IN EACH DIRECTION B/W SR-60 & SR-210, CONST 1 EX LN IN EACH DIRECTION B/W CANTU-GALLEANO RANCH RD & SR-60 AND 1 EXP LN IN EACH DIRECTION B/W SR-210 AND DUNCAN CANYON RD. ADDITIONAL IMPROVEMENTS TO AUX LN WIDENING, UNDERCROSSINGS, AND RECONSTRUCTION OF RAMPS AND LANE TRANSITIONS WHERE NEEDED.	$476,590	S
A.81	SAN BERNARDINO	I-215 @ PALM AVE INTERCHANGE IMPROVEMENTS	$17,878	L
A.82	SAN BERNARDINO	I-215 @ CAMPUS PKWY NEW INTERCHANGE	$60,000	L
A.83	SAN BERNARDINO	SR-60 @ CENTRAL AVE - ULTIMATE INTERCHANGE IMPROVEMENTS - POSSIBLE RAMP WIDENING AND AUXILIARY LANES	$24,000	L

TABLE 9 Goods Movement Project List - Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
A.84	SAN BERNARDINO	SR-60 @ MOUNTAIN AVE INTERCHANGE RECONSTRUCTION	$17,014	M
A.85	SAN BERNARDINO	SR-60 @ RAMONA AVE INTERCHANGE RECONSTRUCTION	$30,000	M
A.86	SAN BERNARDINO	SR-60 @ GROVE AVENUE INTERCHANGE RECONSTRUCTION AND GROVE AVE. +/-300 FT. N/S OF SR 60-WIDEN FROM 4-6 LANES	$7,621	S
A.87	SAN BERNARDINO	FROM CONE PINE INTERSECTION TO JUNCTION I-15: WIDEN TWO BNSF BRIDGE STRUCTURES FROM 2-4 LANES. CONSTRUCT RETAINING WALLS.	$16,734	S
A.88	SAN BERNARDINO	WIDEN SR-138 FROM SR-18 TO PHELAN RD FROM 2 TO 4 LANES (PHASE II)	$92,738	S
A.89	VENTURA	HUENEME RD FROM OXNARD CITY LIMITS TO RICE RD - WIDEN FROM 2 TO 4 LANES (PHASE I)	$6,953	S
A.90	VENTURA	STACKED PROJECT (STRUCTURE FOR TRANSFER OF AUTOMOBILES CREATING KEY ECONOMIC DEVELOPMENT) WILL ENTAIL A 3 STORY TALL PARKING LIKE STRUCTURE FOR A LAST/FIRST POINT OF REST FOR AUTOMOBILE EXPORTS/ IMPORTS. IT WILL INCREASE PORT CAPACITY BY 33%, INCREASE EFFICIENCY WITH ITS TECHNOLOGY AND ELECTRICAL UPGRADES WITH SOLAR POWER. IT WILL CREATE 724 NEW LONG-TERM JOBS, $36.5 MILLION IN LOCAL BUSINESS REVENUE, AND $6 MILLION IN STATE/LOCAL TAX REVENUE.	$40,000	S

TABLE 9 Goods Movement Project List - Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
A.91	VENTURA	INTERMODAL IMPROVEMENT PROJECT: WHARF & BERTH IMPROVEMENTS INCLUDES REPAVING OF THE TERMINAL SURVACES AT EACH OF THE BERTHS.	$3,266	S
A.92	VENTURA	THE PORT OF HUENEME INTERMODAL INFRASTRUCTURE PROJECT WILL INCLUDE DREDGING OF THE HARBOR CHANNEL FROM 35 FT. TO 40 FT. DEEP TO ACCOMMODATE HEAVIER SHIPS WITH MORE CARGO ON THEM, MODERNINZATION OF CARGO FACILITIES AND ON-DOCK RAIL SPUR UPDATING.	$19,000	S
A.93	VENTURA	LEAP: LEADING ELECTRIC ADVANCEMENTS FOR PORTS PROJECT WILL INCLUDE SOLAR PANEL INSTALLATION, CLEAN ENERGY STORAGE, 3 UTRS, AND THE INFRASTRUCTURE FOR NEW CLEAN ENERGY CHARGING STATIONS FOR PORT ZEVS.	$2,300	S
A.94	VENTURA	PORT CORRIDOR OPTIMIZATION & EFFICIENCY PROJECT INCLUDES RECONFIGURATION OF TERMINAL TRAFFIC CIRCULATION, INTELLIGENT TRANSPORTATION SYSTEM (ITS), ELECTRICAL SYSTEM UPGRADES FOR REEFERS, AND A SOLAR POWER COMPONENT TO PROGRESS ZERO EMISSION INITIATIVES.	$12,000	S
A.95	VENTURA	PORT OF HUENEME INTERMODAL IMPROVEMENT PROJECT TO MODERINZE THE PORT'S WHARF AND PIER AND CARGO FACILITIES INCLUDING DEEPENING THE WATER DEPTH FROM THE CHANNEL TO VESSEL BERTHS AND EXTENDING RAIL FOR ON-TERMINAL ACCESS.	$30,800	S
A.96	IMPERIAL	WIDEN AND IMPROVE TO 6 LANE FREEWAY WITH INTERCHANGES AT HEBER, MCCABE, AND JASPER AND OVERPASS AT CHICK RD.	$999,136	M
A.97	IMPERIAL	EXPANSION OF THE CALEXICO EAST PORT OF ENTRY - PHASE 1: WIDEN BRIDGE OVER THE ALL AMERICAN CANAL. PHASE 2: INCREASE THE NUMBER OF COMMERCIAL VEHICLE LANES FROM EXISTING 3 TO 6 LANES; ADD 6 NEW NORTHBOUND PRIVATELY OWNED VEHICLE (POV) LANES; PEDESTRIAN PATHWAY IMPROVEMENTS INCLUDING SHADED SIDEWALKS AND TRANSIT LOTS (PICK-UP AND DROP-OFF AREA).	$90,000	S
A.98	IMPERIAL	FORRESTER ROAD FROM I-8 TO SR-78. WIDEN AND IMPROVE TO FOUR-LANE STATE HIGHWAY. PHASE 1 OPERATIONAL IMPROVEMENTS. PHASE 2 TO INCLUDE A FOUR (4) LANE ROAD WIDENING AND WESTMORLAND BYPASS.	$307,168	M

TABLE 9 Goods Movement Project List - Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
A.99	IMPERIAL	MENVIELLE ROAD FROM CARR ROAD TO SR-98. MENVIELLE ROAD WIDENING, FROM 2 TO 4 LANES BETWEEN CARR ROAD TO SR-98	$4,432	M
A.100	IMPERIAL	SR-98 FROM OLLIE AVENUE TO ROCKWOOD DRIVE. IN CALEXICO - WIDEN CONVENTIONAL HIGHWAY PHASE 1A - FROM 32.4 TO 32.6 WIDEN FROM 4 TO 6 LANES	$12,922	S
A.101	IMPERIAL	SR-98 FROM ALL AMERICAN CANAL TO VV WILLIAMS AVENUE. PHASE 1C - FROM 30.9 TO 32.2 WIDEN FROM 2 TO 4 LANES	$58,850	S
A.102	IMPERIAL	SR-98 FROM DOGWOOD ROAD TO ALL AMERICAN CANAL. PHASE 2 - FROM 30.0 TO 30.9 WIDEN FROM 2 TO 4 LANES	$79,652	S
A.103	IMPERIAL	SR-115 FROM I-8/SR-7 INTERCHANGE TO EVAN HEWES HIGHWAY/SR-115 JUNCTION. CONSTRUCT 4-LANE EXPRESSWAY	$232,157	M
A.104	IMPERIAL	SR-98 FROM SR-111 TO SR-7. WIDEN AND IMPROVE TO 4/6 LANES. ON EITHER JASPER ROAD OR SR-98	$29,844	S

TABLE 9 Goods Movement Project List - Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
B. FREIGHT CORRIDOR SYSTEM				
B.1	LOS ANGELES	I-710 CORRIDOR CAPACITY ENHANCEMENT - ADD 1 MIXED FLOW LANES BETWEEN OCEAN BLVD AND SR-1 (EACH DIRECTION), ADD 2 TRUCK LANES BETWEEN WILLOW ST AND DEL AMO BLVD (EACH DIRECTION), ADD 1 MIXED FLOW LANES BETWEEN I-105 AND SR-60 (EACH DIRECTION), AND INTERCHANGE IMPROVEMENTS BETWEEN OCEAN BLVD IN LONG BEACH AND SR-60 IN EAST LOS ANGELES	$5,941,000	L
B.2	VARIOUS	EAST-WEST FREIGHT CORRIDOR SEGMENT 1 (FROM I-710 TO JUST WEST OF I-605)	$2,413,086	L
B.3	VARIOUS	EAST-WEST FREIGHT CORRIDOR SEGMENT 2 (FROM JUST WEST OF I-605 TO JUST EAST OF SR-57)	$9,102,359	L
B.4	VARIOUS	EAST-WEST FREIGHT CORRIDOR SEGMENT 3 (FROM JUST EAST OF SR-57 TO I-15)	$3,777,816	L
B.5	VARIOUS	I-15 FREIGHT CORRIDOR (INITIAL SEGMENT) (SR-60 TO I-10)	$856,570	L
C. OFF DOCK AND NEAR DOCK INTERMODAL YARD PROJECTS				
C.1	SAN BERNARDINO	TRACK AND INTERMODAL YARD IMPROVEMENTS (PHASES 1 THROUGH 4)	$799,616	M
C.2	LOS ANGELES	INTERMODAL FACILITIES (SCIG/ICTF)	$1,000,000	M

TABLE 9 Goods Movement Project List - Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
D. MAINLINE RAIL				
D.1-A TO D.1-N	VARIOUS	RAIL PACKAGE — MAINLINE RAIL CAPACITY EXPANSION: BARSTOW TO KEENBROOK–BNSF SAN BERNARDINO SUBDIVISION; COLTON CROSSING TO REDONDO JUNCTION–UP MOJAVE SUBDIVISION; DEVORE ROAD TO WEST COLTON (INC. RANCHO FLYING JUNCTION)–UP ALHAMBRA SUBDIVISION; WEST COLTON TO CITY OF INDUSTRY–UP LOS ANGELES SUBDIVISION; UPRR YUMA SUBDIVISION.	$3,092,400	L
D.2	LOS ANGELES	BRIGHTON TO ROXFORD DOUBLE TRACK: THIS PROJECT ADDS 11MILES OF 2ND TRACK BETWEEN BURBANK AND SYLMAR ON METROLINK'S ANTELOPE VALLEY LINE (AVL). THE PROJECT WILL ELIMINATE THE CURRENT BOTTLENECK AND IMPROVE ON TIME PERFORMANCE AND OPERATIONAL RELIABILITY ON THE AVL. THIS PROJECT WILL BE DESIGNED TO BE COMPATIBLE WITH THE POTENTIAL FUTURE HIGH SPEED RAIL ALIGNMENT	$238,000	M
D.3	LOS ANGELES	ANTELOPE VALLEY LINE CAPACITY IMPROVEMENT PROJECT: ADD CAPACITY BETWEEN LOS ANGELES UNION STATION AND LANCASTER WHERE UPRR OPERATES FREIGHT TRAINS. PHASE I INCLUDES DOUBLE TRACK SECTIONS, BURBANK JUNCTION SPEED IMPROVEMENTS, AND SIGNAL RESPACING. THE PROJECT WILL ELIMINATE RAIL BOTTLENECKS AND IMPROVE TRAVEL TIME AND RELIABILITY FOR BOTH FREIGHT AND COMMUTER RAIL.	$856,348	M
D.4	LOS ANGELES	LONE HILL AVENUE TO CONTROL POINT WHITE DOUBLE TRACK: ON METROLINK SAN BERNARDINO LINE, WHERE UPRR OPERATES FREIGHT RAIL, EXTEND AN EXISTING SIDING TO PROVIDE 8.1 MILES OF CONTINUOUS DOUBLE TRACK BETWEEN LONE HILL AVE AND CP CENTRAL TO IMPROVE TRAVEL TIME AND RELIABILITY FOR BOTH FREIGHT AND COMMUTER RAIL.	$130,000	S
D.5	ORANGE	BNSF LINE - 10 MILES OF TRIPLE TRACK FROM FULLERTON TO ORANGE/ RIVERSIDE COUNTY LINE; (SAME AS ATWOOD TO FULLERTON AND ESPERANZA TO FULLERTON); (COST INCLUDED IN THE RAIL PACKAGE - MAINLINE RAIL CAPACITY EXPANSION).	$70,000	M

TABLE 9 Goods Movement Project List - Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
E. ON-DOCK RAIL				
—	LOS ANGELES	PORT OF LOS ANGELES		
E.1-LA		PORT OF LOS ANGELES ZERO EMISSION (ZE)/TRUCK TRIP REDUCTION/ FREIGHT EFFICIENCY PROGRAM: WEST BASIN CONTAINER TERMINAL RAILYARD MODERNIZATION - RECONSTRCT A 7 TRACK RAILYARD OPERATED WITH DIESEL POWERED TOP PICKS TO A 10 TRACK RAILYARD OPERATED ELECTRIFIED RAIL MOUNTED GANTRY CRANES.	$60,000	S
E.2-LA		OTHER IN-PORT MAINLINE, PORT OF LOS ANGELES PROJECTS - ZERO EMISSION (ZE)/TRUCK TRIP REDUCTION/FREIGHT EFFICIENCY PROGRAM: 1) PIER 400 RAIL EXPANSION; 2) PIER 300 RAIL EXPANSION; 3) BERTH 2ND ALAMEDA CORRIDOR CONNECTION TRACK; 4) WBCT & PIER 300 WHARF/TERMINAL IMPROVEMENTS	$500,000	M
—		PORT OF LONG BEACH		
E.1-LB		PIER G SOUTH WORKING YARD REHABILITATION.	$66,000	L
E.2-LB		MIDDLE HARBOR TERMINAL RAIL YARD (3 PHASES).	$120,000	S
E.3-LB		PIER A ON-DOCK RAIL YARD EXPANSION TO CARRACK.	$156,355	L
E.4-LB		PIER A ON-DOCK RAIL YARD EAST OF CARRACK.	$80,000	L
E.5-LB		PIER G METRO TRACK IMPROVEMENTS.	$16,500	L

TABLE 9 Goods Movement Project List - Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
F. RAIL ACCESS IMPROVEMENTS TO PORT OF LONG BEACH & PORT OF LOS ANGELES				
F.1-LB	LOS ANGELES	RAIL BOTTLENECK RELIEF PROJECT ADDING A 4TH TRACK AT OCEAN BOULEVARD TO IMPROVE ON-DOCK RAIL OPERATIONS: (1) ADDS A 3,000-FOOT RAILROAD TRACK, (2) REALIGNS THE EXISTING LEAD TRACK, (3) RECONFIGURES CROSSOVERS AND TURNOUTS FOR STREAMLINING TRAIN MOVEMENTS, REDUCING DELAYS AND CONGESTION, AND IMPROVING SAFETY OF RAILROAD OPERATIONS.	$25,000	S
F.2-LB	LOS ANGELES	PIER B ON-DOCK RAIL SUPPORT FACILITY PROJECT TO EXPAND PIER B INTERMODAL RAILYARD TO FACILITATE ADDITIONAL RAIL SHIPMENTS.	$720,000	S
F.3-LB	LOS ANGELES	TERMINAL ISLAND WYE RAIL ENHANCEMENT PROJECT ADDS A DOUBLE TRACK ON THE SOUTH LEG OF THE WYE TO ACCOMMODATE SIMULTANEOUS TRAIN SWITCHING MOVES FROM VARIOUS ACTIVITIES ON TERMINAL ISLAND.	$40,000	S
F.1-LA	LOS ANGELES	ALAMEDA CORRIDOR TERMINUS ENHANCEMENT - NEW CERRITOS CHANNEL RAIL BRIDGE	$400,000	M
F.2-LA	LOS ANGELES	ALAMEDA CORRIDOR ENHANCEMENT - TRIPLE TRACK S/O THENARD JUNCTION	$20,000	M
F.3-LA	LOS ANGELES	ALAMEDA CORRIDOR SOUTH TERMINUS GAP CLOSURE PROJECT. THIS PROJECT WILL PROVIDE SEPARATE RAIL ACCESS TO TWO ADJACENT ON-DOCK RAILYARDS, THUS ELIMINATING THE POTENTIAL FOR TRAIN COLLISIONS. THE NEW DOUBLE TRACK SEGMENT WILL ALSO REDUCE MOVING TRAIN BLOCKAGES AT TWO IMMEDIATELY ADJACENT RAIL CROSSINGS ON ROADWAYS, WHICH ALSO REDUCES THE POTENTIAL FOR TRAIN-VEHICULAR COLLISIONS.	$9,529	S
F.4-LA	LOS ANGELES	ALAMEDA CORRIDOR TERMINUS/CALIFORNIA COASTAL TRAIL EXTENSION GRADE SEPARATION (PEDESTRIAN/CLASS I BICYCLE PATH BRIDGE OVER FREIGHT MAINLINE): PROVIDE A PEDESTRIAN/BICYCLE BRIDGE OVER TWO RAIL MAINLINE TRACKS TO PROVIDE A DIRECT CONNECTION BETWEEN THE WILMINGTON COMMUNITY AND THE WATERFRONT.	$23,800	S
F.5-LA	LOS ANGELES	ZERO EMISSION (ZE)/TRUCK TRIP REDUCTION/FREIGHT EFFICIENCY PROGRAM: TERMINAL ISLAND ON-DOCK RAILYARD EXPANSION (TICTF MODERNIZATION)	$100,000	S

TABLE 9 Goods Movement Project List - Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
G. RAIL-HIGHWAY GRADE SEPARATIONS				
SEE EXHIBITS B1 THROUGH B5	VARIOUS	RAIL PACKAGE- GRADE SEPARATIONS. (SEE DETAILED LIST)	$5,900,574	L
H. BOTTLENECK RELIEF PROJECTS				
H.1-H.22	VARIOUS	GOODS MOVEMENT - BOTTLENECK RELIEF STRATEGY	$5,079,652	L
H.23	LOS ANGELES	THIS IS AN I-605 HOT SPOT RELATED INTERSECTION PROJECT. THE PURPOSE OF THIS PROJECT IS TO REPLACE/ADJUST 2 SIGNALS FOR THE TIMING, ALLEVIATE THE CONGESTION AND DELAYS.	$454	S
H.24	LOS ANGELES	THIS PROJECT IS AN I-605 HOT SPOT RELATED INTERSECTION PROJECT. THE PURPOSE OF THIS PROJECT IS TO INCREASE THE LEFT-TURN STORAGE CAPACITY, ALLEVIATE THE CONGESTION AND DELAYS.	$493	S

TABLE 9 Goods Movement Project List - Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
I. TECHNOLOGY & OTHER GOODS MOVEMENT INITIATIVES				
NA	VARIOUS	GOODS MOVEMENT - ITS STRATEGY (INCLUDES LOS ANGELES METRO'S ICM/ATM/ TSM PROJECTS BELOW)	$3,000,000	L
	LOS ANGELES	I-105 INTEGRATED CORRIDOR MANAGEMENT/ACTIVE TRAFFIC MANAGEMENT (ICM/ATM) ELEMENTS		
	LOS ANGELES	THE PROJECT PROPOSES A CONNECTED CORRIDOR APPROACH ALONG A PORTION OF I-710 FROM SR-47 (POSTMILE 3.4) IN LONG BEACH TO I-10 (POSTMILE 26.5) FOR TRANSPOTATION MANAGEMENT SYSTEM (TMS) INSTALLATIONS AND UPGRADES AND FOR LIFE CYCLE REPLACEMENTS. THE PROJECT PROPOSES TO INSTALL CLOSED-CIRCUIT TELEVISION CAMERAS, UPGRADE RAMP METER CONTROLLERS AND DETECTION, REPLACE LOOP DETECTORS, INSTALL AND UPGRADE ELECTRONIC CHANGEABLE MESSAGE SIGNS, UPGRADE THE EXISTING COMMUNICATION SYSTEM TO ALL FIBER OPTICS COMMUNICATIONS, INSTALL RAMP METERS AND VEHICLE DETECTION STATIONS, AND PROVIDE LIFE CYCLE REPLACEMENT FOR TMS FIELD ELEMENTS WHERE NEEDED.		
	LOS ANGELES	FRATIS WILL PROVIDE TRUCKING COMPANIES THE ABILITY TO EFFICIENTLY PLAN DAILY CONTAINER PICK-UPS AND DROP-OFFS AT THE PORTS. FRATIS WILL USE INFORMATION FROM THE MARINE TERMINAL OPERATORS (MTO), TRUCKING COMPANIES, AND TRAVELER INFORMATION TO PROVIDE STATUS UPDATES ON CONTAINER AVAILABILITY, ENABLE TRUCKING COMPANIES TO SET UPRR AUTOMATED APPOINTMENTS, AND PROVIDE TRUCK DRIVERS THE BEST ROUTES TO USE TO AND FROM THE PORTS.		
NA	VARIOUS	ZERO-EMISSION GOODS MOVEMENT	$5,000,000	L
NA	VARIOUS	FREIGHT ARTERIAL O&M	$5,045,604	L

Source: SCAG

TABLE 10 Constrained Grade Separation Projects (not in Priority Order)

County	Crossing Street	Under Construction	Complete	Planned
LOS ANGELES	DORAN STREET			X
LOS ANGELES	MONTEBELLO/MAPLE			X
LOS ANGELES	TURNBULL CYN RD			X
LOS ANGELES	FULLERTON RD		X	
LOS ANGELES	DURFEE AVE		X	
LOS ANGELES	ROSECRANS AVE			X
LOS ANGELES	GRADE SEP XINGS SAFETY IMPR			X
LOS ANGELES	AT GRADE CROSSING SAFETY IMP (POMONA)			X
LOS ANGELES	AT GRADE CROSSING SAFETY IMP (MONTEBELLO)			X
LOS ANGELES	ALAMEDA CORRIDOR TERMINUS/TERMINAL WAY			X
ORANGE	LAKEVIEW AVENUE		X	
ORANGE	RAYMOND AVENUE		X	
ORANGE	STATE COLLEGE		X	
ORANGE	ORANGETHORPE AVENUE		X	
RIVERSIDE	MARY STREET			X

TABLE 10 Constrained Grade Separation Projects (not in Priority Order) - Continued

County	Crossing Street	Under Construction	Complete	Planned
RIVERSIDE	MCKINLEY ST			X
RIVERSIDE	CHICAGO AVE			X
RIVERSIDE	PIERCE ST			X
RIVERSIDE	BELLGRAVE AV			X
RIVERSIDE	MADISON ST			X
RIVERSIDE	SPRUCE ST			X
RIVERSIDE	JURUPA RD			X
RIVERSIDE	TYLER ST			X
RIVERSIDE	RADIO RD			X
RIVERSIDE	ADAMS ST			X
RIVERSIDE	22ND ST			X
RIVERSIDE	SAN GORGONIO AVE			X
RIVERSIDE	HARGRAVE ST			X
RIVERSIDE	AVENUE 62			X
RIVERSIDE	AVENUE 66			X

TABLE 10 Constrained Grade Separation Projects (not in Priority Order) - Continued

County	Crossing Street	Under Construction	Complete	Planned
RIVERSIDE	3RD STREET			X
RIVERSIDE	JACKSON ST/BNSF RAIL CROSSING			X
RIVERSIDE	CALIFORNIA AVE UPRR (Beaumont)			X
RIVERSIDE	PENNSYLVANIA AVE AND UPRR (Beaumont)			X
RIVERSIDE	JURUPA RD and CEDA GRADE SEP			X
RIVERSIDE	ETHANAC RD			X
RIVERSIDE	MENIFEE RD			X
RIVERSIDE	ELLIS AVE			X
RIVERSIDE	MCCALL BLVD/MENIFEE RD			X
RIVERSIDE	McCALL BLVD/SR-79			X
SAN BERNARDINO	GREEN TREE BLVD EXTENSION			X
SAN BERNARDINO	LENWOOD ROAD		X	
SAN BERNARDINO	MT. VERNON VIADUCT	X		
SAN BERNARDINO	MAIN ST			X
SAN BERNARDINO	N. VINEYARD AVE		X	

TABLE 10 Constrained Grade Separation Projects (not in Priority Order) - Continued

County	Crossing Street	Under Construction	Complete	Planned
SAN BERNARDINO	S. MILLIKEN AVE		X	
SAN BERNARDINO	SOUTH ARCHIBALD AVE			X
SAN BERNARDINO	CAMPUS AVE			X
SAN BERNARDINO	SAN ANTONIO AVE			X
SAN BERNARDINO	MONTE VISTA		X	
SAN BERNARDINO	BEAUMONT			X
SAN BERNARDINO	CENTRAL AVENUE (BRIDGE REHAP)			X
SAN BERNARDINO	VISTA ROAD / SHADOW MOUNTAIN & BNSF			X
SAN BERNARDINO	FOGG ST (COLTON)			X
VENTURA	RICE AVE/FIFTH STREET			X
VENTURA	VINEYARD AVENUE			X
VENTURA	ROSE AVENUE			X
VENTURA	GONZALES RD			X
VENTURA	LOS ANGELES AVENUE			X
VENTURA	COUNTYWIDE			X

Source: SCAG

TABLE 11 Strategic Plan Grade Separation Projects (not in Priority Order)

County	Crossing Street
IMPERIAL	WARD ROAD (IMPERIAL COUNTY)
IMPERIAL	SR-78/SR-111 (BRAWLEY)
IMPERIAL	MALAN STREET (BRAWLEY)
IMPERIAL	MEAD ROAD (BRAWLEY)
IMPERIAL	KEYSTONE ROAD (IMPERIAL COUNTY)
IMPERIAL	ATEN ROAD (IMPERIAL)
IMPERIAL	EVAN HEWES HIGHWAY (IMPERIAL COUNTY)
IMPERIAL	DOG WOOD ROAD (IMPERIAL COUNTY)
IMPERIAL	HERBER AVENUE (IMPERIAL COUNTY)
IMPERIAL	WEST COLE ROAD (CALEXICO)
ORANGE	JEFFERSON ST (ANAHEIM)
ORANGE	VAN BUREN AVE (PLACENTIA)
ORANGE	RICHFIELD RD (PLACENTIA)
ORANGE	KELLOGG DRIVE UNDERCROSSING (ANAHEIM)
RIVERSIDE	SMITH AVE (CORONA)
RIVERSIDE	RAILROAD ST (CORONA)
RIVERSIDE	COTA STREET (CORONA)
RIVERSIDE	BUCHANAN ST (RIVERSIDE)

TABLE 11 Strategic Plan Grade Separation Projects (not in Priority Order) - Continued

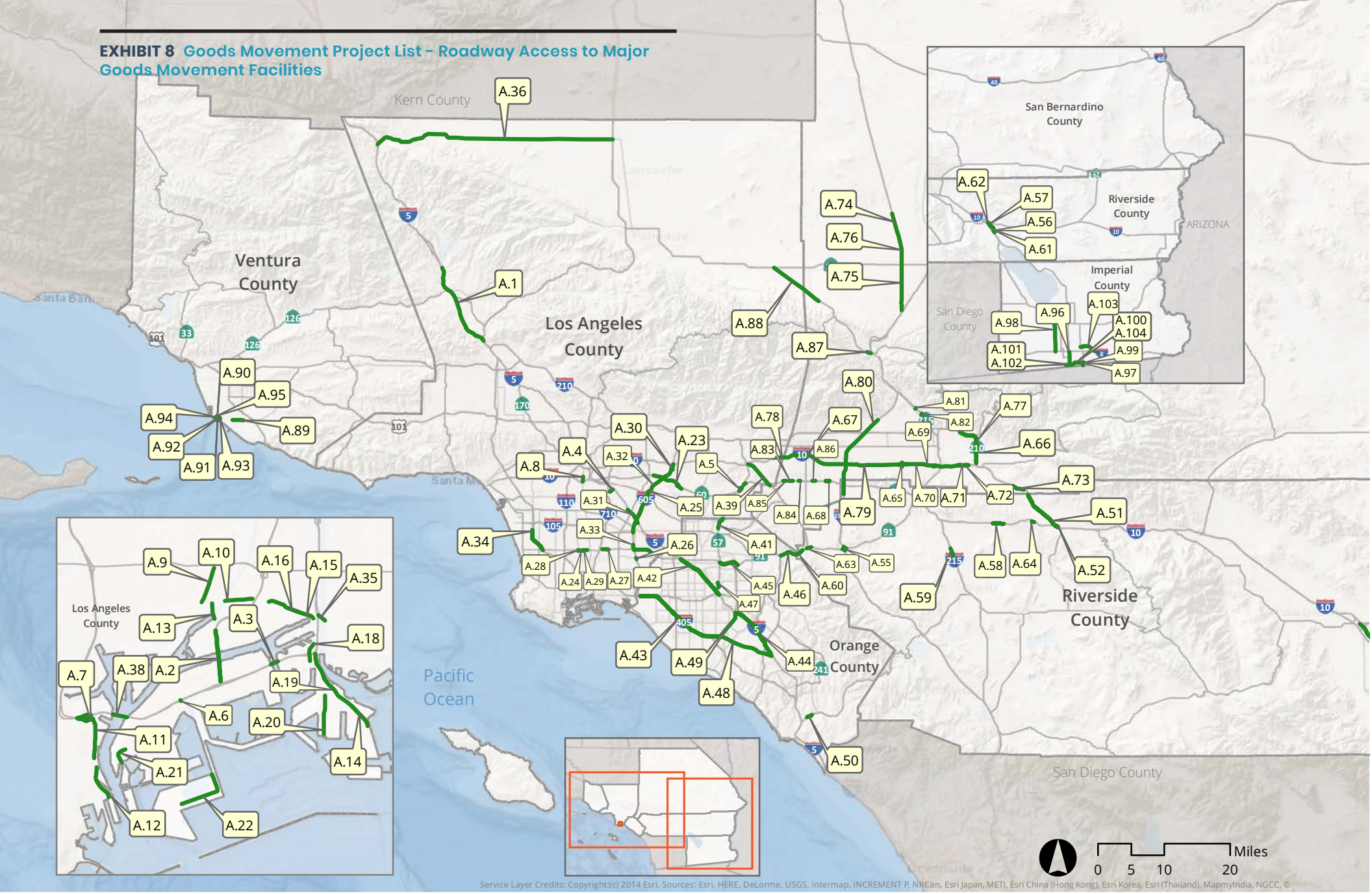
County	Crossing Street
RIVERSIDE	RUTILE STREET (JURUPA VALLEY)
RIVERSIDE	HARRISON STREET (RIVERSIDE)
RIVERSIDE	GIBSON STREET (RIVERSIDE)
RIVERSIDE	WASHINGTON STREET (RIVERSIDE)
RIVERSIDE	BROCKTON AVE (RIVERSIDE)
RIVERSIDE	APACHE TRAIL (RIVERSIDE COUNTY)
RIVERSIDE	PANORAMA ROAD (RIVERSIDE)
RIVERSIDE	CRIDGE STREET (RIVERSIDE)
RIVERSIDE	PALMYRITA AVE (RIVERSIDE)
RIVERSIDE	CENTER ST (RIVERSIDE COUNTY)
RIVERSIDE	MAIN STREET (RIVERSIDE COUNTY)
RIVERSIDE	SAN TIMOTEO CANYON (CALIMESA)
RIVERSIDE	SHETIDAN ST (CORONA)
RIVERSIDE	7TH ST (RIVERSIDE)
RIVERSIDE	BROADWAY (RIVERSIDE COUNTY)
RIVERSIDE	TIPTON ROAD (PALM SPRINGS)
RIVERSIDE	AVENUE 54 (COACHELLA)
RIVERSIDE	AVENUE 58 (RIVERSIDE COUNTY)

TABLE 11 Strategic Plan Grade Separation Projects (not in Priority Order) - Continued

County	Crossing Street
RIVERSIDE	2ND MAIN TRACK FROM MORENO VALLEY TO PERRIS
RIVERSIDE	3RD MAIN TRACK FROM HIGHGROVE TO COLTON
RIVERSIDE	3RD MAIN TRACK FROM RIVERSIDE TO FULLERTON
RIVERSIDE	4TH MAIN TRACK AND MAIN STATION IMPROVMENTS FROM WEST CORONA TO CORONA-LA SIERRA
SAN BERNARDINO	HINCKLEY AVE (SAN BERNARDINO COUNTY)
SAN BERNARDINO	PHELAN RD (SAN BERNARDINO COUNTY)
SAN BERNARDINO	VINE AVE (ONTARIO)
SAN BERNARDINO	SULTANA AVE (ONTARIO)
SAN BERNARDINO	BON VIEW AVR (ONTARIO)
SAN BERNARDINO	OLIVE ST (SAN BERNARDINO)
SAN BERNARDINO	ALESSANDRO RD (REDLANDS)
SAN BERNARDINO	VALLEY BOULEVARD (COLTON)
VENTURA	ROUTE 118 (VENTURA COUNTY)

Source: SCAG

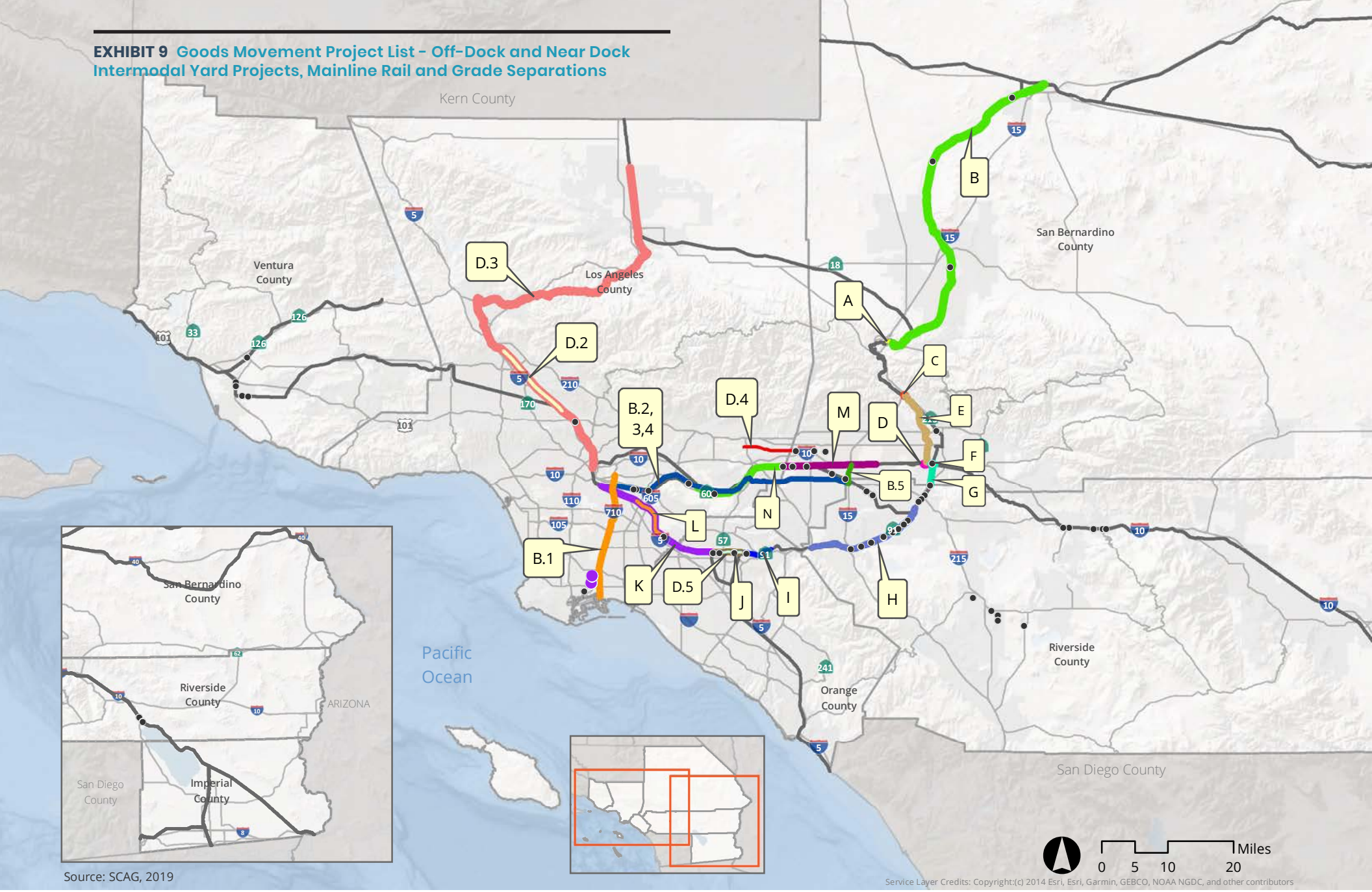
EXHIBIT 8 Goods Movement Project List - Roadway Access to Major Goods Movement Facilities



Roadway Access Projects

Source: SCAG, 2019

EXHIBIT 9 Goods Movement Project List - Off-Dock and Near Dock Intermodal Yard Projects, Mainline Rail and Grade Separations

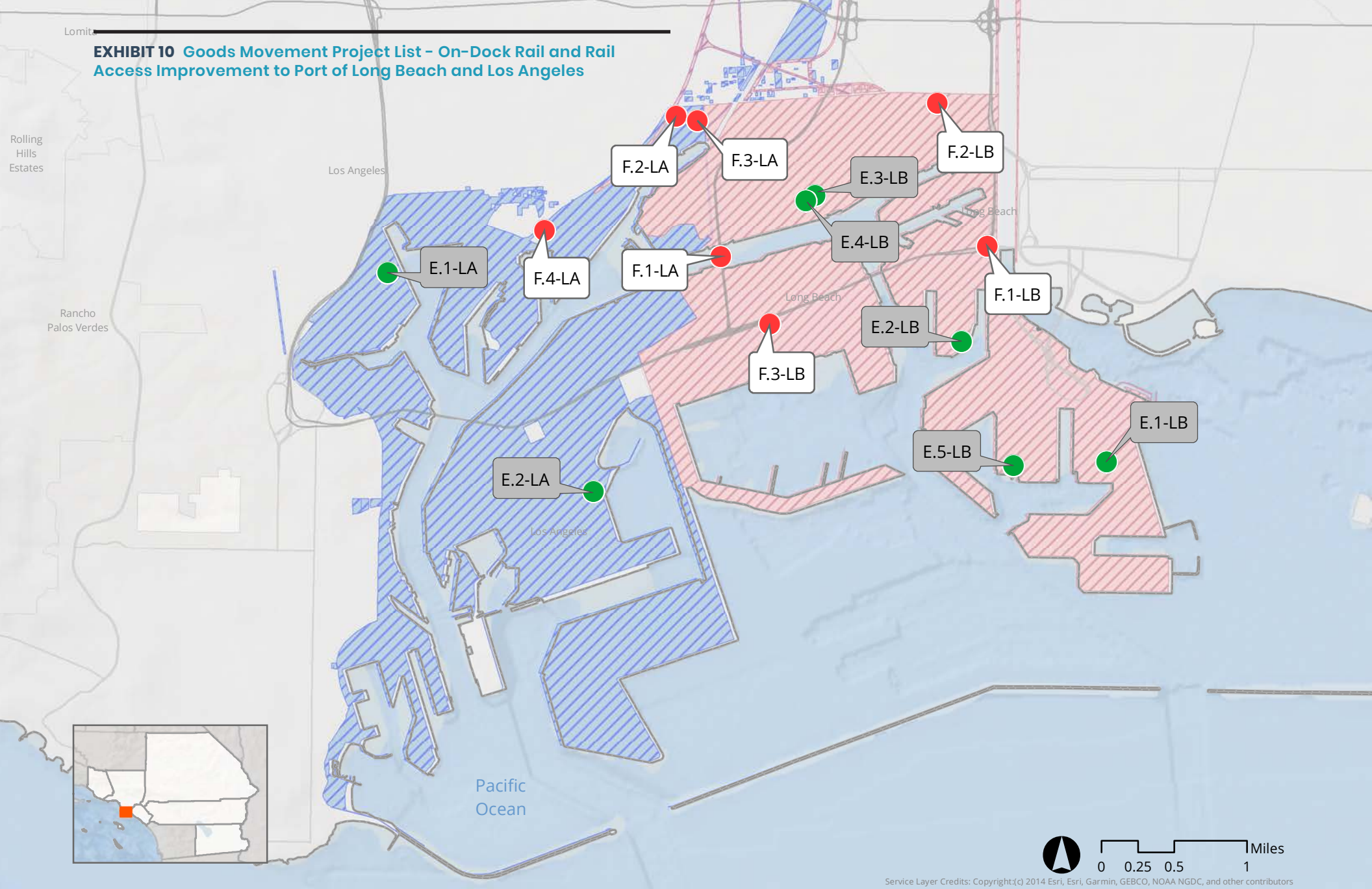


Source: SCAG, 2019

Service Layer Credits: Copyright:(c) 2014 Esri, Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

- A - Fourth Main Track from Silverwood to Frost
- B - Third Main Track Martinez to Barstow
- B.1 - I-710 Corridor Capacity Enhancement
- B.2, 3, 4 - East-West Freight Corridor Segments
- B.5 - I-15 Freight Corridor
- C - Devore Rd Crossovers
- D - Flying Junction at Rancho
- D.2 - Brighton To Roxford Double Track
- D.3 Antelope Valley Line Capacity Improvement Proj
- D.4 - Lone Hill Ave To CP White Double Track
- D.5 - Fullerton To Orange/Riverside County Line
- E - Second Main Track Devore to Rancho
- F - Colton Crossing Grade Separation
- G - Third Main Track MP 2.9 to Highgrove MP 6.1
- H - Third Main Track West Riverside to Prado Dam
- I - Third Main Track Esperanza to Atwood
- J - Third Main Track Atwood to Fullerton
- K - Fourth Main Track Fullerton to Hobart
- L - Third Main Track Valley View to Serapis
- M - Second Main Track South Fontana to Reservoir
- N - Second Main Track Pomona to City of Industry
- Off Dock
- Grade Separations
- Main Line Rail

EXHIBIT 10 Goods Movement Project List - On-Dock Rail and Rail Access Improvement to Port of Long Beach and Los Angeles

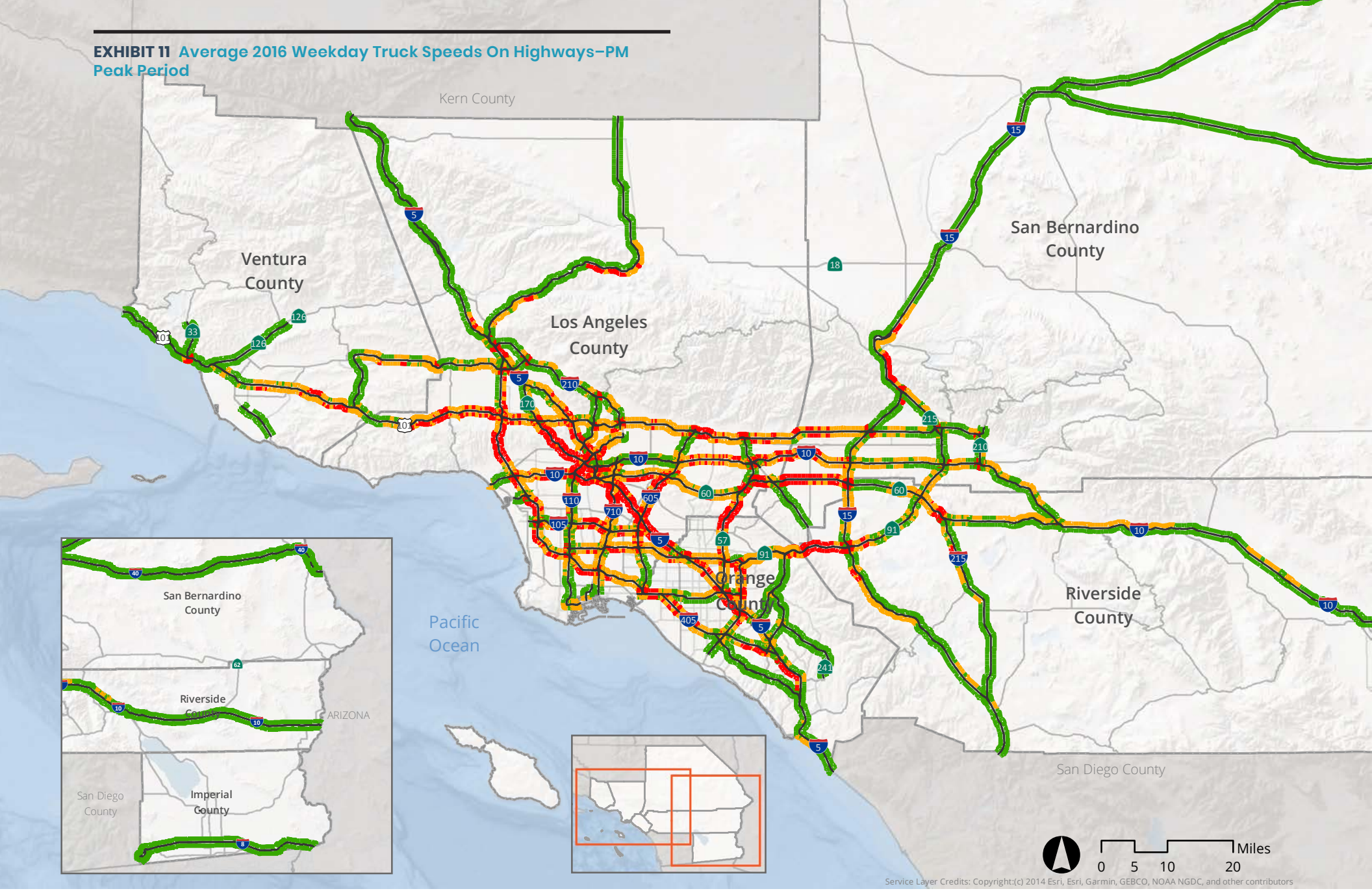


E - On-Dock Rail F - Rail Access Improvements to Ports of Long Beach and Los Angeles

Port of Long Beach (LB) Port of Los Angeles (LA)

Source: SCAG, 2019

EXHIBIT 11 Average 2016 Weekday Truck Speeds On Highways–PM Peak Period

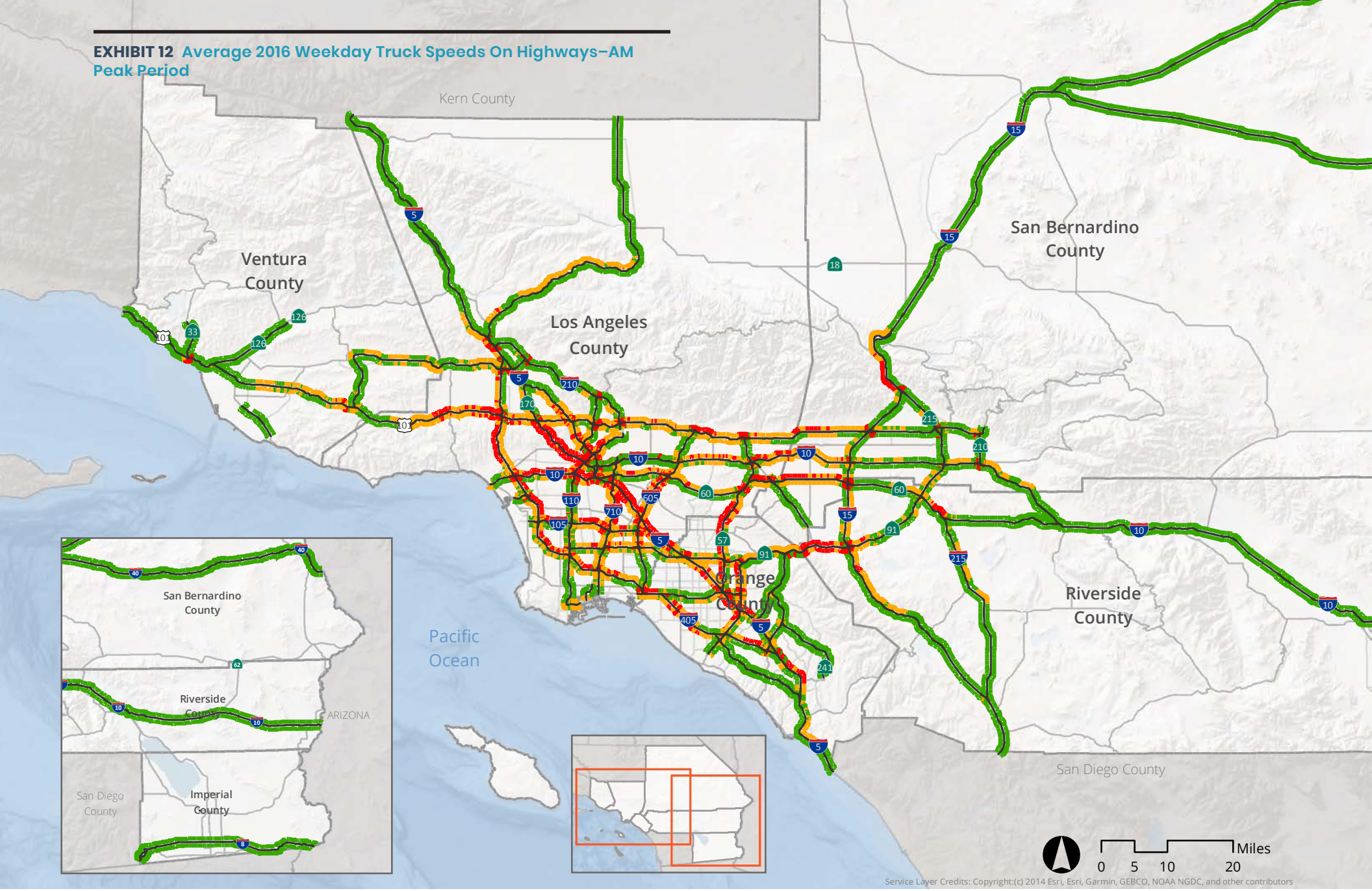


PM Peak Speed (mph) 2016

Less than 35 — 36 to 50 — Greater than 50

Source: SCAG, 2019

EXHIBIT 12 Average 2016 Weekday Truck Speeds On Highways–AM Peak Period



AM Peak Speed (mph) 2016

Less than 35 — 36 to 50 — Greater than 50

Source: SCAG, 2019

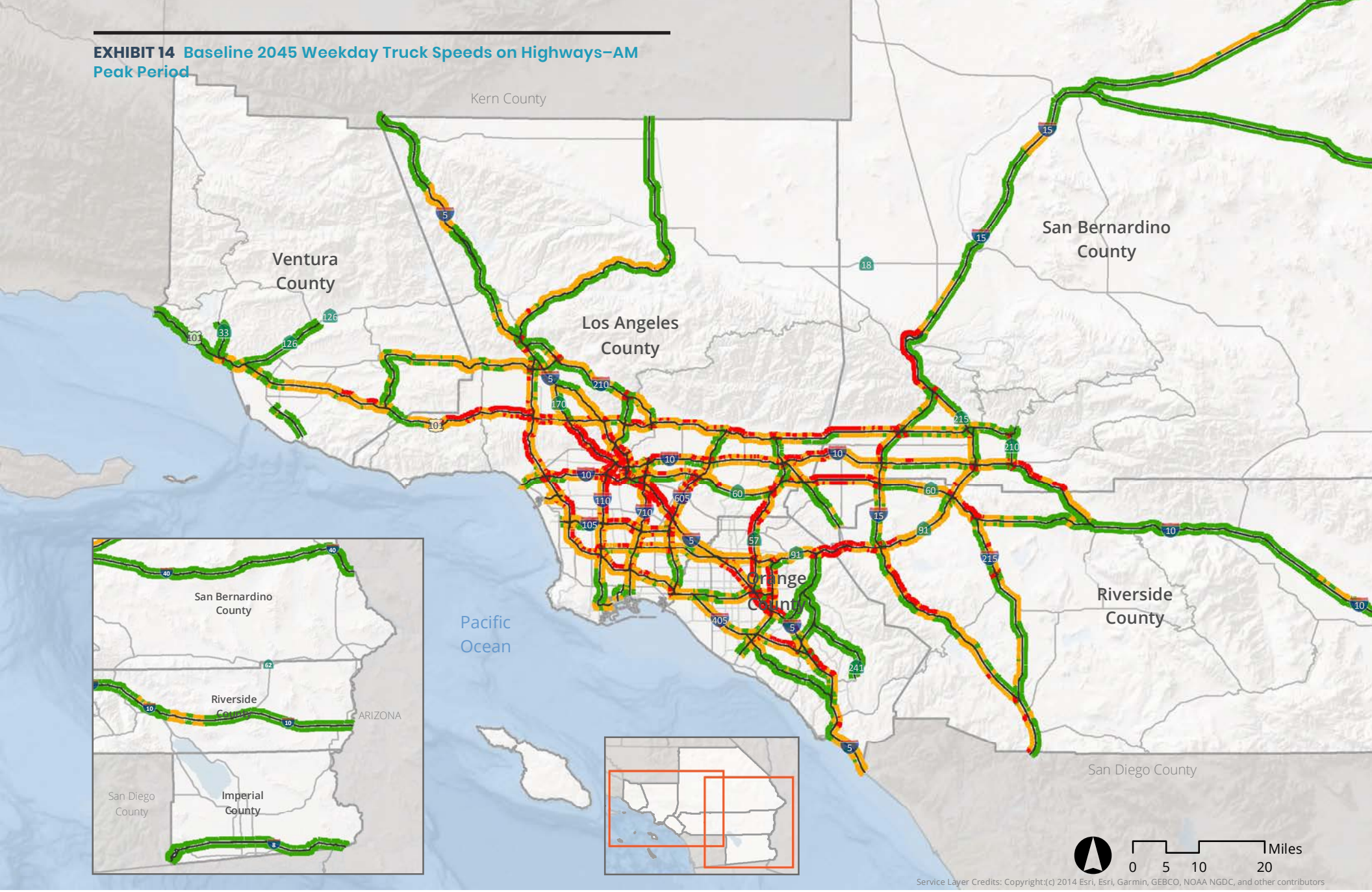
EXHIBIT 13 Baseline 2045 Weekday Truck Speeds on Highways–PM Peak Period

PM Peak Speed (mph) 2045

Less than 35 | 36 to 50 | Greater than 50

Source: SCAG, 2019

EXHIBIT 14 Baseline 2045 Weekday Truck Speeds on Highways–AM Peak Period



AM Peak Speed (mph) 2045

Less than 35 | 36 to 50 | Greater than 50

Source: SCAG, 2019

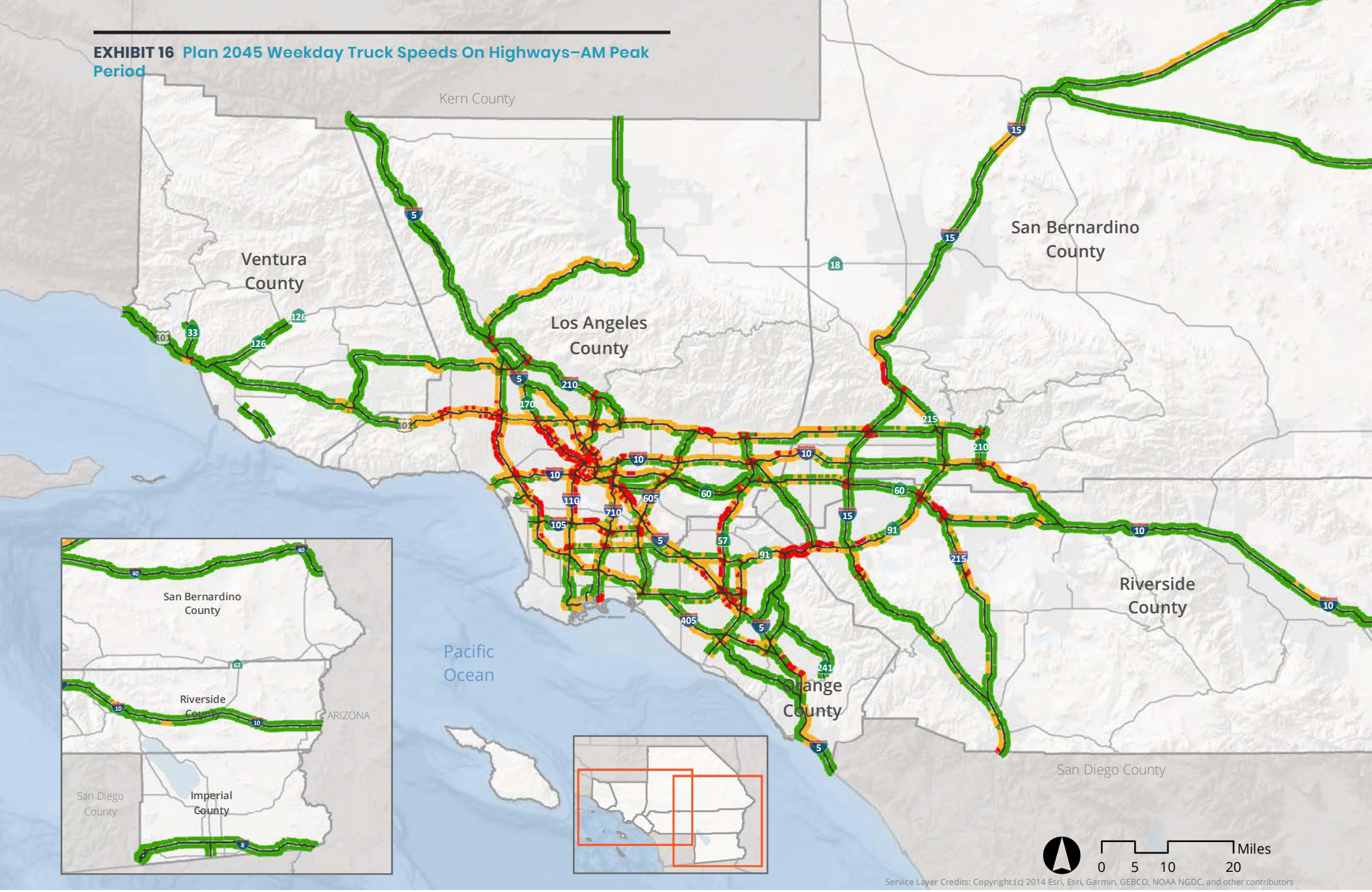
EXHIBIT 15 Plan 2045 Weekday Truck Speeds on Highways–PM Peak Period

PM Peak Speed (mph) 2045 Plan

Less than 35 35 to 50 Greater than 50

Source: SCAG, 2019

EXHIBIT 16 Plan 2045 Weekday Truck Speeds On Highways–AM Peak Period

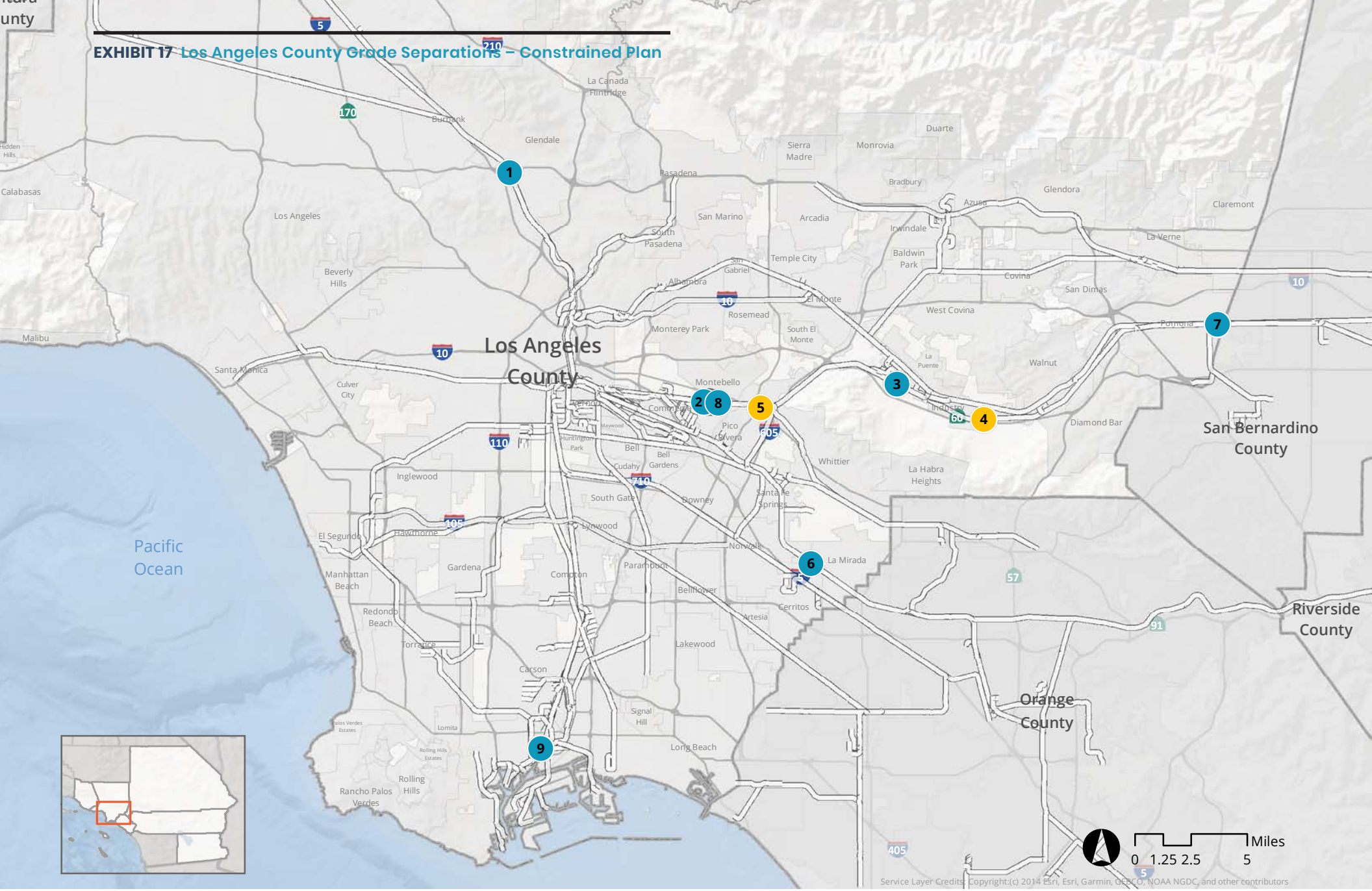


AM Peak Speed (mph) 2045 Plan

Less than 35 | 36 to 50 | Greater than 50

Source: SCAG, 2019

EXHIBIT 17 Los Angeles County Grade Separations – Constrained Plan

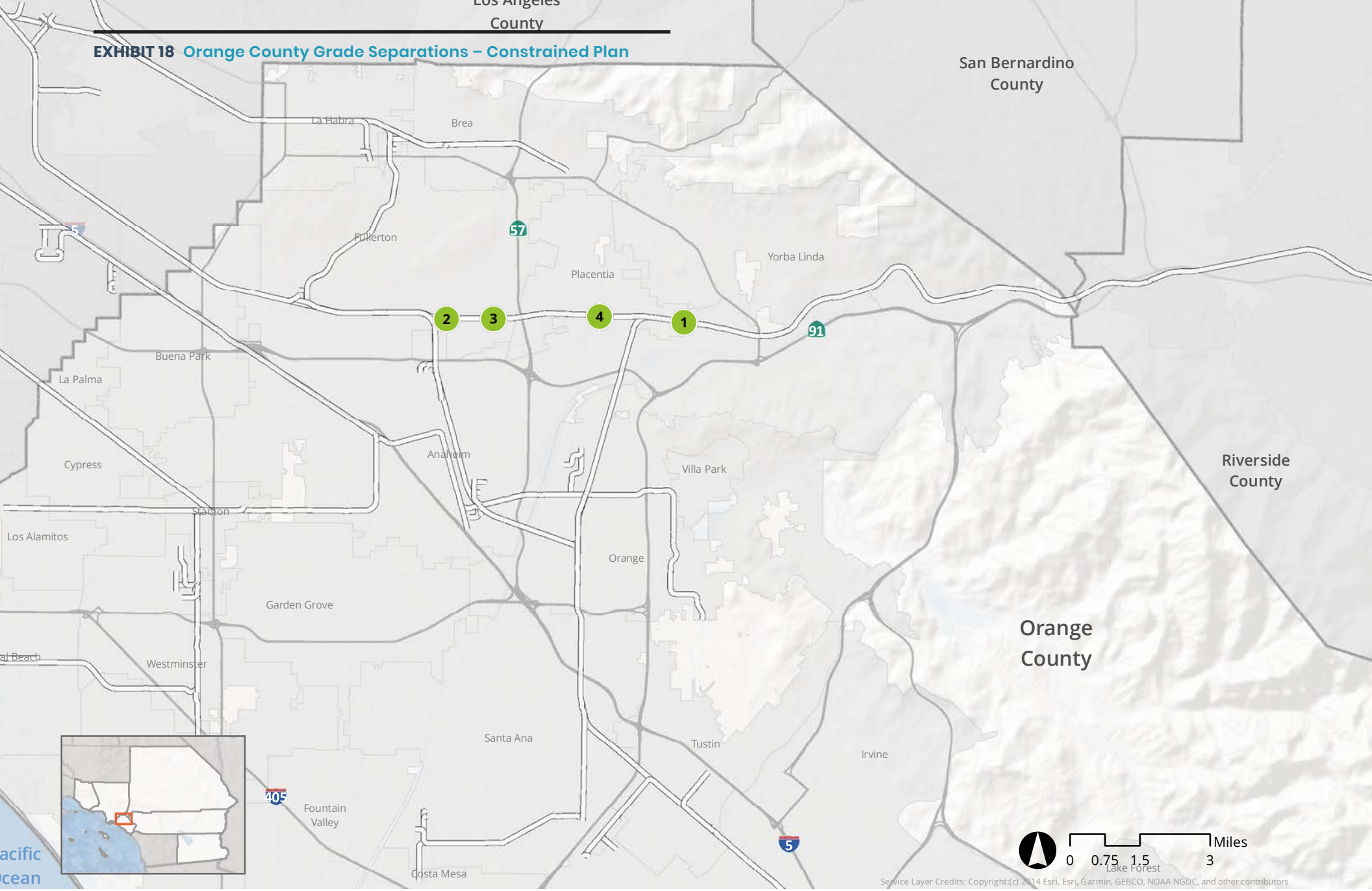


Complete Planned Under construction Regional Rail Lines

1. Doran Street
2. Montebello/Maple
3. Turnbull Cyn Rd
4. Fullerton Rd
5. Durfee Ave
6. Rosecrans Ave
7. At Grade Crossing Safety Imp (Pomona)
8. At Grade Crossing Safety Imp (Montebello)
9. Alameda Corridor Terminus/Terminal Way

Source: SCAG, 2019

EXHIBIT 18 Orange County Grade Separations – Constrained Plan

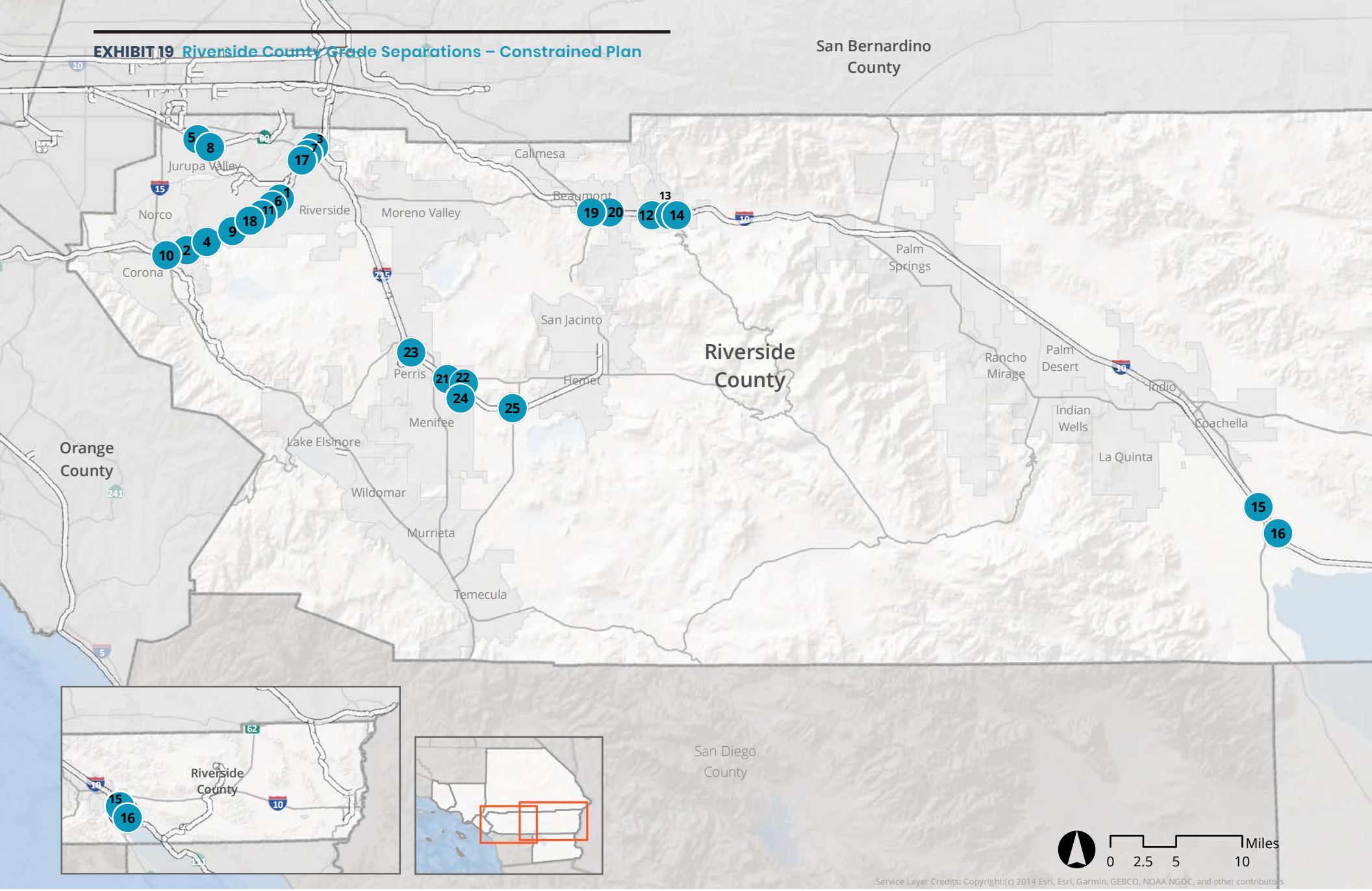


Complete Planned Under construction Regional Rail Line

1. Lakeview Avenue
2. Raymond Avenue
3. State College
4. Orangethorpe Avenue

Source: SCAG, 2019

EXHIBIT 19 Riverside County Grade Separations – Constrained Plan

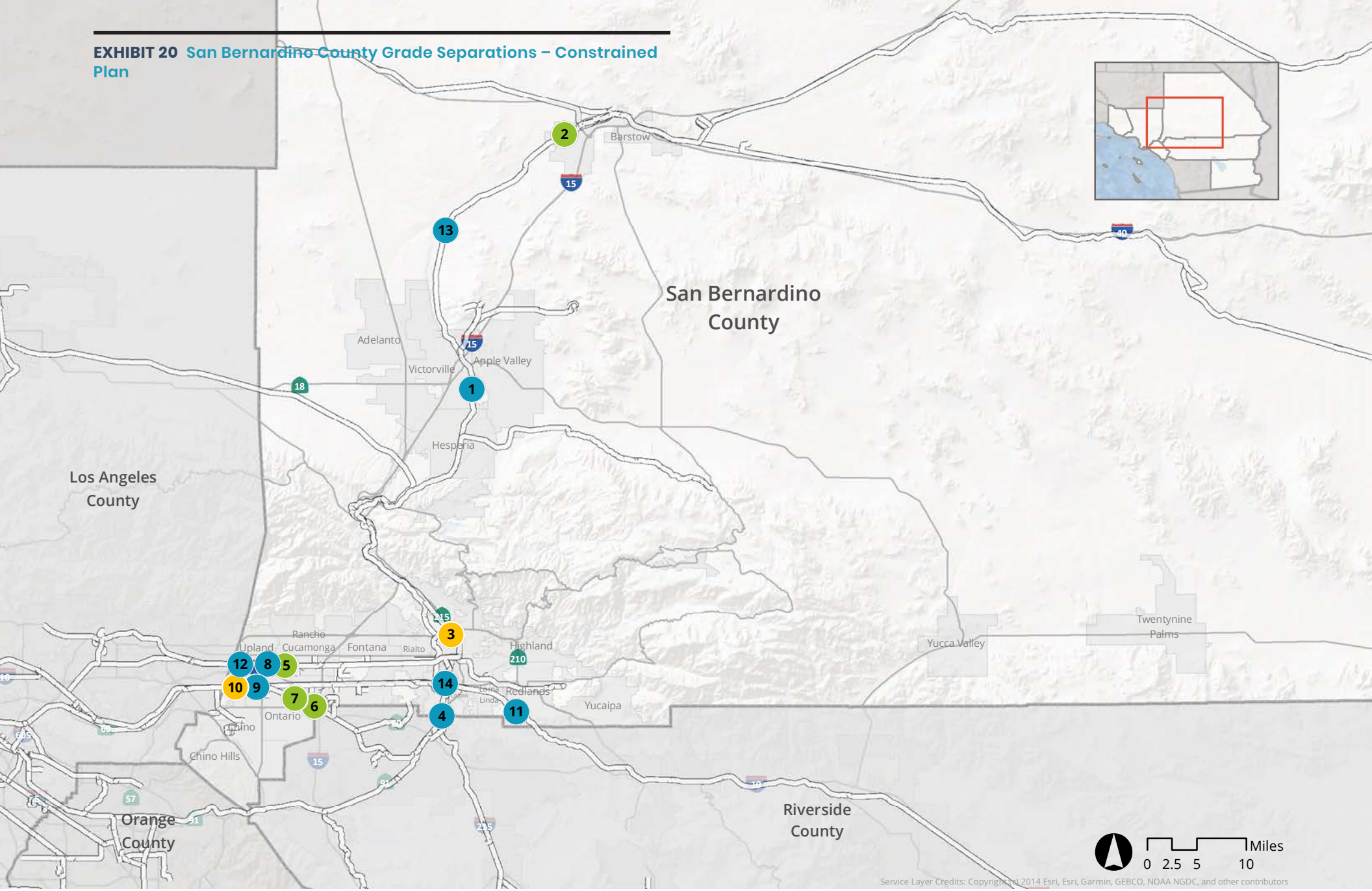


Complete Planned Under construction Regional Rail Line

1. Mary Street
2. Mckinley St
3. Chicago Ave
4. Pierce St
5. Bellgrave Av
6. Madison St
7. Spruce St
8. Jurupa Rd
9. Tyler St
10. Radio Rd
11. Adams St
12. 22nd St
13. San Gorgonio Ave
14. Hargrave St
15. Avenue 62
16. Avenue 66
17. 3rd Street
18. Jackson St/Bnsf Rail Crossing
19. California Ave UPRR
20. Pennsylvania Ave And UPRR
21. Ethanac Rd
22. Menifee Rd
23. Ellis Ave
24. Mccall Blvd/Menifee Rd
25. Mccall Blvd/Sr-79

Source: SCAG, 2019

EXHIBIT 20 San Bernardino County Grade Separations – Constrained Plan

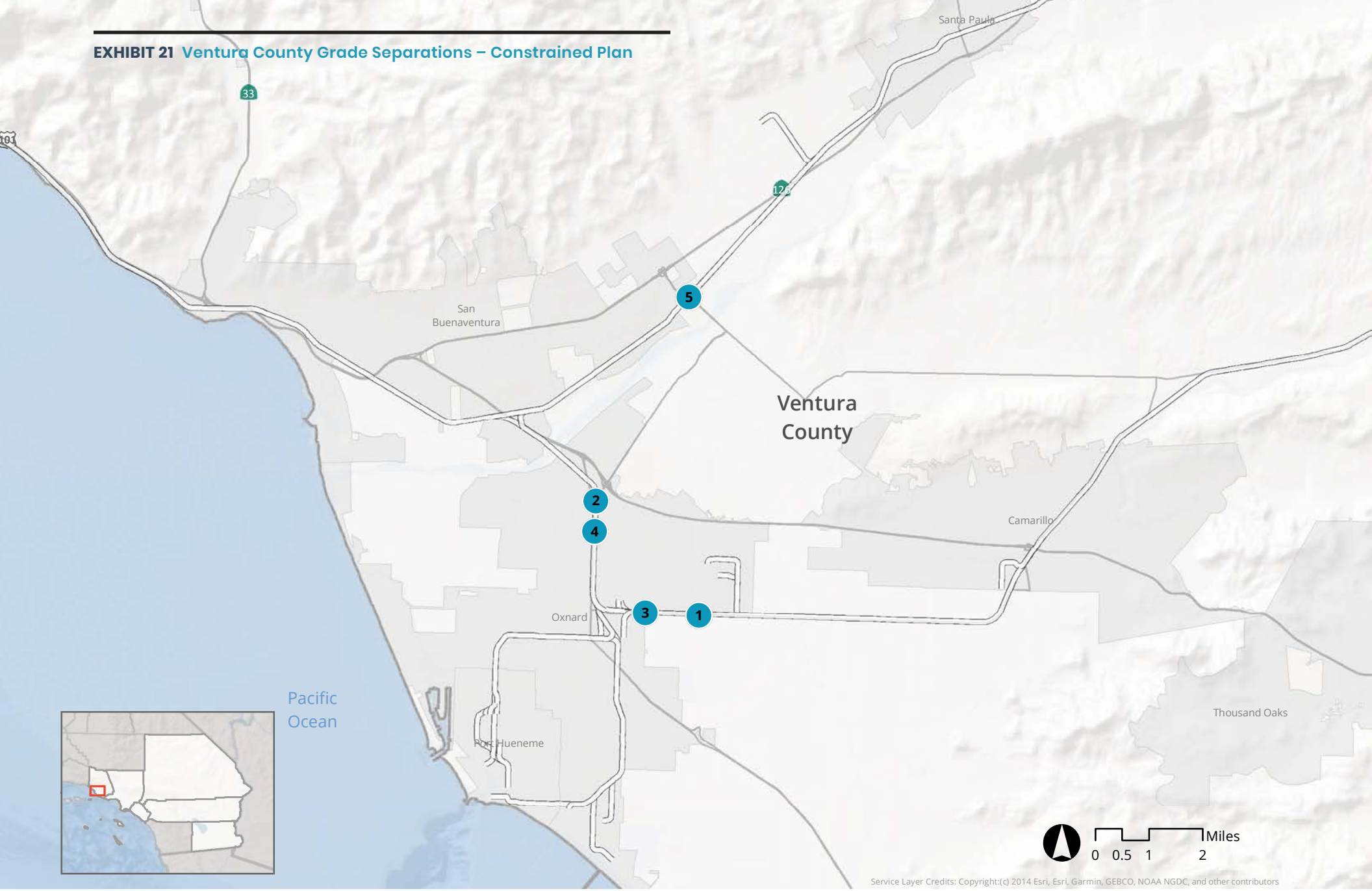


Complete Planned Under construction Regional Rail Line

1. Green Tree Blvd Extension
2. Lenwood Road
3. Mt. Vernon Viaduct
4. Main St
5. N. Vineyard Ave
6. S. Milliken Ave
7. South Archibald Ave
8. Campus Ave
9. San Antonio Ave
10. Monte Vista
11. Beaumont
12. Central Avenue (Bridge Rehap)
13. Vista Road / Shadow Mountain & BNSF
14. Fogg St (Colton)

Source: SCAG, 2019

EXHIBIT 21 Ventura County Grade Separations – Constrained Plan

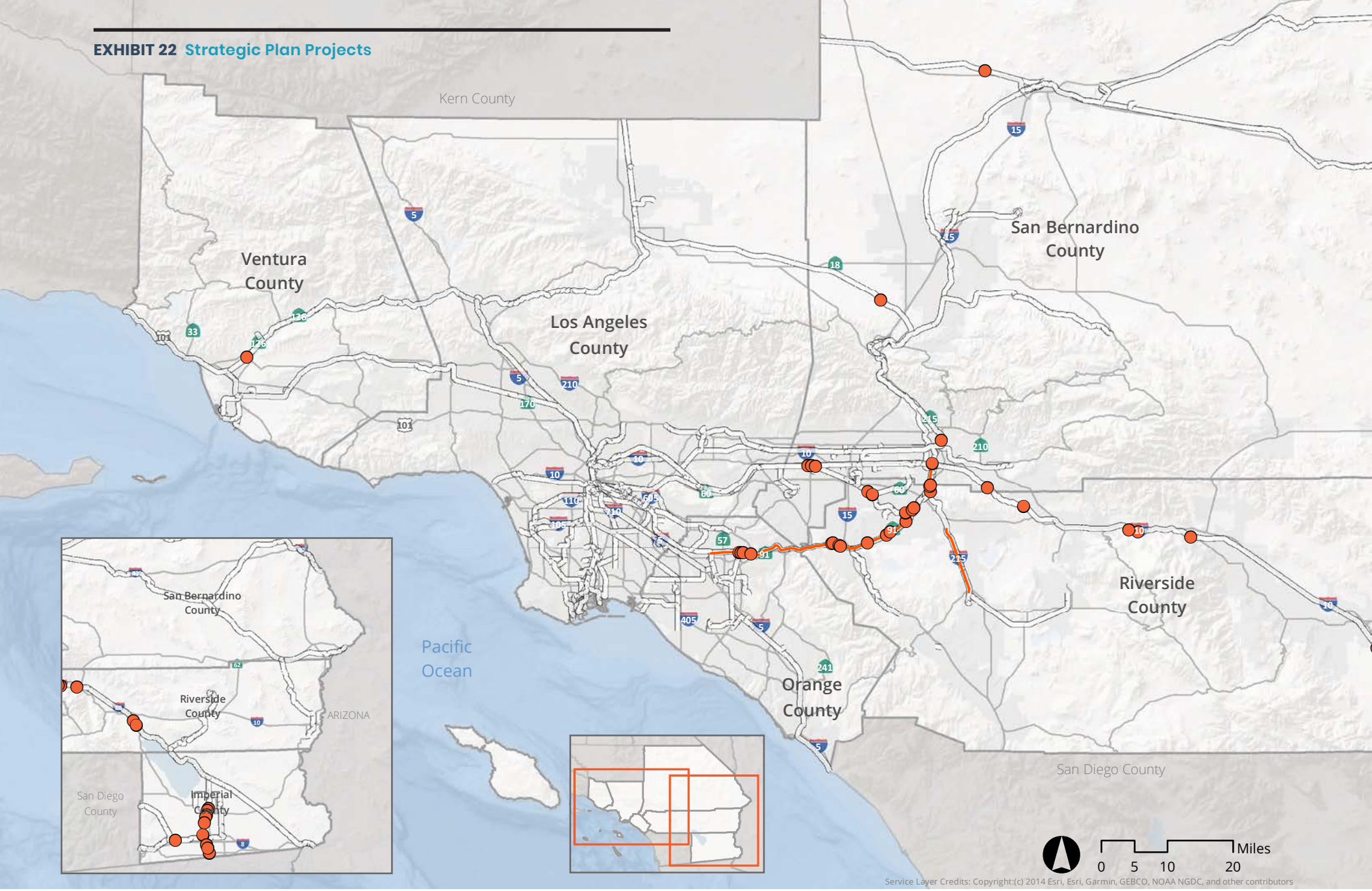


Complete Planned Under construction Regional Rail Line

1. Rice Ave/Fifth Street
2. Vineyard Avenue
3. Rose Avenue
4. Gonzales Rd
5. Los Angeles Avenue
6. Countywide

Source: SCAG, 2019

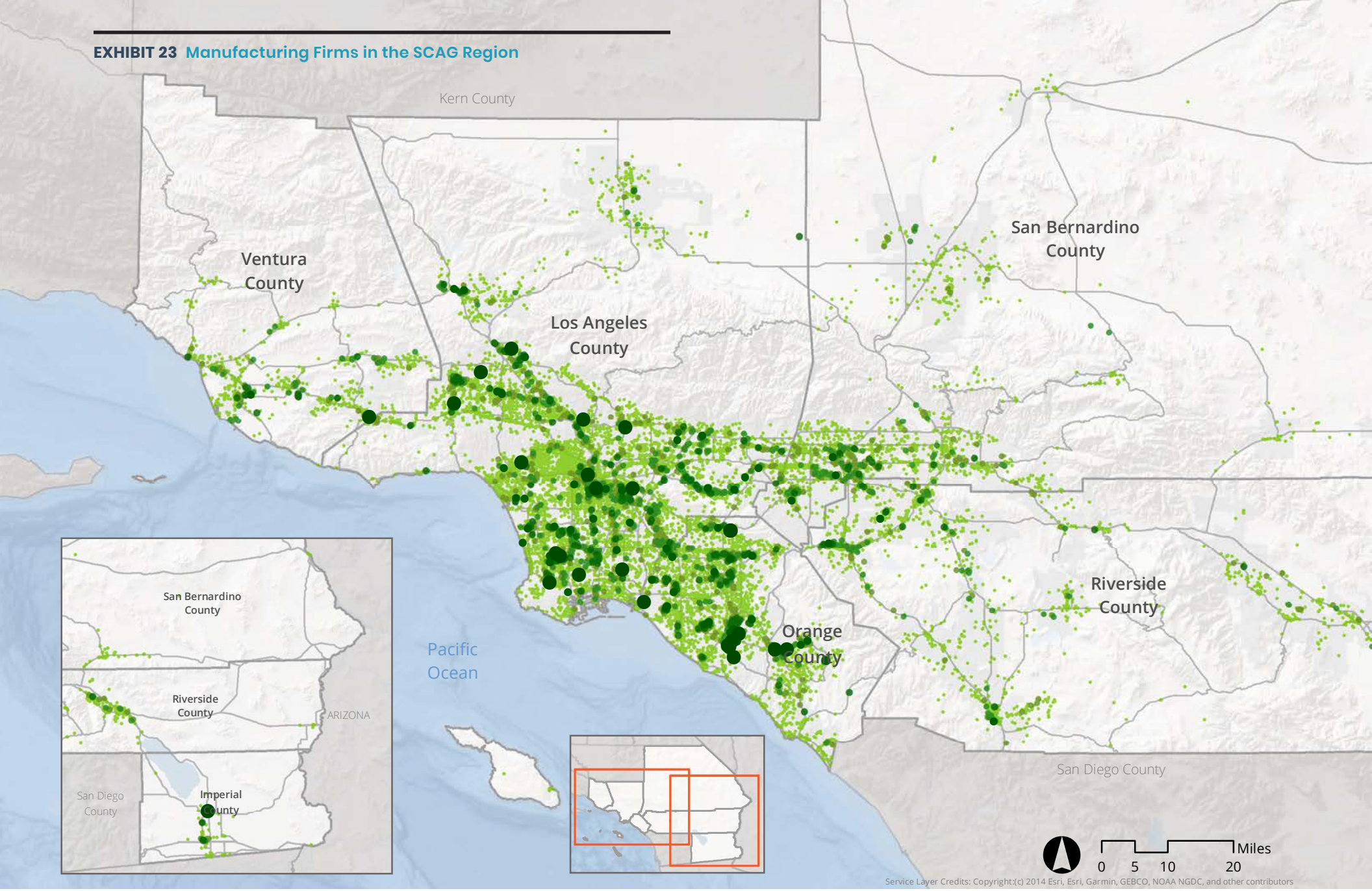
EXHIBIT 22 Strategic Plan Projects



Grade Separations (Strategic) Rail Track Expansion (Strategic) Regional Rail Lines

Source: SCAG, 2019

EXHIBIT 23 Manufacturing Firms in the SCAG Region

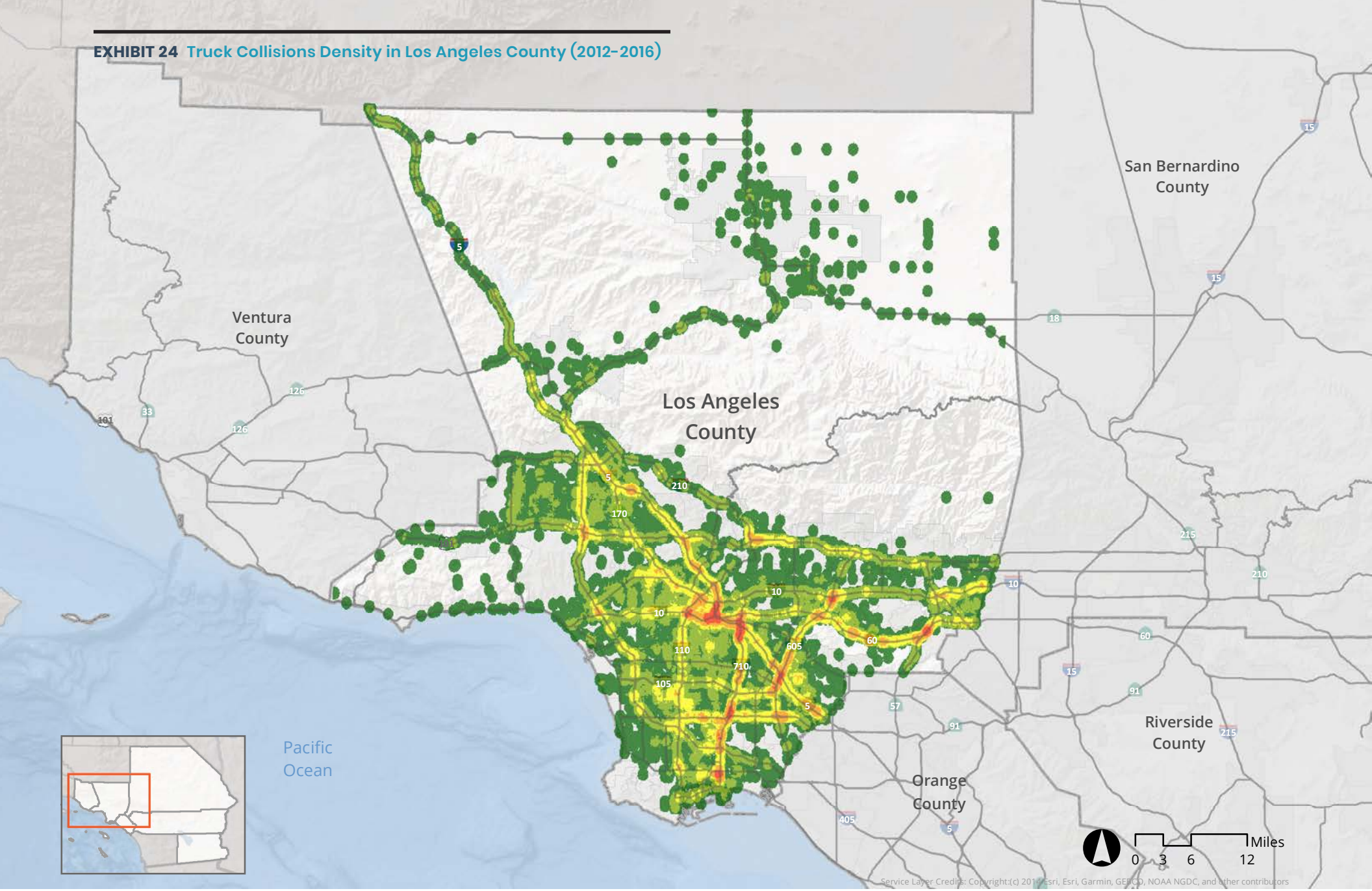


Manufacturing Firms by Total Employment

- <=50
- 51-100
- 101-250
- 251-500
- 501-1000
- 1001-3000

Source: InfoGroup 2011

EXHIBIT 24 Truck Collisions Density in Los Angeles County (2012-2016)



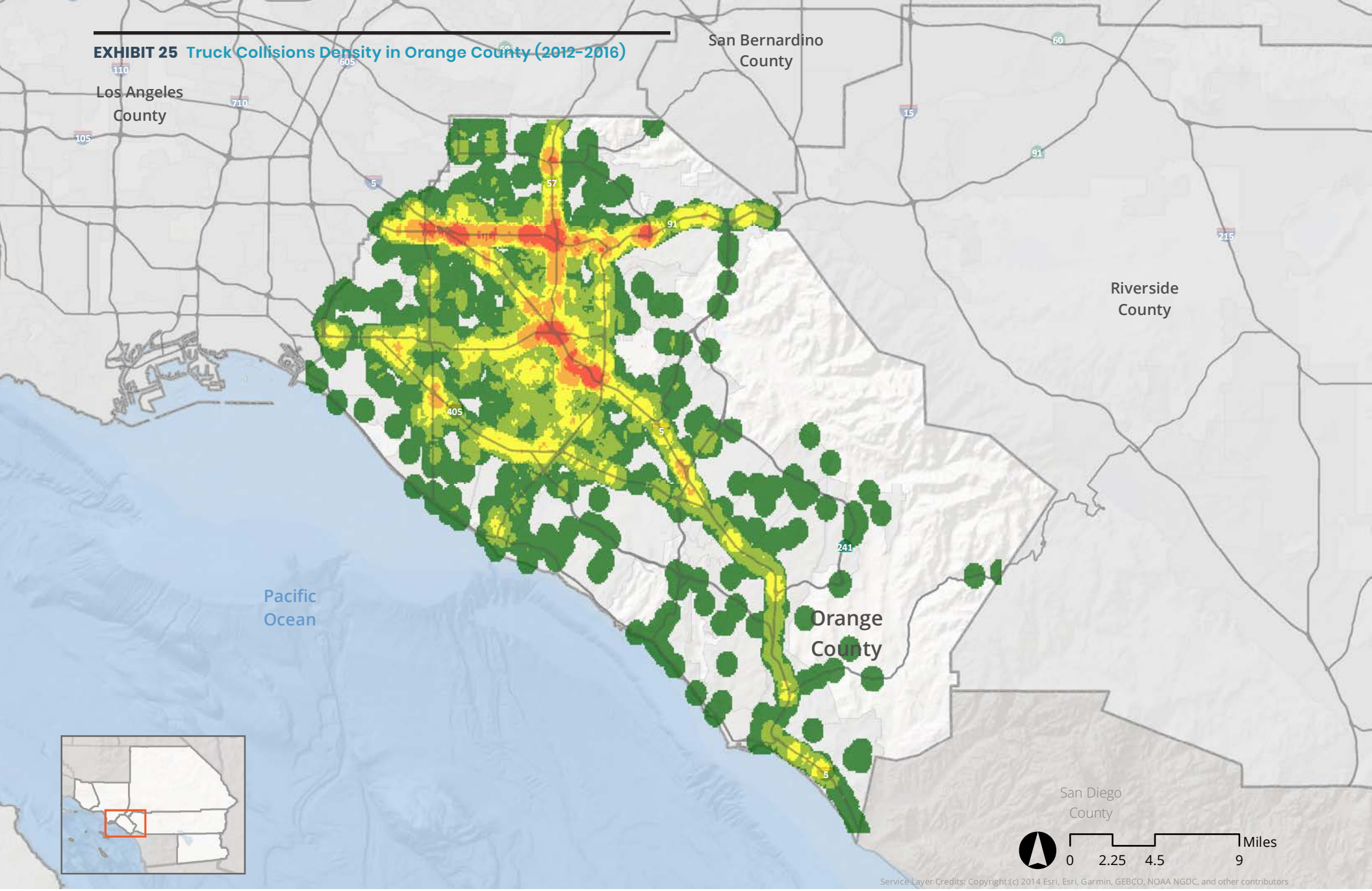
Truck Collision Density

High

Low

Source: SWITRS, TIMS

EXHIBIT 25 Truck Collisions Density in Orange County (2012-2016)



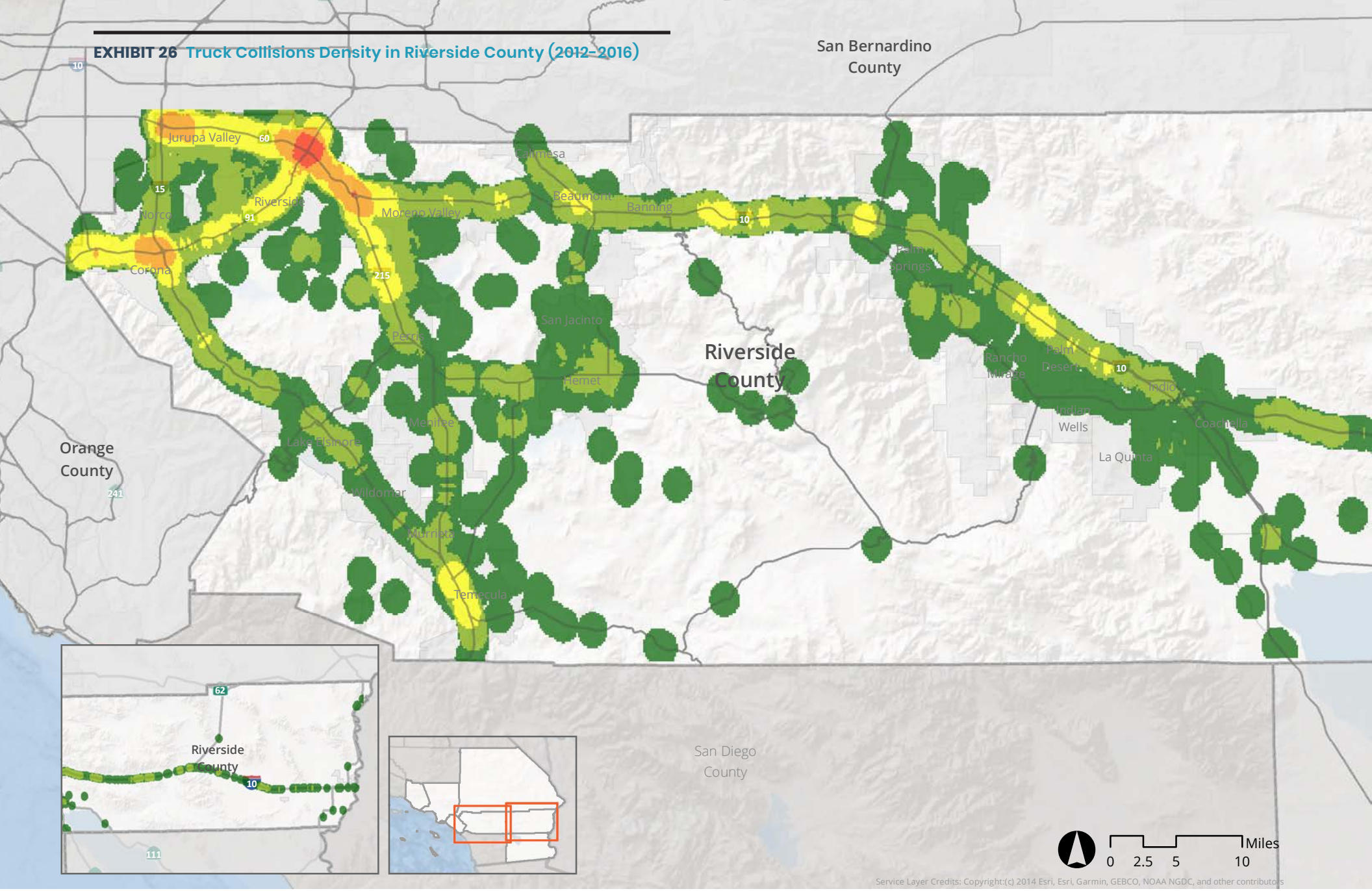
Truck Collision Density

High

Low

Source: SWITRS, TIMS

EXHIBIT 26 Truck Collisions Density in Riverside County (2012–2016)



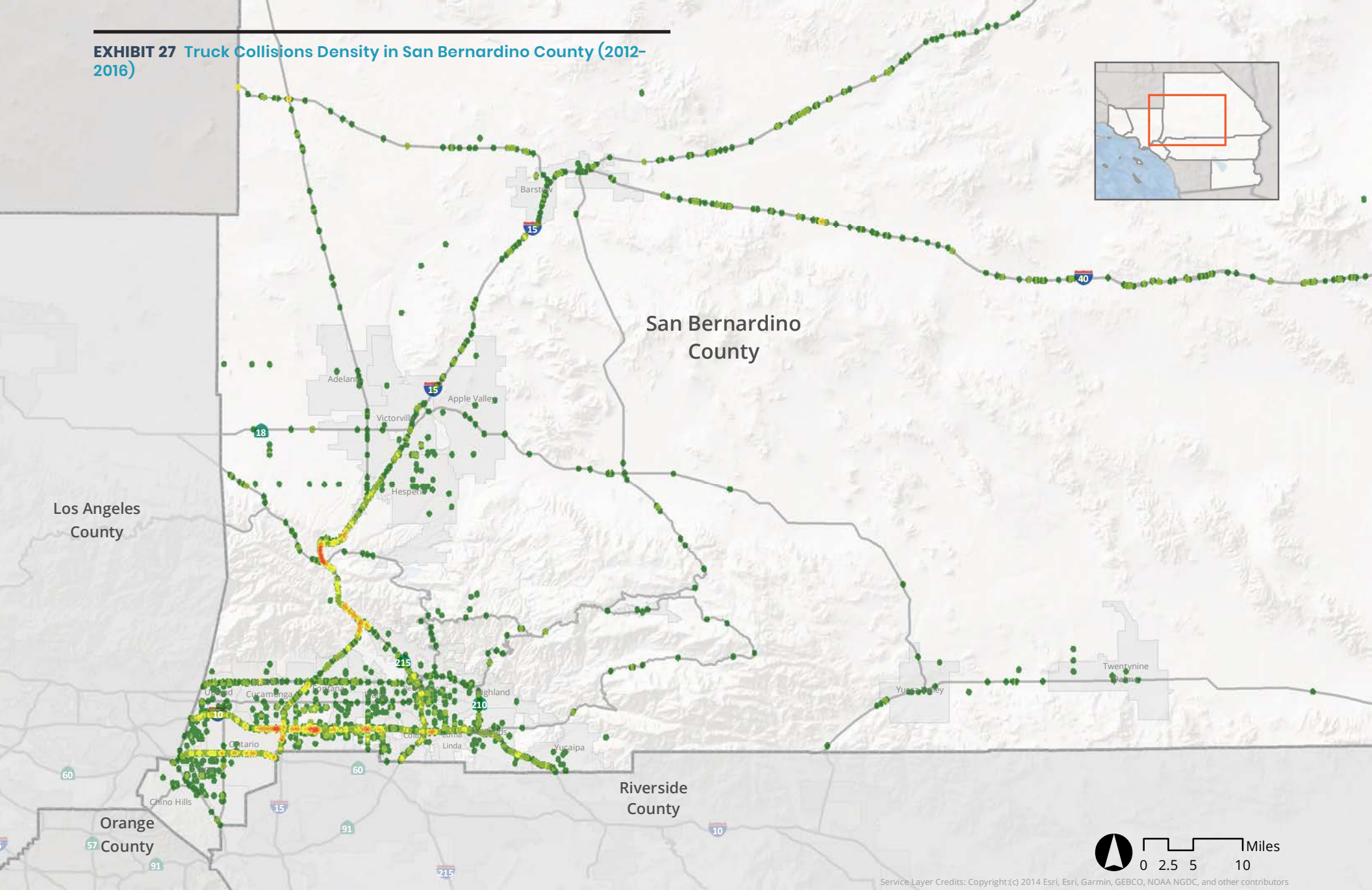
Truck Collision Density

High

Low

Source: SWITRS, TIMS

EXHIBIT 27 Truck Collisions Density in San Bernardino County (2012-2016)



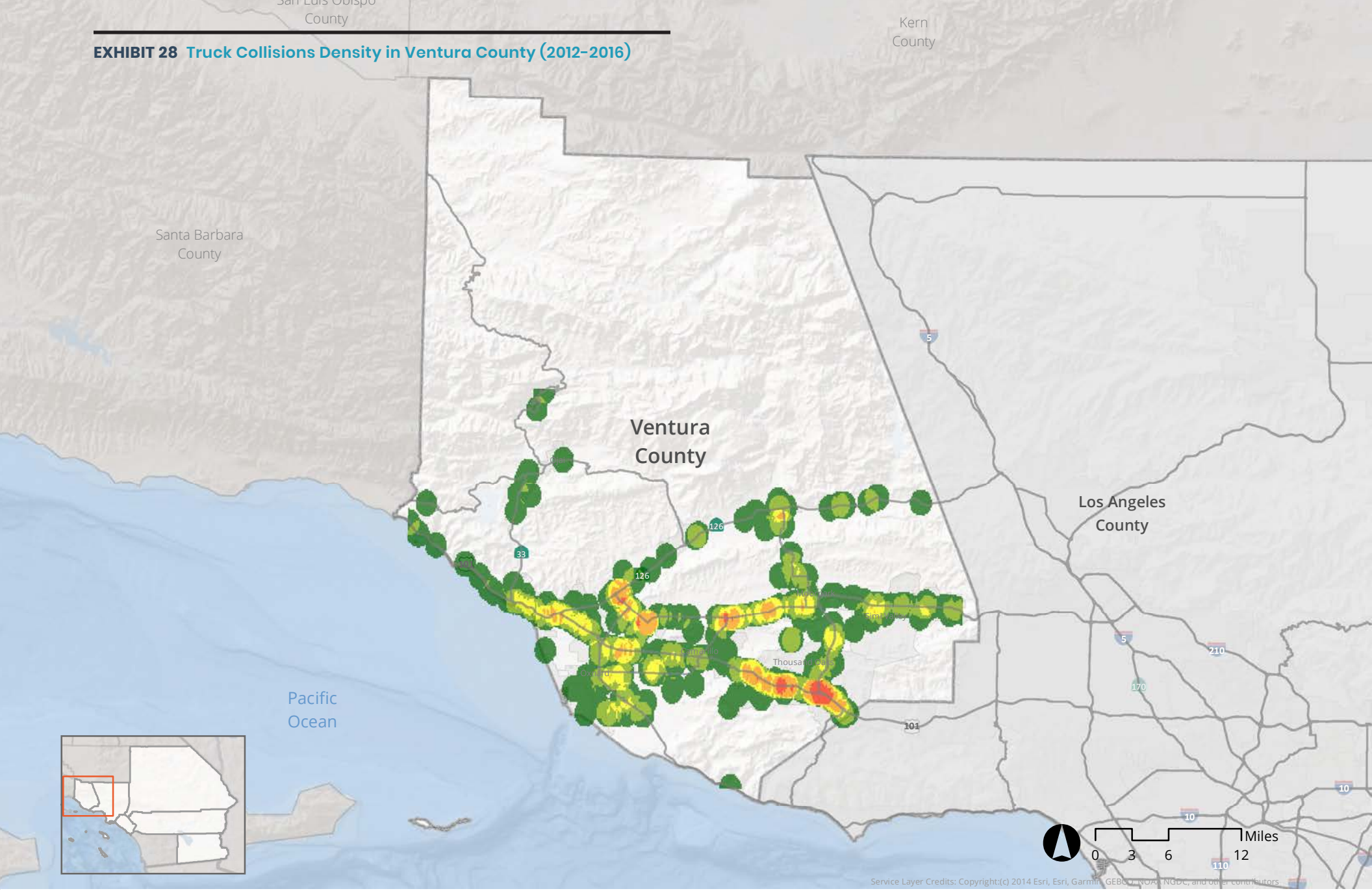
Truck Collision Density

High

Low

Source: SWITRS, TIMS

EXHIBIT 28 Truck Collisions Density in Ventura County (2012-2016)



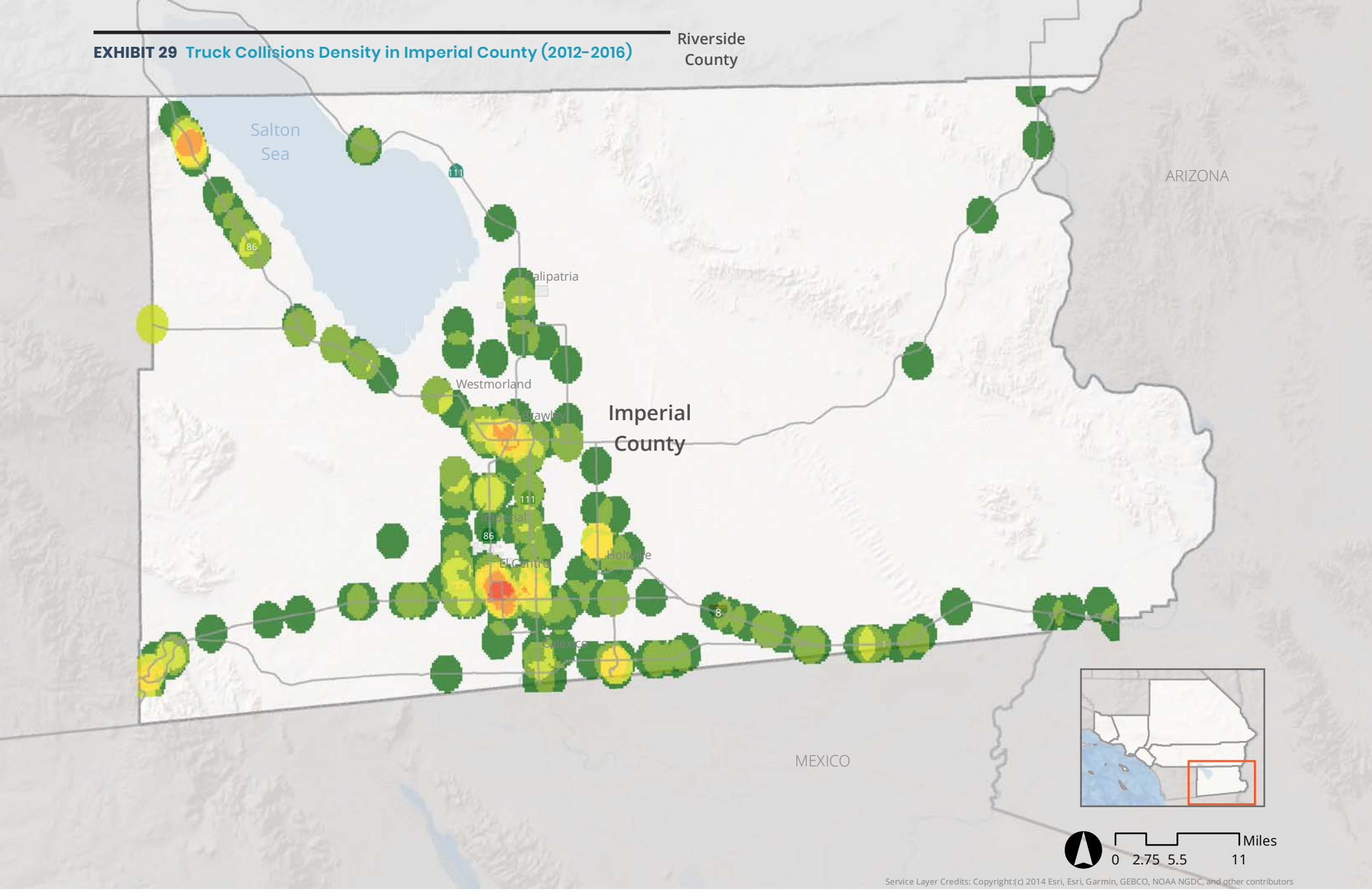
Truck Collision Density

High

Low

Source: SWITRS, TIMS

EXHIBIT 29 Truck Collisions Density in Imperial County (2012-2016)



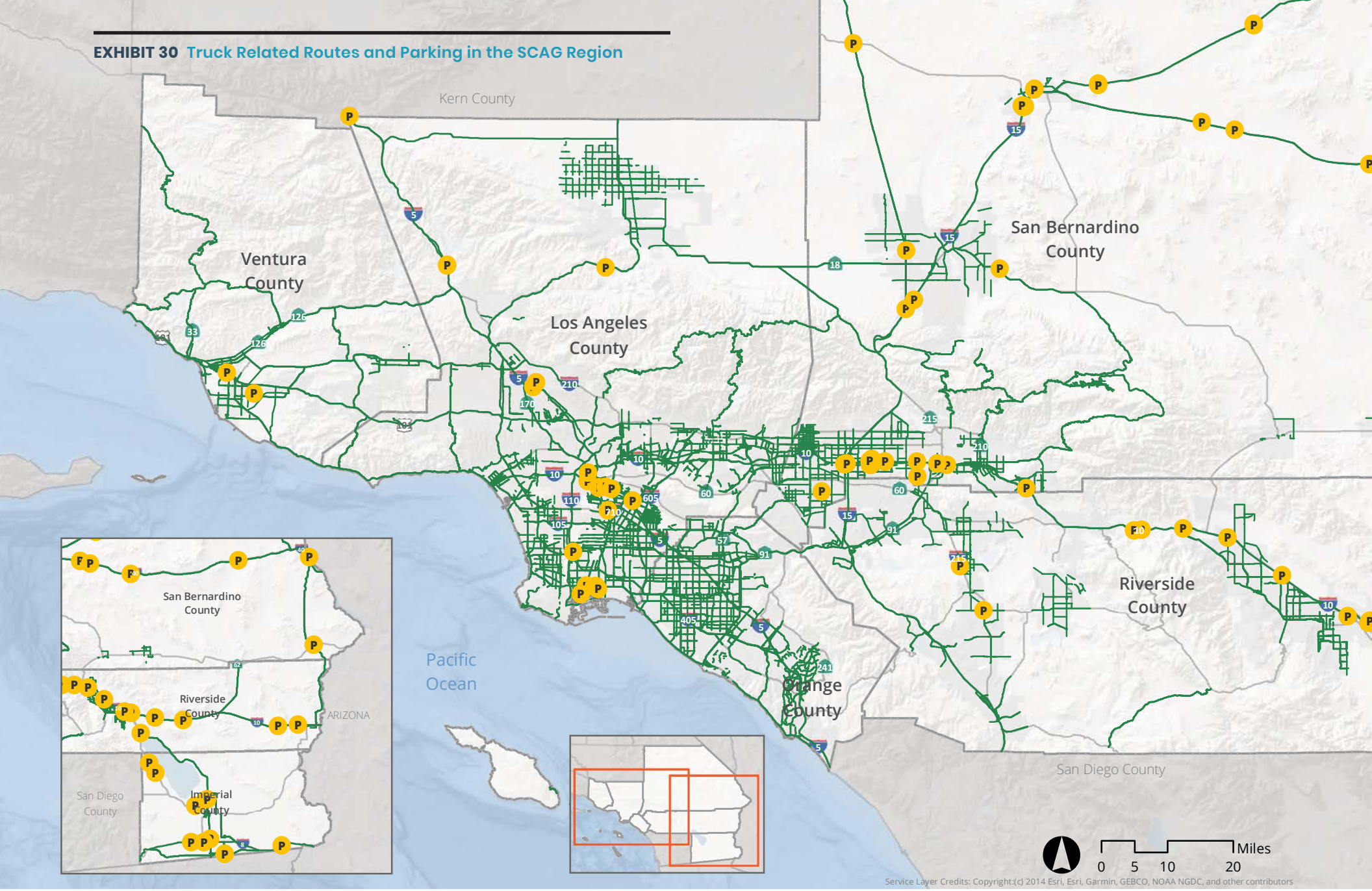
Truck Collision Density

High

Low

Source: SWITRS, TIMS

EXHIBIT 30 Truck Related Routes and Parking in the SCAG Region



Truck Related Routes P Truck Parking

Note: Truck related routes include permitted, restricted and prohibited routes. Truck parking locations are current public and private truck parking location.

Source: SCAG, 2019

APPENDIX 1 OF 1

Near and Long Term Zero and Near-Zero Emissions Technology Opportunities for Trucks and Rail

Appendix will briefly describe both near- and long-term technologies that have the potential to reduce emissions and help the region meet attainment deadlines. The technologies identified serve as examples of potential near- and long-term options for further study and do not constitute specific technologies under the financially constrained RTP/SCS.

OPPORTUNTIES FOR REDUCED EMISSION TRUCKS

EXISTING AND NEAR-TERM TECHNOLOGIES

The trucking market offers unique challenges due to heavy weights, operational performance requirements and high incremental costs. However, several reduced-emissions trucks are currently commercially available and many zero and near-zero emission trucks are under development for future deployment. Three categories of potential near-term improvements are combustion and aerodynamic improvements, trucks using a cleaner fuel, such as natural gas and hybrid-electric trucks.Battery-electric trucks for some medium duty applications can also be considered near term, as companies such as FedEx and Frito Lay have made near term commitments to include these in their fleet.

COMBUSTION ENGINE AND AERODYNAMIC IMPROVEMENTS

While the majority of this Environmental Strategy seeks to develop and deploy a regional fleet of zero emission trucks, it is important to recognize the value of near-term improvements to the existing combustion engine. Improvements to engine efficiency will reduce fuel used and emissions produced in the near-term and lessons learned will help in the design of more power efficient zero emission vehicles as fleets convert to full zero emissions. Improvements to internal combustion engines are discussed in the CARB Draft Technology Assessment: Engine/Powerplant and Drivetrain Optimization and Vehicle Efficiency, released June 2015. This report discusses the potential to obtain increased efficiency in the existing internal combustion engine through engine technologies (such as waste heat recovery) and vehicle efficiency technologies (such as automatically inflating tires and improved aerodynamics). These technologies are relatively low cost ranging from $300 to $3,100 per device, and may improve fuel economy up to 7 Percent.[87] For example, Low Rolling Resistance Tires can improve fuel economy by 4-7 percent[88] and improved aerodynamics such as side skirts may improve fuel economy by roughly 6 percent.[89]

CLEANER FUEL TRUCKS

Alternative fuels include compressed and liquefied natural gas (CNG, LNG), liquefied petroleum gas (LPG, i.e., propane), ethanol, methanol, dimethyl ether (DME), hydrogen and nonpetroleum biodiesel fuels. Some biodiesels are produced through processing other oils such as soy or canola, or are byproducts of other processes, or waste products such as used cooking oil. Most new medium and heavy duty are engines have warranties that accommodate up to 20 percent blend of biodiesel with conventional diesel.

Currently, up to 5 percent biodiesel can be added to conventional diesel with no labeling. Renewable biodiesel also comes from biomass though it is produced differently. It can be blended into the conventional fuel supply without limit.[90] Emissions benefits vary greatly depending on the biomass and process used. Concerns exist about the true sustainability of biodiesel, depending on the source material used. For instance, palm oil may be grown as a result of unsustainable rainforest deforestation. Also, some of the biomass produced could alternatively be used for food production. Therefore, this fuel source has tradeoffs that must be considered.

Natural gas trucks use CNG or LNG to power an internal combustion engine. Natural gas trucks have already been deployed and may experience greater market penetration if more fueling infrastructure is provided. For Class 7–8 heavy duty vehicles, the Cummins–Westport CWI line has a certified 12L engine that meets CARB low–NO_x engine standards. Engines are also available in 6.7 and 9L sizes that are used for transit buses, shuttles, and medium duty trucks. Compared to diesel trucks, on board fuel storage may limit range, depending on the size of the tank. While the number of fueling stations has increased, for natural gas trucks to obtain greater market share, more fueling stations are needed.

Renewable natural gas, also known as biomethane, is another alternative fuel source. It is produced from the capture and reuse of methane that is naturally released from the decomposition of natural sources such as organic matter from landfills or dairy farms. This methane has a higher greenhouse gas intensity than CO_2, so the ability to capture, convert and reuse it is important and results in a negative carbon intensity for renewable natural gas produced in this manner. The captured methane must be processed so that it is pipeline ready before it can be injected into the natural gas pipeline. United Parcel Service (UPS) has included renewable natural gas vehicles in their fleet and has recently increased it is commitment to use renewable natural gas (RNG) to 170 million gallon equivalents through 2026.[91] UPS currently has about 6100

87 SCAG and ICF. (May 2019). Draft Task 3 report, part of SCAG and SBCTA study on Paths to Clean Vehicle Technology and Alternative Fuels Implementation in San Bernardino County
88 Johnson, Dennis (May 2019) Diesel Emission Controls and Fuel Saving Technologies, Talking Freight Webinar.
89 National Academies of Sciences, Engineering, and Medicine 2017. Guide to Deploying Clean Truck Freight Strategies.

90 Source: SCAG "Paths to Clean Vehicle Technology and Alternative Fuels Implementation in San Bernardino County".
91 Globe News Wire (May 2019). UPS Makes Largest Purchase of Renewable Gas Ever in the US

natural gas vehicles (or just under 2 percent[92] of their entire vehicle fleet.) Of these natural gas vehicles, roughly 25 percent will be powered by RNG.Southern California Natural Gas has committed to using only 100 percent renewable natural gas in its public fueling stations.

HYBRID-ELECTRIC TRUCKS

Hybrid-electric trucks contain an internal combustion engine as well as an electric motor, generator and energy storage device (e.g., a battery). The electric motor and generator absorb energy via regenerative braking and store that energy to offset acceleration and power demands of the vehicle. However, when battery power is insufficient, the truck draws power from a conventional engine. The incremental cost of this truck remains a barrier to market penetration, though some of this has been offset through incentive programs. Currently, the CARB HVIP program includes seven hybrid truck models with gross vehicle weights ranging from 6000-19,500 lbs, or up to Class 5.

LONG-TERM TRUCK TECHNOLOGIES

The long-term goal is to develop and deploy a fleet of zero emission trucks. Two broad categories of trucks are under development to meet this goal including battery electric and fuel cell. Depending on the truck design and compatibility, wayside power solutions may be used to extend the range of these configurations. In addition to developing zero emission vehicles, charging and fueling infrastructure is also a consideration that must be planned over the long term.

BATTERY-ELECTRIC TRUCKS

Battery-electric trucks replace the entire engine and drive train of a conventional vehicle with an electric motor and generator. The battery can provide all the power needed to power the truck and would ideally be recharged through normal operations; for instance, regenerative breaking could recharge the battery. However, this would likely not be enough power and therefore battery-powered electric trucks could allow for the battery to be recharged through plugging into the grid, using an on-board hydrogen fuel cell or connecting to a wayside power system. Currently, the technology is best for vehicles that travel a lower range, and charging time remains an obstacle.

This technology is most applicable for local delivery and utility vehicles, and companies such as Frito Lay, Stables, Coca-Cola, FedEx and UPS have begun to include medium duty EVs into their fleets.[93] FedEx has just purchased 100 electric delivery vans from Chanje Energy, and is leasing 900 more from Ryder trucks. These vehicles can drive 150 miles when fully charged.[94] Class 7-8 trucks battery electric trucks are also under development and 40 are currently deployed in California.[95] Manufacturers such as Tesla and Daimler Freightliner have prototypes under development with expected ranges between 25-500 miles.[96],[97] As battery power, charging times and costs improve, this technology will likely become more commercially viable. The incremental costs of battery electric technology vary depending on the vehicle class and are somewhat speculative; however, current estimates range from $50,000 to $250,000 per vehicle as compared to a conventional diesel truck.[98] Due to the reduced fuel costs from LCFS, CARB has developed estimates[99] that show that the total cost of ownership for electric urban delivery vans are cheaper today than their equivalent conventional diesel counterparts, and electric day cab tractors will become cheaper by 2024, even without purchase subsidies.

92 Calculated by author based on information found in Greenbiz (May, 2019). UPS to buy huge amount of renewable natural gas to power its truck fleet.

93 ICF. (2018). Medium-and Heavy-Duty Electrification in California, Literature Review- Final Report
94 FedEx (November, 2018) FedEx Acquires 1,000 Chanje Electric Vehicles.
95 ICF. (2018). Medium-and Heavy-Duty Electrification in California, Literature Review- Final Report
96 Trucks (June 2018). Daimler Unveils Electric Freightliner Cascadia.
97 Electrek. (April 2019). Tesla delays electric semi-truck production to next year.
98 SCAG and ICF. (May 2019). Draft Task 3 report, part of SCAG and SBCTA study on Paths to Clean Vehicle
99 CARB (2019). Advanced Clean Trucks Total Cost of Ownership Discussion Document, Preliminary Draft for Comment.

FUEL-CELL TRUCKS

Fuel cells generate electricity by splitting hydrogen and this power is used to power a motor or recharge a battery. Fuel cells may be combined with other technologies to extend range and power capabilities. Range estimates for fuel cell heavy duty vehicles vary, but have been reported to be between 200-1000 miles between fill-ups, and the vehicle range is generally limited only by the amount of on-board hydrogen storage possible.[100,101] Another benefit of the fuel-cell truck is the ability to fuel relatively quickly. Hydrogen used in the fuel cell can be produced with different means, each with different energy requirements, and different CO2 life-cycle impacts. Fuel cell technology has had early applications in transit vehicles and several OEMs are developing fuel cell trucks.

CHARGING INFRASTRUCTURE FOR ZERO EMISSION TRUCK TECHNOLOGIES

The deployment of the technologies discussed above cannot be completed without supporting infrastructure to provide either fuel or power to the vehicle. For electric technologies, this implies a network of electric heavy–duty vehicle charging stations. Fuel cell vehicles, would also require a network of stations that provide their fuel. Alternatively, wayside power systems could allow a vehicle to charge or draw power during on–road operations.

Wayside power technologies allow a vehicle to charge while in operation, drawing power as it moves along the road. Ideally, these systems would allow for trucks to enter and exit seamlessly and change lanes, and they could be shared with standard trucks. They offer the potential to extend the range of a vehicle that is charged from a stationary power source by providing additional power in motion. As an example of this, an Overhead Catenary System (OCS) was recently demonstrated by the SCAQMD and other partners in the City of Carson (see above for more detail on the demonstration project).

Both in-road or distributed charging systems draw power, which leads to emissions being produced during electricity generation. Therefore, the increased use of renewable energy sources will help move the vehicles described above which are designed to be zero tailpipe emissions closer to a truly zero emissions vehicle.

EXISTING NEAR–TERM RAIL EMISSION REDUCTION STRATEGIES

A fully zero emission rail system offers unique challenges as freight rail operates as a national system and locomotives cannot remain captive to the region. For instance, CARB estimates that 8,400 of 10,000 interstate line-haul locomotives operated in the SCAB in 2013.[102] Any new technology will require an operational strategy to change out locomotive types, or will require compatible infrastructure nationwide to provide power and/or fuel to locomotives. Locomotives also have relatively long lifespans. Even given these challenges, several near-zero and zero emission rail technologies are under development and investigation. Near-zero emission opportunities include acceleration of Tier 4 engines, use of after-treatment technologies that can be compatible with Tier 4 and earlier engine types, and further development of liquid natural gas tender cars.

EXISTING TECHNOLOGIES

EPA standards for locomotives became effective in 2015, requiring that all new locomotives purchased after that date must meet Tier 4 standards. In addition, any re-manufactured locomotive must be retrofited with stricter emission controls. In 2015 General Electric released a commercially viable Tier 4 line-haul locomotive. Relative to Tier 2 engines, Tier 4 engines produce between 75-85 percent less NOx and PM emissions;[103] they also offer combustion improvements, enhanced cooling and exhaust gas recirculation. While Tier 2

100 Port of Los Angeles and Port of Long Beach, April 2019, 2018 Feasibility Assessment for Drayage Trucks
101 Erik Neandross, September 2017, Insights, Hydrogen Fuel-Cell Trucks.

102 CARB. (September 3, 2014). ARB Freight Locomotive Advanced Technology Assessment
103 CARB. (August 26, 2014). Draft Handout: Rail Technology Assessment Summary of Results

locomotives are estimated to cost $2.3 million per unit, Tier 4 locomotives are estimated to cost $3 million.[104] SCAG encourages partnerships to accelerate the transition to these new engines.

Distributed power units are currently in use by Union Pacific Railroad (UPRR) on two thirds (2/3) of its gross ton miles. Distributed power units are spread throughout the train rather than all in the front, making the train less prone to derailments and facilitating more even braking. These units also provide a fuel savings of four to six (4-6) percent compared to standard locomotive power.[105]

TECHNOLOGIES IN DEVELOPMENT

To go beyond the Tier 4 standard, Selective Catalytic Reduction (SCR) for NOx and Diesel Oxidation Catalysts (DOCs) and Diesel Particulate Filters (DPFs) for PM are estimated to reduce NOx and PM emissions 70 percent beyond the Tier 4 standard at a cost of approximately $4 million per unit.[106] These units may require additional maintenance costs, but are otherwise compatible with the national fleet. These units, as applied to Tier 4 locomotives, are still in the conceptual phase. However, DOCs, DPFs and a third technology called Exhaust Gas Recirculation (EGR) have all been tested by UPRR in intermediate length halls of approximately 200 miles. The smaller size of this engine allowed for all after treatment to be applied simultaneously.[107]

Liquid natural gas has also been considered as a fuel for rail locomotives. It is estimated that use of LNG with a Tier 4 locomotive would lead to NOx and PM reductions of 70 percent beyond the Tier 4 locomotive.[108] Tender car prototypes currently exist; however, there are operational considerations such as the need to carry an additional tender car to store the LNG fuel and the need for fueling infrastructure.

UPRR and BNSF are working with stakeholders such as locomotive and engine manufacturers, cryogenic fuel tank suppliers, natural gas/LNG suppliers, the Federal Railroad Administration and first responders to evaluate how natural gas could safely and economically be incorporated into their operations.

LONG-TERM EMISSION REDUCTIONS STRATEGIES FOR RAIL

The longer term goal of a fully zero emission system could potentially be accomplished with an electric catenary or linear synchronous motor system. A hybrid-electric engine or a battery tender car could also provide additional battery power to allow for locomotives to operate in zero emissions mode where battery power is available. The CARB Sustainable Freight Strategy promotes a long-term vision of zero emission rail as the technology permits. Without a full system conversion, this goal would allow for zero emission track miles where possible as facilitated by battery or fuel cell tender cars to allow locomotives to operate in zero emission mode when these tender cars can provide power. Similarly, LNG tender cars may allow for operation in near-zero emission mode. One opportunity to provide electric range to an existing diesel locomotive is to use a battery electric consist. BNSF is developing a battery electric consist where a battery is paired with a diesel engine to allow the locomotive to operate in zero emission mode where possible. The battery recharges with regenerative braking and can dramatically cut diesel usage.

Battery electric technology may also be applicable for switcher locomotives. Referred to as the Port of Los Angeles Zero Emission Track Miles Locomotive Demonstration Project, the Port of Los Angeles, VeRail Technologies and Pacific Harbor Line, LA DWP, and the Coalition for a Safe Environment were awarded funds to demonstrate a zero emission battery powered switcher locomotive. However, due to complications, this project was terminated and the funding was returned to CARB to redistribute. The Port of Los Angeles is looking for other candidate projects to test electric locomotives at the ports.

ELECTRIFICATION TECHNOLOGIES

Electrification technologies require further evaluation to more precisely address

104 Ibid.
105 Union Pacific. (n.d.). Technology
106 Ibid.
107 Ibid.
108 CARB. (August 26, 2014). Draft Handout: Rail Technology Assessment Summary of Results.

questions about cost, funding and how to best implement such systems with minimal operational impacts. Because of the cost and potential operational challenges associated with mainline electrification, such a strategy should be considered a longer-term initiative, requiring further studies as well as proof of concept and prototype testing of zero emission locomotive technologies that have the potential to minimize cost and operational impacts, as discussed under the phased implementation section of this Appendix. Construction of any electrified rail system in Southern California would be a large investment and would need the participation of the BNSF and UPRR railways.

ELECTRIC CATENARY RAIL SYSTEMS

These are perhaps the most technologically ready; however, construction of an electrified rail system in Southern California would be a major undertaking in terms of labor, timeline and cost for the SCAG region and would require a large investment as well as cooperation and investment by the BNSF and UPRR railways. Though electric catenary systems are widely used for passenger and light rail and electric freight rail has been used in other countries, locomotives would need to be re-engineered for use with trains of the size and length operated in the United States.

DUAL-MODE LOCOMOTIVES

These have been deployed for passenger rail applications, but would need development for freight applications. They have the ability to operate on a catenary or with traditional diesel power. The ability to operate in both modes could potentially reduce operational difficulties associated with the need to remove the engine at the end of the electrified system. However, additional operational considerations remain to be addressed.

LINEAR SYNCHRONOUS MOTORS

This technology propels rail cars by creating an electromagnetic field from motors embedded in the railway. One advantage of LSM is that overhead electric lines would not be needed, allowing the electric rail system to extend further into ports and railyards. Because the propulsion comes from the track, locomotives would not need to be switched when leaving the electrified portion of the system. LSM technology is in its early stages and costs cannot be estimated, however demonstration projects are underway.

OPTIONS FOR ZERO EMISSIONS OPERATION

While the scale of a fully electrified system may be challenging, opportunities may exist to supplement locomotive power with zero emissions options. One option is the hybrid electric locomotive engine, where a battery is built into the frame of the engine and can recharge through regenerative braking. Prototypes of this model currently exist. 69 Battery tender cars could also supplement a main engine with zero emission propulsion by using the battery power. In contrast with the hybrid electric locomotive, the tender car would need to be charged prior to use, likely at railyards. The number of tender cars required to move a train long distances is challenging as space is at a premium on interstate trains. Similarly, facilitating the change out of the tender car is a big operational challenge for this type of system. Conventional locomotives generally refuel every 1,000 miles 70, so a tender car system that offered less power would create operational challenges. Currently a prototype is being demonstrated in the San Joaquin Valley.

Hydrogen Fuel Cell locomotives would also allow for zero emission miles, but would require a national fueling infrastructure and have similar challenges as described above. These are conceptual for line-haul locomotives but prototypes exist for a switcher and a green goat.

SCAG™
INNOVATING FOR A BETTER TOMORROW

MAIN OFFICE

900 Wilshire Blvd., Ste. 1700
Los Angeles, CA 90017
Tel: (213) 236-1800

REGIONAL OFFICES

IMPERIAL COUNTY
1405 North Imperial Ave., Ste.104
El Centro, CA 92243
Tel: (213) 236-1967

ORANGE COUNTY
OCTA Building
600 South Main St., Ste. 741
Orange, CA 92868
Tel: (213) 236-1997

RIVERSIDE COUNTY
3403 10th St., Ste. 805
Riverside, CA 92501
Tel: (951) 784-1513

SAN BERNARDINO COUNTY
1170 West 3rd St., Ste. 140
San Bernardino, CA 92410
Tel: (213) 236-1925

VENTURA COUNTY
4001 Mission Oaks Blvd., Ste. L
Camarillo, CA 93012
Tel: (213) 236-1960

CONNECT SoCal

TECHNICAL REPORT

GOODS MOVEMENT
ADOPTED ON SEPTEMBER 3, 2020

connectsocal.org

PLEASE RECYCLE 2907 2020.09.14