Chapter 2-2: Freight System Condition and Performance

Introduction

Knowing the condition of California's freight system is critical to guiding informed investment decisions and ensuring future economic sustainability. The following National Freight Policy goals from Chapter 1-1 are used as guides to assess system performance.

- Improve the state of good repair of the freight transportation system.
- Reduce congestion on the freight transportation system.
- Improve the safety, security, and resilience of the freight transportation system.
- Improve the contribution of the freight transportation system to economic efficiency, productivity, and competitiveness.
- Use advanced technology, performance management, innovation, competition, and accountability in operating and maintaining the freight transportation system.
- Reduce adverse environmental and community impacts of the freight transportation system.

The first three goals on this list reflect the physical condition of the freight infrastructure system and can be readily measured. The last three goals are less tangible and more difficult to measure. Initially, this chapter will discuss the physical freight system conditions, and then performance measures for the remaining goals will be presented. The United States Department of Transportation (U.S. DOT) will establish performance measures for use by states to guide highway-related freight decisions. With input from the California Freight Advisory Committee (CFAC), this chapter recommends interim multimodal measures while awaiting final federal guidance. The chapter will be amended at a later date to reflect consistency with the final guidance.

Freight System Conditions

The following summarized list of proposed measures by facility type precedes detailed information by three categories: freight infrastructure, congestion, and safety.

Highway

- Pavement Condition
- Bridge Condition
- Truck Travel Speed
- Truck Hours of Delay
- Highway Bottlenecks/Chokepoints
- Reliability Buffer Index
- Highway Truck Involved Fatalities and Injuries

Rail

- Height Allowances
- Weight Accommodation
- Train Speed

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- Rail Bottlenecks/Chokepoints
- Railroad Grade Crossing Fatalities and Injuries

Seaport

- Navigation Channel and Berth Depths
- Bridge Clearance

Freight Infrastructure

Preserving vital and valuable freight infrastructure is imperative to California's economic health and quality of life. The great majority of freight tonnage is moved throughout the State by vast roadway and rail systems. California air cargo valued at $198.9 billion was handled in 2010, and the 12 seaports processed $579.7 billion in foreign trade value[i] in 2012. With over 37 million inhabitants and multimodal trade throughout the state, nation, and beyond; nurturing California's freight infrastructure and helping the freight industry thrive while meeting community and environmental freight impact reduction needs is essential to our well-being.

Roadway

Pavement Condition

Most highway pavement damage is caused by heavy vehicles. Fully-loaded, multi-axle trucks weighing up to 80,000 pounds[ii] (40 tons) produce "as much pavement wear as up to 10,000 automobiles[iii]". Pavement along highways that have high numbers of heavy trucks is constructed to be thicker with greater reinforcement; however, according to "*Bumpy Roads Ahead*…" published in 2013 by TRIP (a national transportation research organization), California road conditions in major urban areas are still some of the worst in the nation.

Many local roads that provide first and last mile access to critical freight facilities have much poorer pavement condition than the State Highway System (SHS) and are not constructed to accommodate the loads traveling over them. Among the industries that may exacerbate roadway damage, especially along local freight routes due to their maximum allowed load weights, are agriculture/food product, wood product, mining, and machinery/manufacturing. Appendix 2-2.1 details locations where concentrations of these activities are occurring statewide.

Tracking roadway pavement condition is a way of measuring performance to preserve and protect asset health. According to the Caltrans 2011 *State of the Pavement Report*, distressed pavement is considered in poor condition when it has significant to extensive cracks or a poor ride. Pavement in this category would trigger Capital Preventive Maintenance (CAPM) rehabilitation or reconstruction projects. For every $1 Caltrans spends on preventive pavement maintenance, $4 on future pavement repairs can be saved[iv].

In 2011, of the total 49,518 highway lane miles in California, 12,333 (25 percent) were in distressed condition[v]. In 2013, mainly due to a change in roadway project approach which shifted more funds directly to pavement, the number of distressed lane miles was down to 7,821 (16 percent)[vi]. Of the proposed federal Primary Freight Network (PFN) system within the State of approximately 2,790 centerline miles, [to be determined (TBD)] miles (TBD percent) were

considered distressed in 2011. The current State Highway Freight Network equals approximately 5,772 centerline miles. Of those miles, TBD were distressed in 2011, which equates to TBD percent.

Bridge Condition

Fifty-two (52) percent of California bridges are on the SHS consisting of overcrossings or under crossings of streets or highways, and the remaining bridges are water crossings, railroads, pedestrian overcrossings, or others. According to the Caltrans Structure Maintenance and Investigation (SM&I) *State of California's Highway Bridge Inventory Annual Report* 2012/13, the average age of California's State Highway bridges is 42 years old. Many of these bridges are reaching an age that more complex maintenance and rehabilitation actions are required.

Bridge preservation performance can be measured by tracking the number of distressed (deficient/obsolete) bridges along the national and/or state freight networks. Vehicle weight restrictions due to bridge deterioration causes redirected freight trips which can lengthen travel time, waste fuel, and reduce efficiency. A structurally deficient bridge is one with routine maintenance concerns that do not pose a safety risk or one that is frequently flooded. A bridge is classified by the Federal Highway Administration (FHWA) as functionally obsolete if it fails to meet its design criteria either by its deck geometry, its load-carrying capacity, its vertical or horizontal clearances, or the approach roadway alignment to the bridge.

According to the federal *State Transportation Statistics* document, in 2012, California had 7,156 structurally deficient/functionally obsolete bridges out of a total of 24,812 structures, equaling 28.8 percent. In 2011, the number of structurally deficient /functionally obsolete bridges along the Primary Freight Network equaled TBD. Of the total number of bridges in this network, TBD percent were distressed. Along the State Highway Freight Network, TBD bridges, or TBD percent were distressed.

Rail

The major Class I railroads, Union Pacific (UP) and BNSF Railway, own and operate 79 percent of the track mileage in the State. They control system maintenance and infrastructure, and process over 3 million carloads originating, and over 3.1 million terminating in California per year. As track and other infrastructure are critical to sustaining freight rail service, the Class I Railroads ensure their operating track is well maintained. Short line freight rail owners and operators tend to have fewer resources and find maintenance upkeep more of a challenge. Accordingly, it is common that short line railroads operate at slower speeds and have lighter rail car weights.

Height Allowances

Economic and energy efficiency can occur when freight containers are stacked one atop another on rail cars. According to the 2013 *California State Rail Plan* (CSRP), the prerequisite for double-stack service is sufficient vertical clearance, which is typically 19 feet for international boxes and 20 feet 6 inches for domestic boxes. In California, all four of the following primary intermodal corridors have sufficient vertical clearances for double-stack service[vii]: BNSF Transcontinental, UP Sunset, UP Donner, and Tehachapi. Height limitations that preclude

double-staking along Class I and major short line railroad routes are depicted in the following maps (Figure 2-2.1). A more detailed listing can be found in Appendix C of the CSRP at http://californiastaterailplan.dot.ca.gov/docs/Final_Copy_2013_CSRP_Appendices.pdf.

Figure 2-2.1
Rail Height Limitations

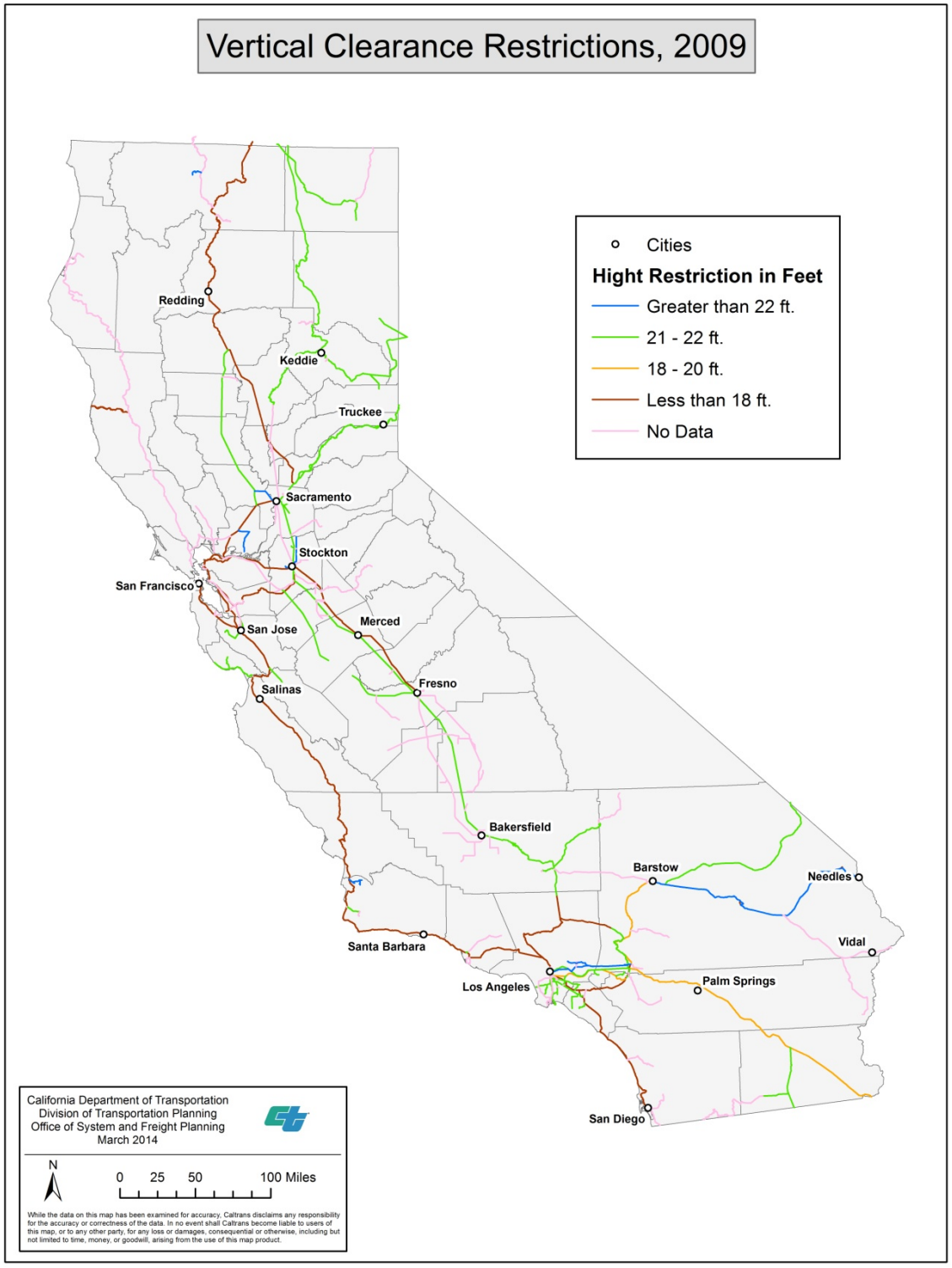
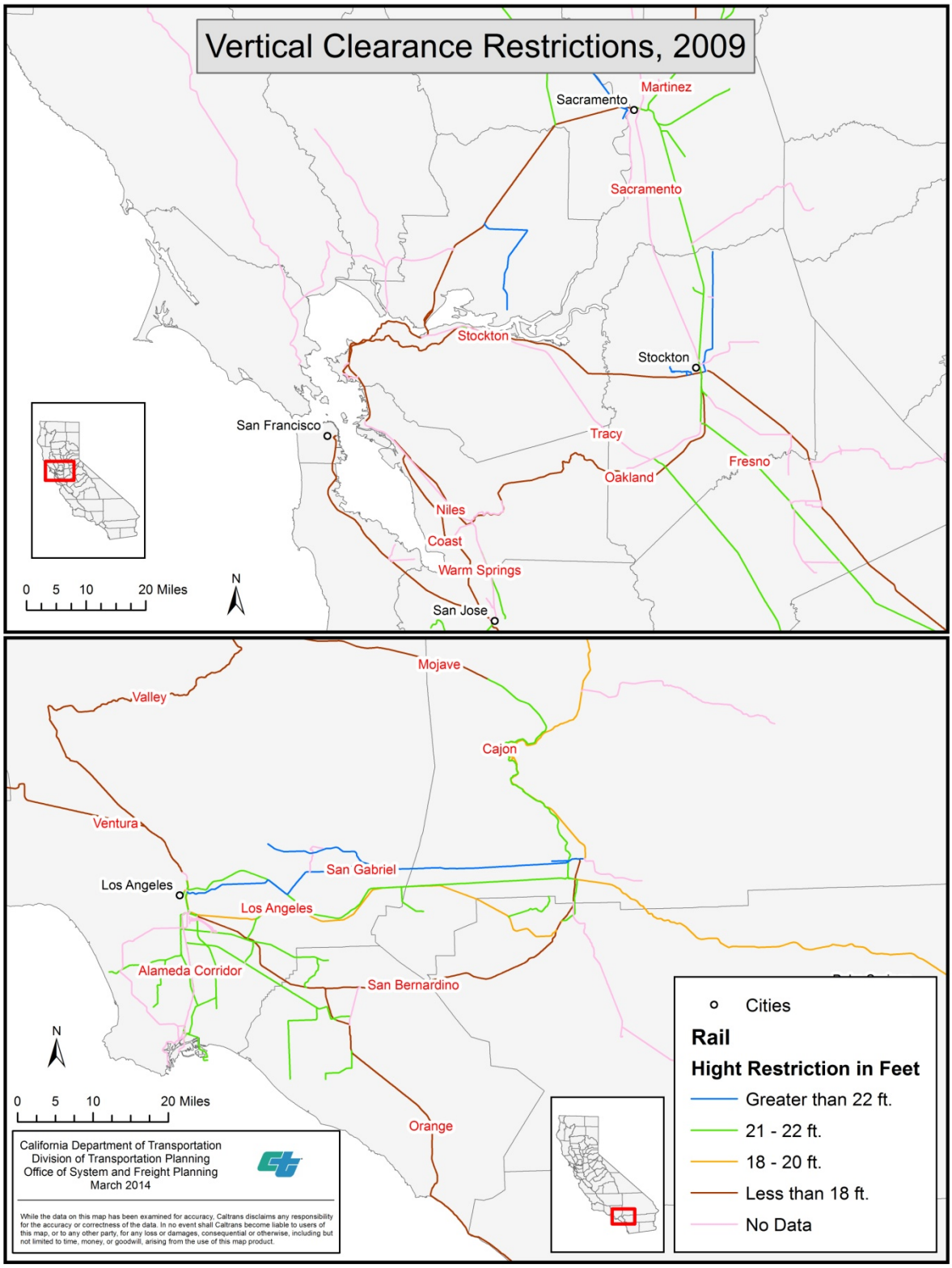


Figure 2-2.1 (continued)



Weight Accommodation

According to the 2013 CSRP, in the mid-1990s, the standard accepted railcar weight was increased from 263,000 to 286,000 pounds, necessitating accommodation of this weight for all Class I railroads. A rail line's ability to handle this weight is a function of track conditions, rail weight or gauge, and weight bearing structures such as bridges. Over 95 percent of California's Class I network is generally able to handle this standard weight with only 1.2 percent of total miles (39 miles in Orange County) rated at less than the standard. Weight data was not available for 120.5 miles of Class I track along the following subdivisions: San Diego, Olive, and San Gabriel.

Short lines are important for access to industrial sites and transporting heavy loads to last mile final destinations; however, their infrastructure conditions tend to be inferior to those of the large Class I railroads. Generally, short lines have track with lighter-weight rail which is not as well maintained, their tie and ballast conditions are inferior, and they often lack an active signaling system. As a result, mainline train speeds are lower [typically 40 miles per hour (mph) or less for freight trains] and operations are less automated. CSRP data revealed that only 27.2 percent (283.7 miles) of reported short line mileage can accommodate 286,000 pound railcars; 19 percent can handle only up to 263,000 pounds; and 19.2 percent reported that less than that amount can be handled. No weight restriction data was available on 362.6 miles of major freight short line track. A complete listing of freight rail system characteristics by location can be found in Appendix C of the CSRP, Tables C.5 and C.6. Although current conditions are probably adequate for existing business, lack of the ability to handle standard modern rolling stock will place carriers at a disadvantage when it comes to attracting and competing for future customers.

Seaport

Navigation Channel and Berth Depths

Efficient in- and outbound commerce movement at California seaports is critical for economic health. To preserve maritime transportation infrastructure, channels and harbors for all ports must be dredged and maintained to adequate navigable depths to accommodate the size of ships the ports are designed to handle. In addition to the State's 12 ports, there are 16 waterways that require minimum vessel depths. According to the U.S. Army Corp of Engineers (USACE), the following are minimum required depths at each location in order to handle the largest vessels calling at California ports in 2011. The second column of numbers reflects channel depths from the 2013 *American Association of Port Authorities (AAPA) Seaport Directory*. Minimum berthing depths at all 12 ports follow the channel depth list. [The listed figures are for planning purposes only and not intended for use in navigation decision making.]

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Channel	USACE	AAPA
San Diego Harbor	39’	37’-47’
Long Beach Harbor	68’	76’
Los Angeles Harbor	57’	53’
Port Hueneme	39’	35’ Mean Lower Low Water[viii] (MLLW)
Redwood City Harbor	38’	30’ MLLW
San Francisco Bay Entrance	47’	--
San Francisco Harbor	45’	55’ (approximately)
Oakland Harbor	45’	50’
Richmond Harbor	47’	38’
San Pablo Bay and Mare Island Strait	42’	--
Carquinez Strait	42’	38’ (from amports.us website)
Suisun Bay Channel	42’	--
San Joaquin River	40’	--
Stockton	40’	35’ MLLW
Sacramento River	34’	30’
Humboldt Harbor and Bay	34’	38’ MLLW

The following berth depths were mostly adapted from the 2013 *AAPA Seaport Directory*. The number of berths is in parenthesis.

- Port of San Diego 20’ (1); 30’ (2); 35’ (7); 42’ (6)
- Port of Long Beach 11’ (1); 30’ (3); 32’ (2); 33’ (3); 35’ (4); 36’ (8); 37’ (1); 38’ (2); 40’ (7); 42’ (6); 43’ (1); 48’ (6); 50’ (8); 52’ (6); 55’ (5); 76’ (1)
- Port of Los Angeles 32’-34’ (5); 35’ (14); 35’-45’ (11); 35’-51’ (2); 36.5’ (1); 37’ (1); 37.5’ (1); 38’ (2); 38’-45’ (3); 40’-45’ (1-2); 45’ (4); 45’53’ (6); 55’ (7)
- Port of Hueneme 35’ (5)
- Port of Redwood City 30’ (3)
- Port of San Francisco 40’ MLLW (3)
- Port of Oakland 37’ (1); 42’ (8); 50’ (17)
- Port of Richmond 12’ (2); 16’ (1); 20’ (1); 22’(1); 27’ (1); 35’ (4); 36’ (1)
- Port of Benicia 38 ft. MLLW (3)
- Port of Stockton 35’ (20)
- Port of West Sacramento 35’ (5)
- Port of Humboldt 26’ (1); 35’ (2); 38’ (3)

Bridge Clearance

To access some California ports, navigating vessels must heed minimum bridge clearances to avoid collisions. Vertical clearance is measured as the distance from the mean high water level (high tide) to the bottom of the structural span. The minimum vertical bridge height information for major seaport bridges below was extracted from National Oceanic and Atmospheric Administration (NOAA) charts (found at

http://ocsdata.ncd.noaa.gov/BookletChart/PacificCoastBookletCharts.htm). Access to the inland ports of Stockton and West Sacramento may require navigation under smaller fixed and draw bridges. [The listed numbers are for planning purposes only and not intended for use in navigation decision making.]

Major Bridges	Vertical Clearances
San Diego-Coronado Bay	West Span 156'
	Middle Spans 175'-195'
	East Span 214'
Vincent Thomas	165'
	Middle Span 185'
Gerald Desmond	Current 155'
	New 200'
San Mateo-Hayward	135'
San Francisco-Oakland Bay	West 204'-220'
	East 112'
Golden Gate	Center 225'
	North Pier 213'
	South Pier 211'
Richmond-San Rafael	West Channel 185'
	East Channel 135'
Carquinez	North Span 146'
	South Span 132'

Airport

Runway Condition and Capacity

Eleven (11) of the top twelve (12) Air Cargo airports have commercial passenger service, with Mather being the exception. Runway pavement is regularly inspected by federal and state officials for condition and other compliance. Through these assessments, runways in good or better condition are ensured. The remaining airport infrastructure is typically maintained by municipalities or regional airport systems.

In 2012, Caltrans contracted with System Metrics Group to determine if the top cargo airports have the capacity to handle future air cargo demand. According to the *California Air Cargo Groundside Needs Study*, which can be found at http://www.dot.ca.gov/hq/tpp/offices/ogm/air_cargo.html, there is sufficient capacity within the system to meet 2040 demand.

Congestion

Among other things, congestion wastes time, elevates prices, and increases the emission of harmful pollutants. Recognizing areas where traffic flow improvements are needed throughout the freight network is part of the solution. This section brings to light several areas within California that may need further scrutiny in order to improve mobility on the freight system.

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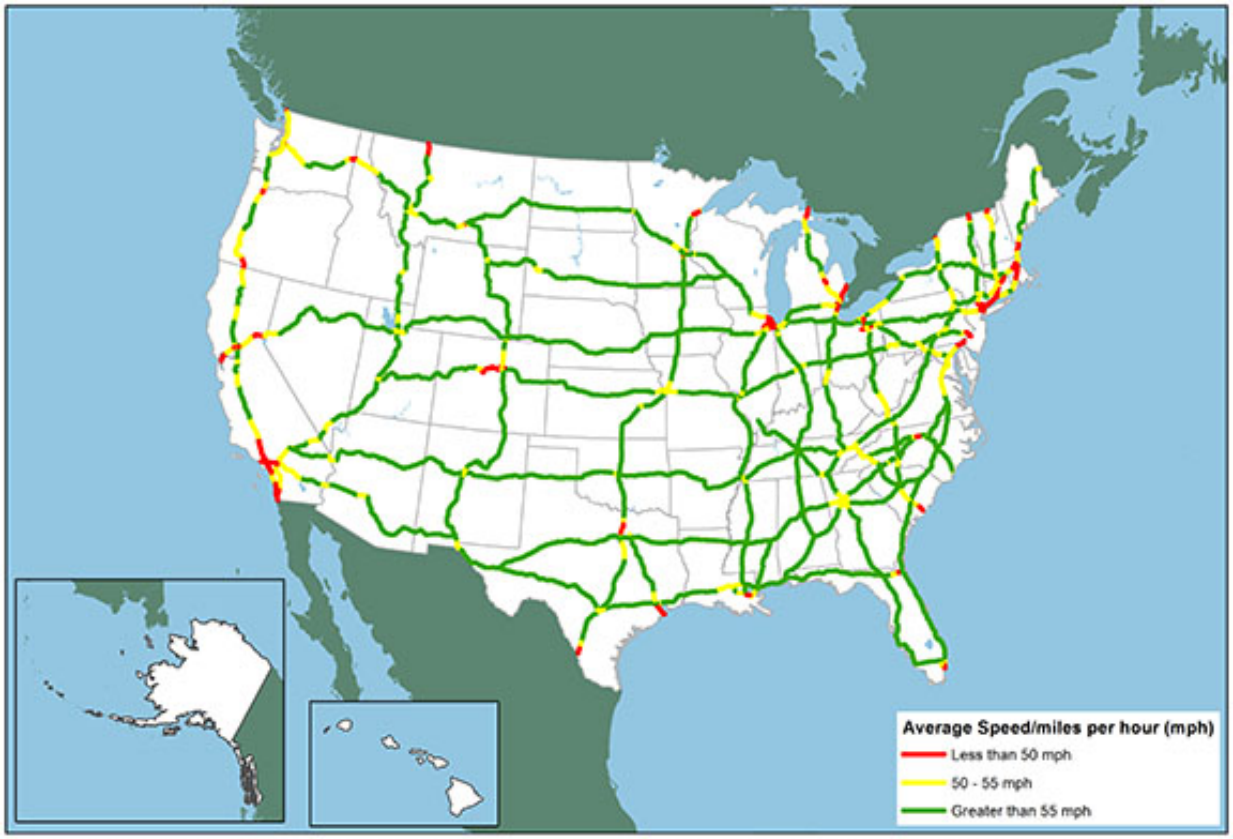
Freight Travel Speed

Truck

Vehicle travel speed is indicative of levels of congestion along a highway. The FHWA, in cooperation with private industry, measures the speed and travel time reliability of more than 500,000 trucks at 250 freight-significant highway infrastructure locations on an annual basis. Average truck speeds generally drop below 55 mph near major urban areas, border crossings and gateways, and in mountainous terrain. As identified in the map below (Figure 2-2.2), both the Los Angeles and Bay Area regions have large stretches of slower-than-average truck speeds which seem to emanate from the Ports of Entry. Slower travel speeds increase truck turnaround times and reduce the number of trips per truck per day, resulting in diminished efficiency, elevated costs, and more pollution.

Figure 2-2.2
Average Truck Speeds on Selected Interstate Highways: 2011



Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Performance Measurement Program, 2012.

http://www.ops.fhwa.dot.gov/freight/freight_analysis/nat_freight_stats/docs/12factsfigures/figure3_19.htm

Train

The Federal Railroad Administration (FRA) categorizes all tracks into six classes, segregated by maximum speed limits. Following is a list of these track classes along with the associated California Class I railroad track miles by each category.

Class 1	10 mph	38.5 miles
Class 2	25 mph	380.2 miles
Class 3	40 mph	794.8 miles
Class 4	60 mph	1,086.1 miles
Class 5	80 mph	1,167.2 miles
Class 6	110 mph	None

The CSRP identified portions of the network in each region that can only handle speeds of 40 mph (Class 3) or lower, which have been detailed in Appendix 2-2.2. Among the many factors contributing to reduced speed include:

- Shared track with passenger train service
- Insufficient sidings
- Classification yard locations
- Heavy freight and/or vehicle traffic
- Steep terrain
- Curved rail geometry
- Tunnels
- Limited number of tracks
- Track gauge and tie/ballast strength

Hours of Delay

The longer freight lingers in traffic, the more desired products and services cost. As previously mentioned, efficiency diminishes as the number of trips per day per truck is reduced, and same-day vehicle turnaround use is lost. According to the 2013 *Caltrans Mobility Performance Report*, the total 2010 statewide vehicle hours of delay (VHD) experienced at the severe congestion threshold speed of 35 mph was 95.7 million hours, which equates to an opportunity cost (lost value in terms of salaries and wages) of $1.4 billion, or $3.9 million a day. The 2013 *Caltrans Executive Fact Booklet* states that in 2011, annual (automobile and truck) VHD at the 35 mph threshold was 86.5 million. The dramatic reduction in VHD was due to impacts of the recession. As described within the truck travel speed measure, there is a discrepancy between what Caltrans considers as a delay threshold (35 mph) and FHWA (55 mph). It is recommended that a standard federal/state truck delay speed be set and that times and speed be measured regularly to monitor performance.

Bottlenecks/Chokepoints

Highway

Traffic congestion (where vehicular volume creates demand for more space than available capacity) in a petroleum-based fuel dominant nation is inefficient and exacerbates unhealthy emissions. When a roadway is approaching capacity, it is characterized by slower speeds, longer trip times, and prolonged vehicular queuing. Congestion can be caused by several factors including: the number and width of lanes; the location, spacing, and type of interchanges; the width of shoulders; the condition of the pavement; gaps in the freeway system; sheer vehicle volume; mixed modal user conflicts; roadway geometry; merges or weaving at transition ramps; steep grades; traffic incidents; road work; and weather.

Bottlenecks and chokepoints are common causes of congestion. The following segments within California, identified by national rank[ix], were included among the top 250 U.S. Freight Bottleneck locations (September 2011). All are along the Primary Freight Network.

10. Los Angeles: SR 60 @ SR 57
33. Los Angeles: I-710 @ I-105
36. San Bernardino: I-10 @I-15
41. Oakland: I-80 @ I-580/I-880
57. Corona: I-15 @ SR 91
61. Oakland: I-880 @ I-238
77. Los Angeles: I-110 @ I-105
110. Los Angeles: SR 91 @ SR 55
116. Sacramento I-80 @ I-5
119. Los Angeles I-405 @ I-605
134. San Rafael: I-580 @ US 101
141. Sacramento: I-80 @ SR 99
143. Los Angeles: SR 134 @ SR 2
154. Sacramento: I-80 @ I-305
160. San Diego: I-5 @ SR 163

Many other congested areas throughout the state have been identified through various regional plans, reports, and studies. The following maps depict bottlenecks/chokepoints along highway segments in the San Diego, Los Angeles, San Francisco Bay Area, and Valley regions. The Caltrans maps reflect the latest published values for peak periods using automated vehicle detection systems that track travel speed and vehicle volumes.

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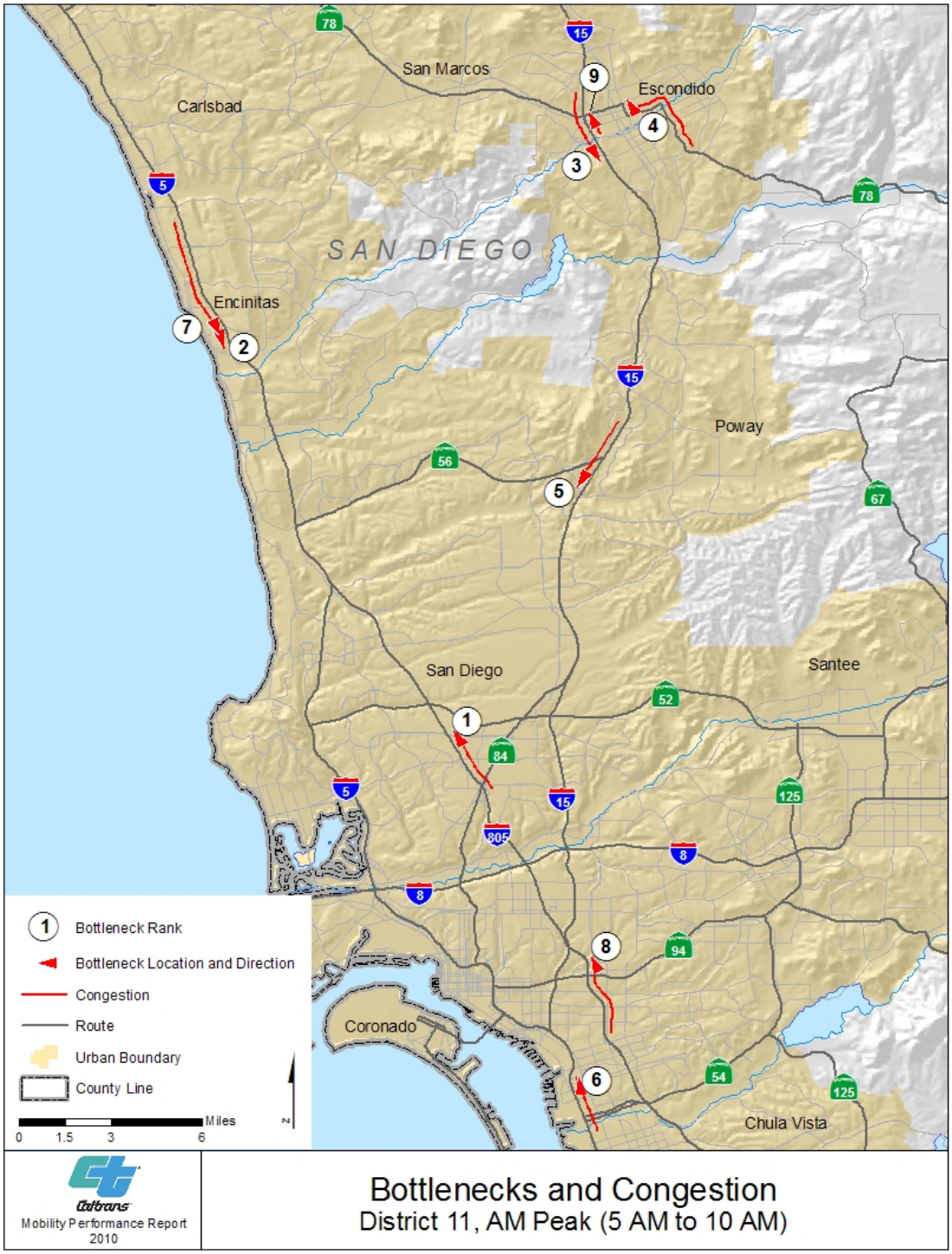
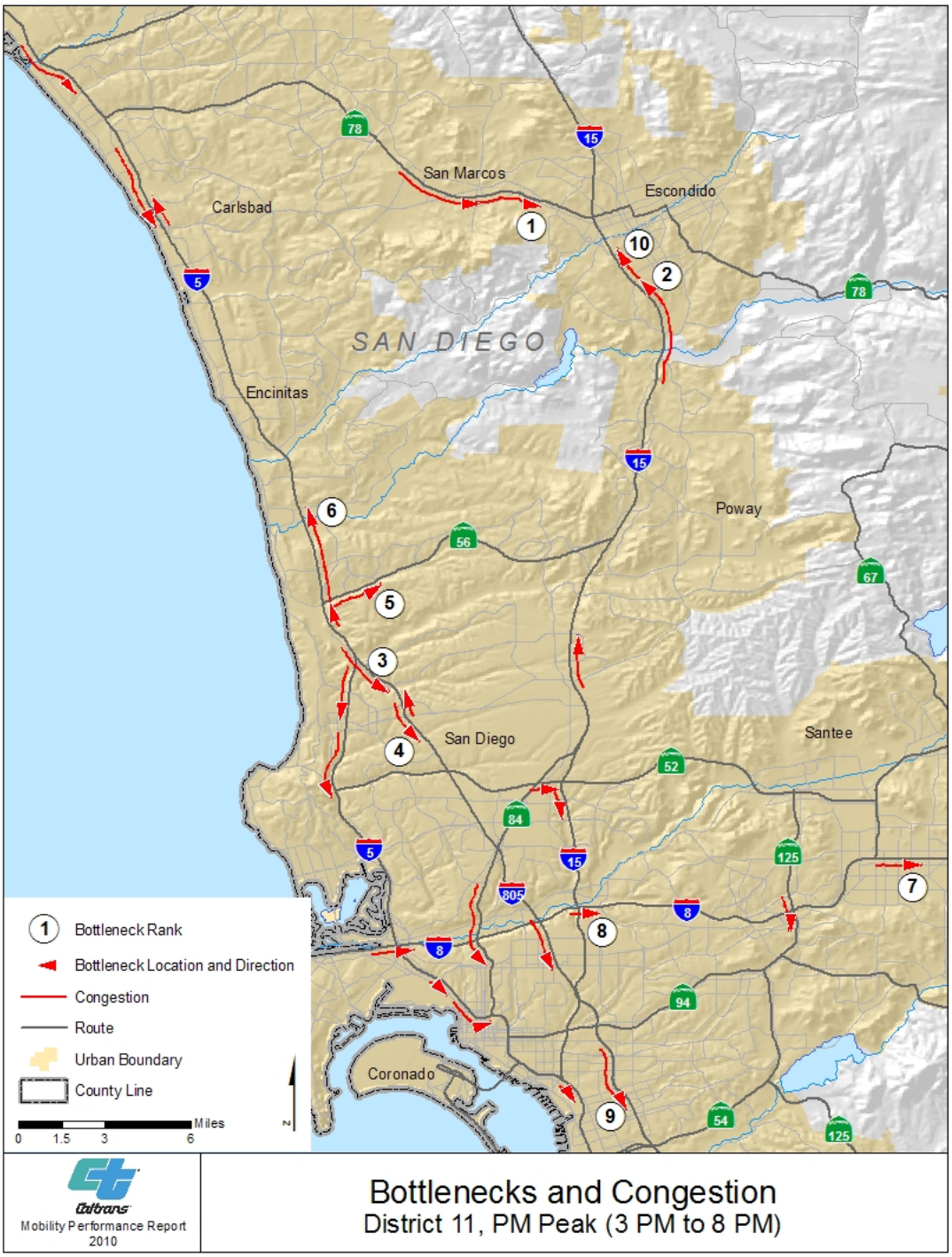
San Diego Region

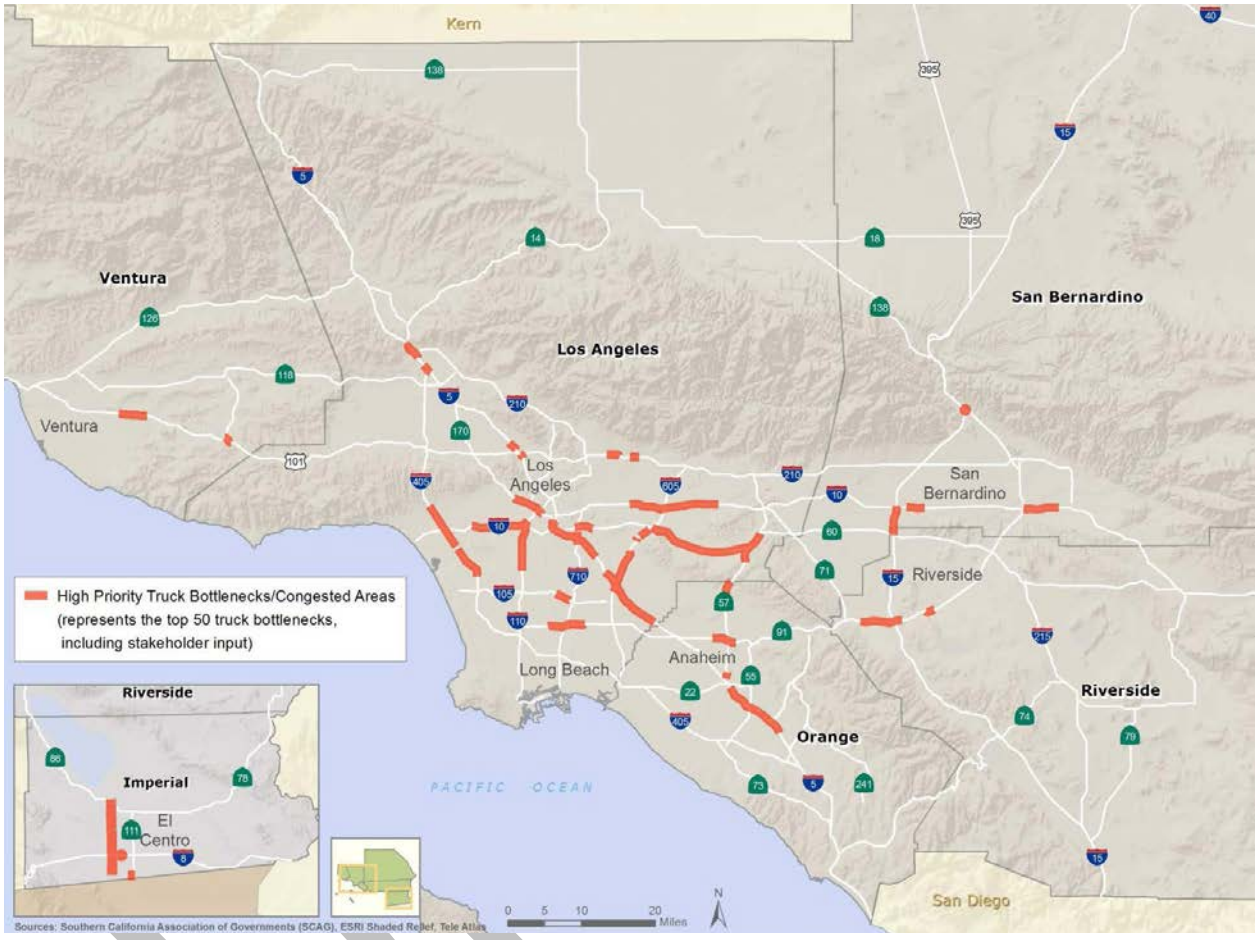




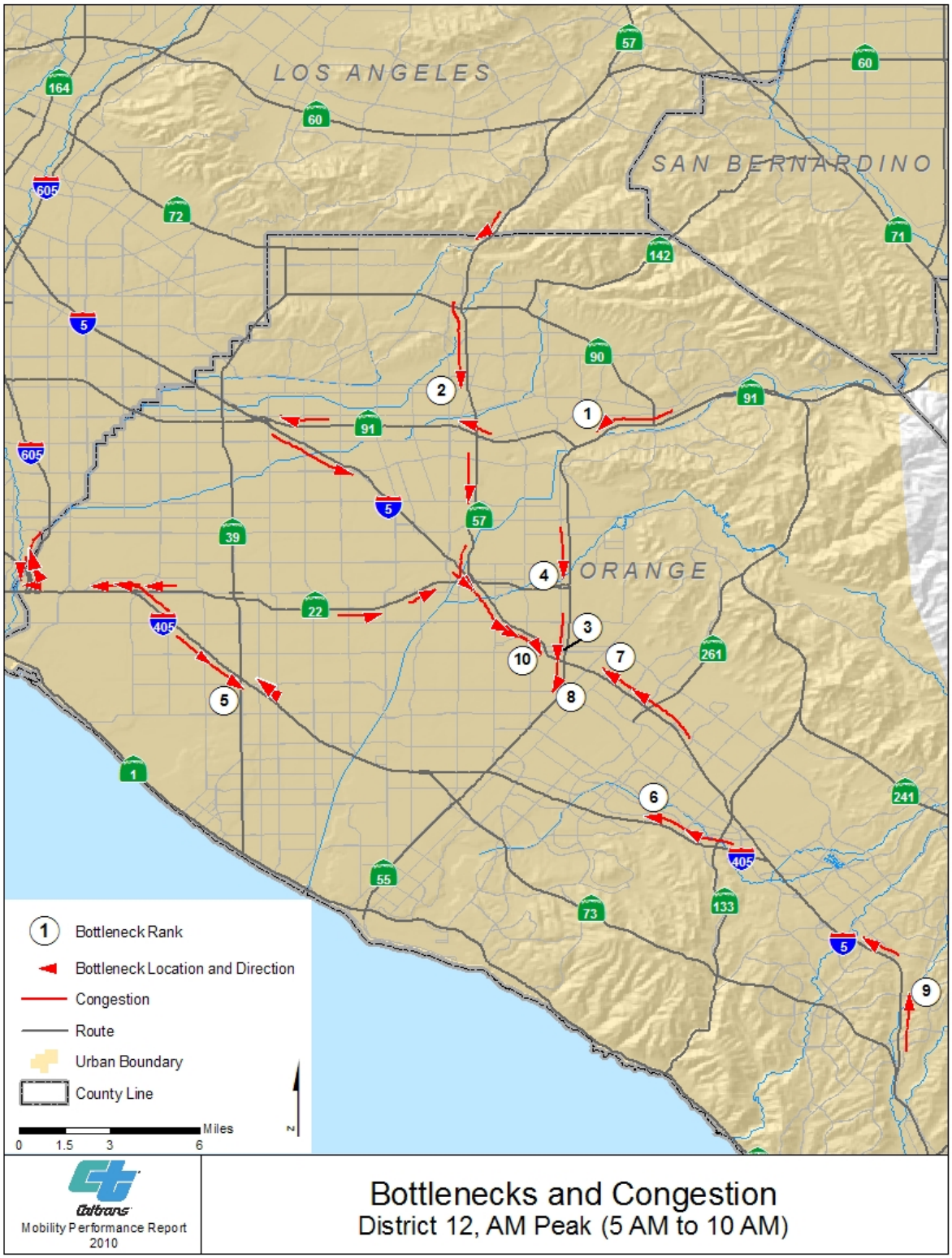
Please note that the San Diego area maps do not illustrate the existing congested areas along the border with Mexico.

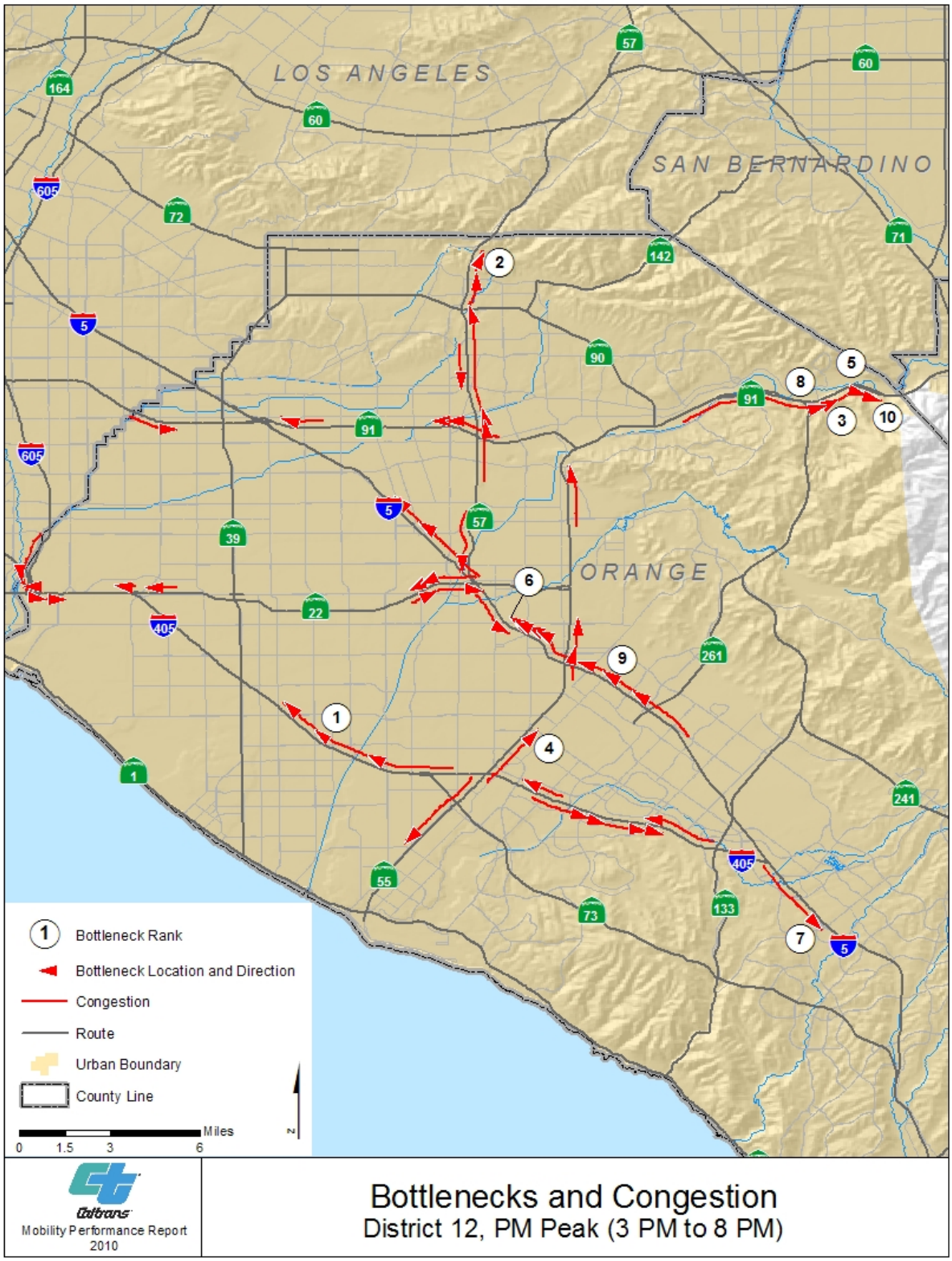
Los Angeles Region

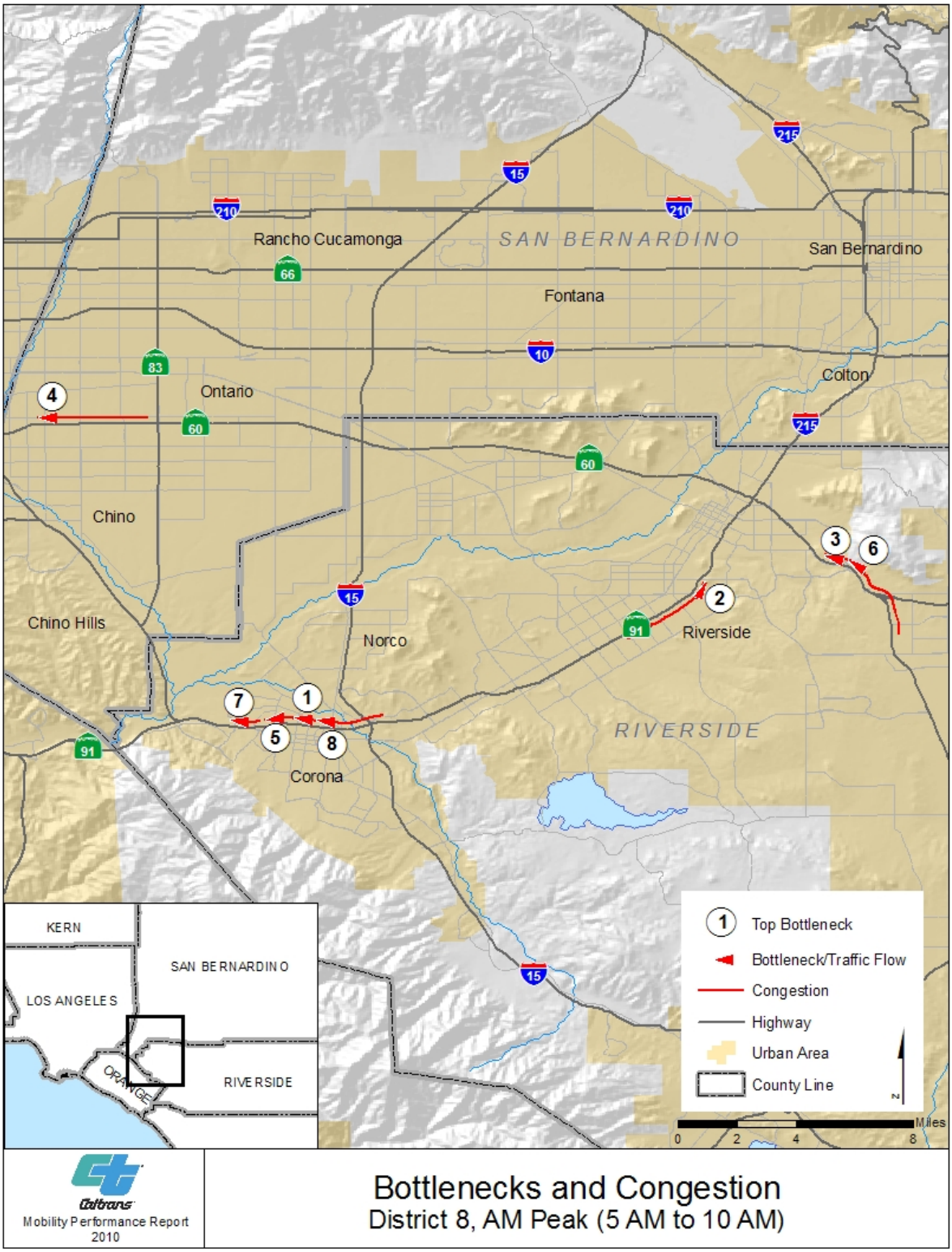
The Southern California Association of Governments (SCAG) region identified the following locations marked in orange as high-priority truck bottleneck/congested areas in their December 2012 *On the Move* freight planning document.

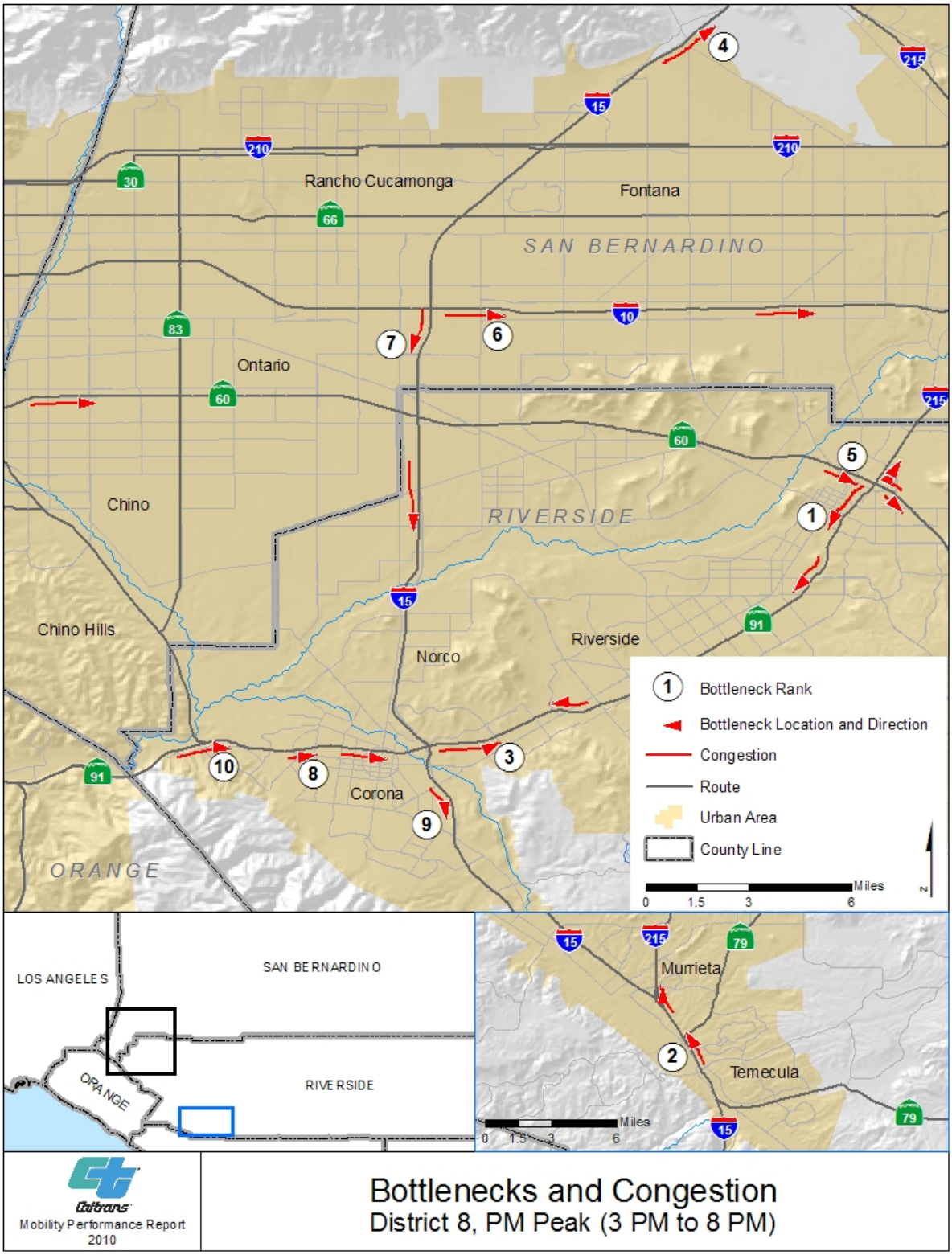


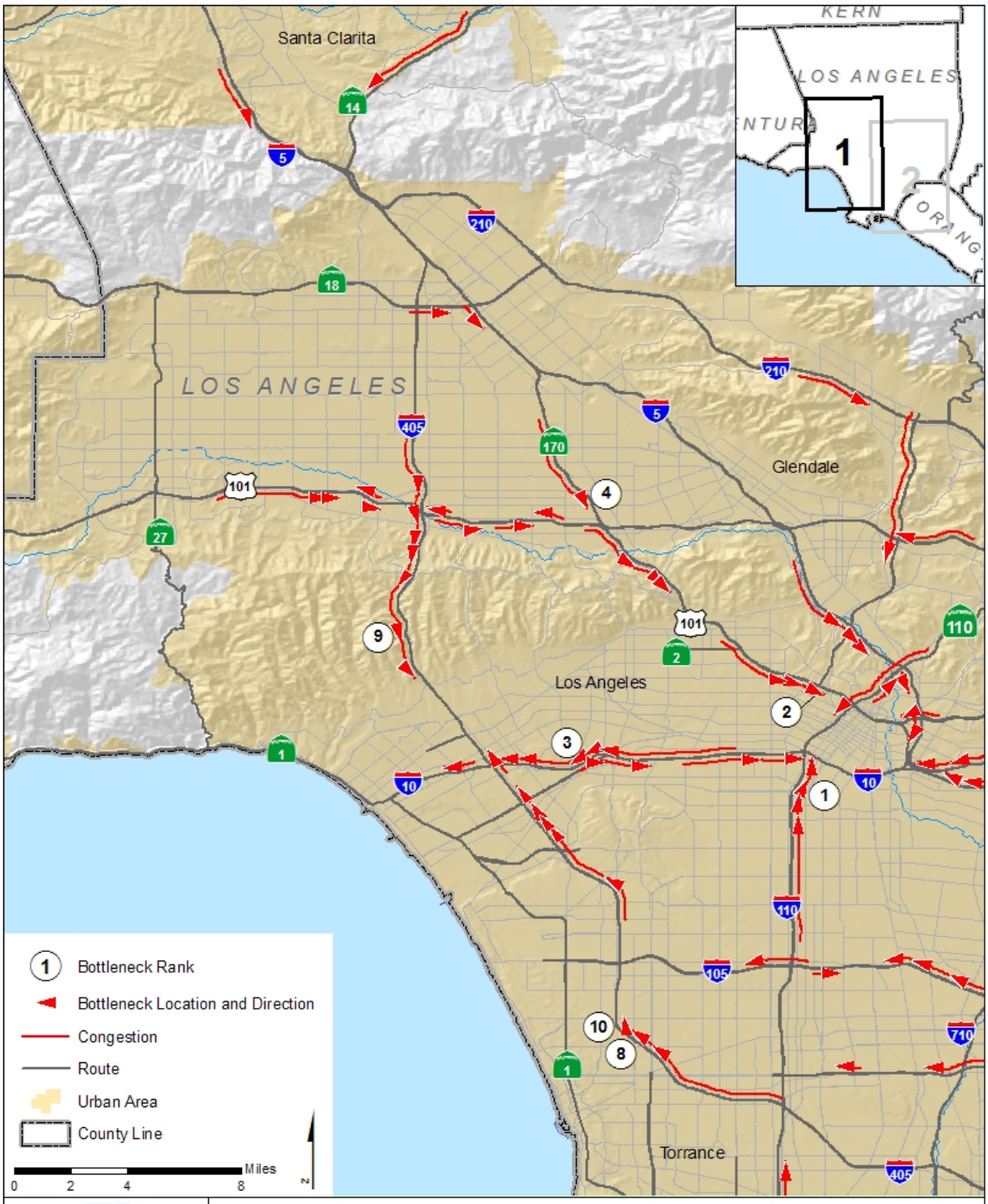
The following eight Caltrans maps reflect congested highway sections within Southern California's Los Angeles Basin.


LOS ANGELES
SAN BERNARDINO
ORANGE
Bottleneck Rank
Bottleneck Location and Direction
Congestion
Route
Urban Boundary
County Line
Miles
0 1.5 3 6
Caltrans
Mobility Performance Report 2010
Bottlenecks and Congestion
District 12, AM Peak (5 AM to 10 AM)


LOS ANGELES
SAN BERNARDINO
ORANGE
Bottleneck Rank
Bottleneck Location and Direction
Congestion
Route
Urban Boundary
County Line
Miles
0 1.5 3 6
Caltrans
Mobility Performance Report 2010
Bottlenecks and Congestion
District 12, PM Peak (3 PM to 8 PM)

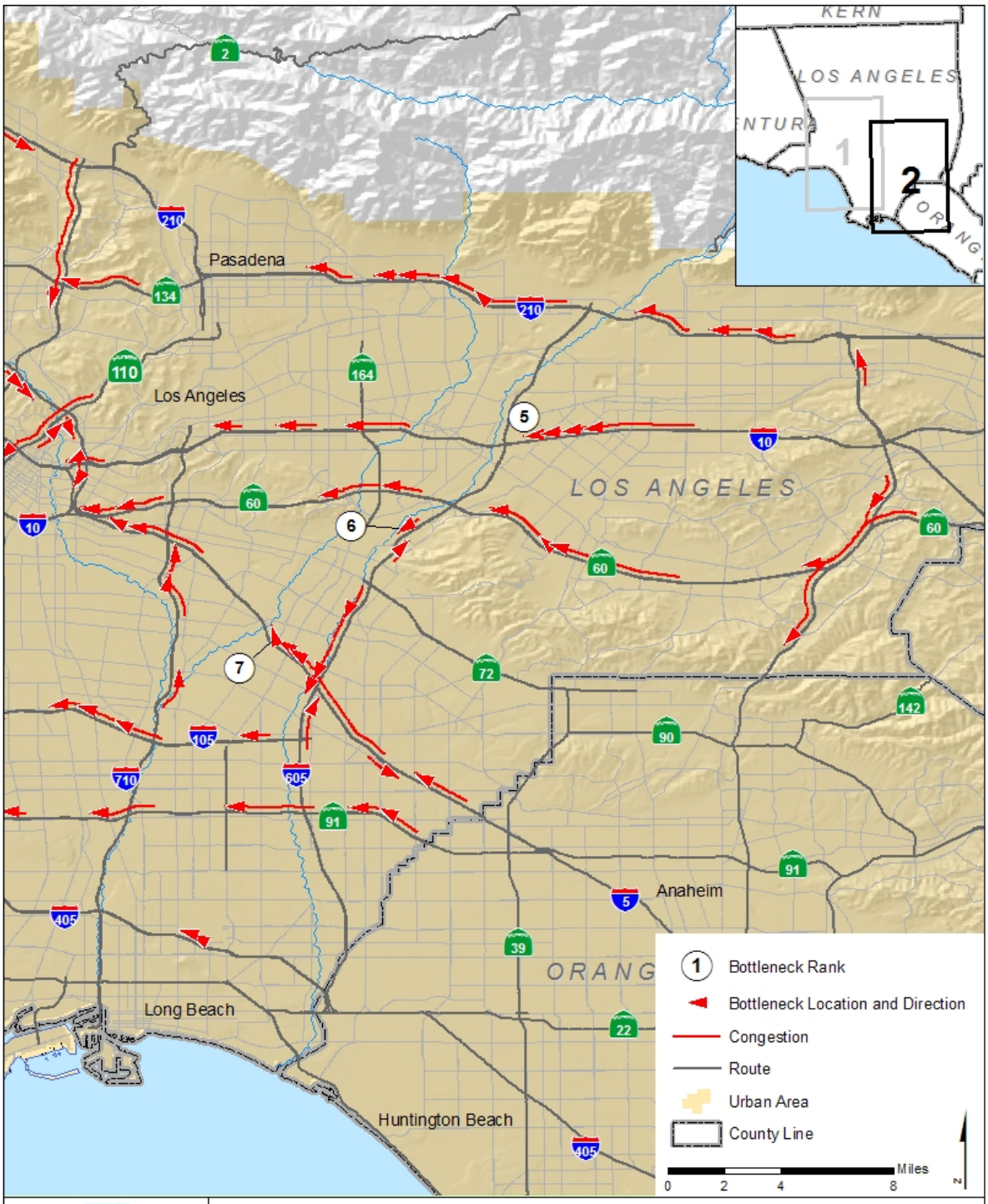

Rancho Cucamonga
SAN BERNARDINO
San Bernardino
Fontana
Ontario
Colton
Chino
Chino Hills
Norco
Riverside
RIVERSIDE
Corona
KERN
SAN BERNARDINO
LOS ANGELES
ORANGE
RIVERSIDE
Top Bottleneck
Bottleneck/Traffic Flow
Congestion
Highway
Urban Area
County Line
Miles
0 2 4 8
Caltrans
Mobility Performance Report 2010
Bottlenecks and Congestion
District 8, AM Peak (5 AM to 10 AM)


Rancho Cucamonga
Fontana
SAN BERNARDINO
Ontario
Chino
RIVERSIDE
Chino Hills
Norco
Riverside
Corona
ORANGE
Bottleneck Rank
Bottleneck Location and Direction
Congestion
Route
Urban Area
County Line
Miles
0 1.5 3 6
LOS ANGELES
SAN BERNARDINO
RIVERSIDE
ORANGE
Murrieta
Temecula
Caltrans
Mobility Performance Report 2010
Bottlenecks and Congestion
District 8, PM Peak (3 PM to 8 PM)



Caltrans
Mobility Performance Report 2010

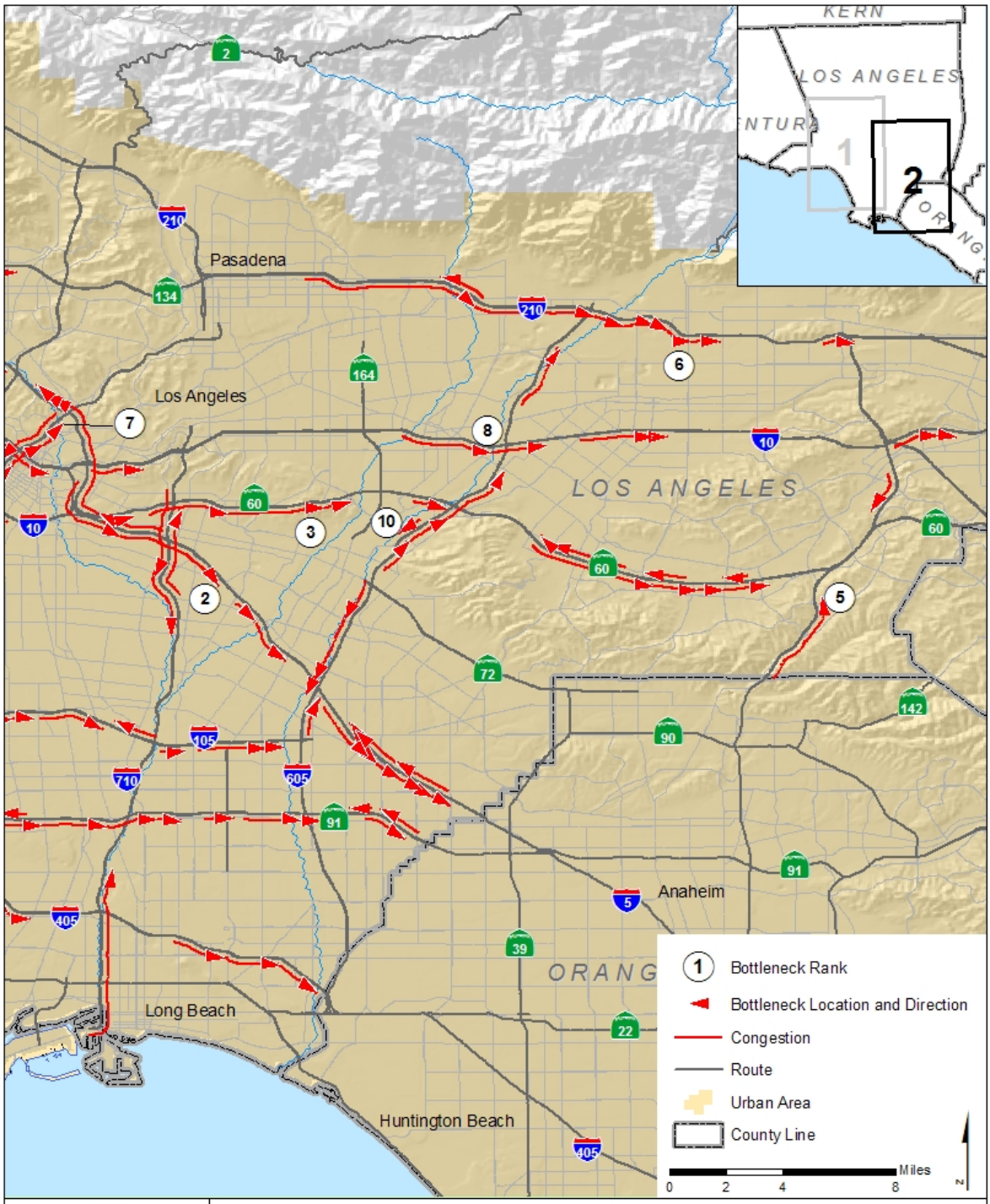
Bottlenecks and Congestion
District 7, AM Peak (5 AM to 10 AM) Map 1



Caltrans
Mobility Performance Report 2010

Bottlenecks and Congestion
District 7, AM Peak (5 AM to 10 AM) Map 2

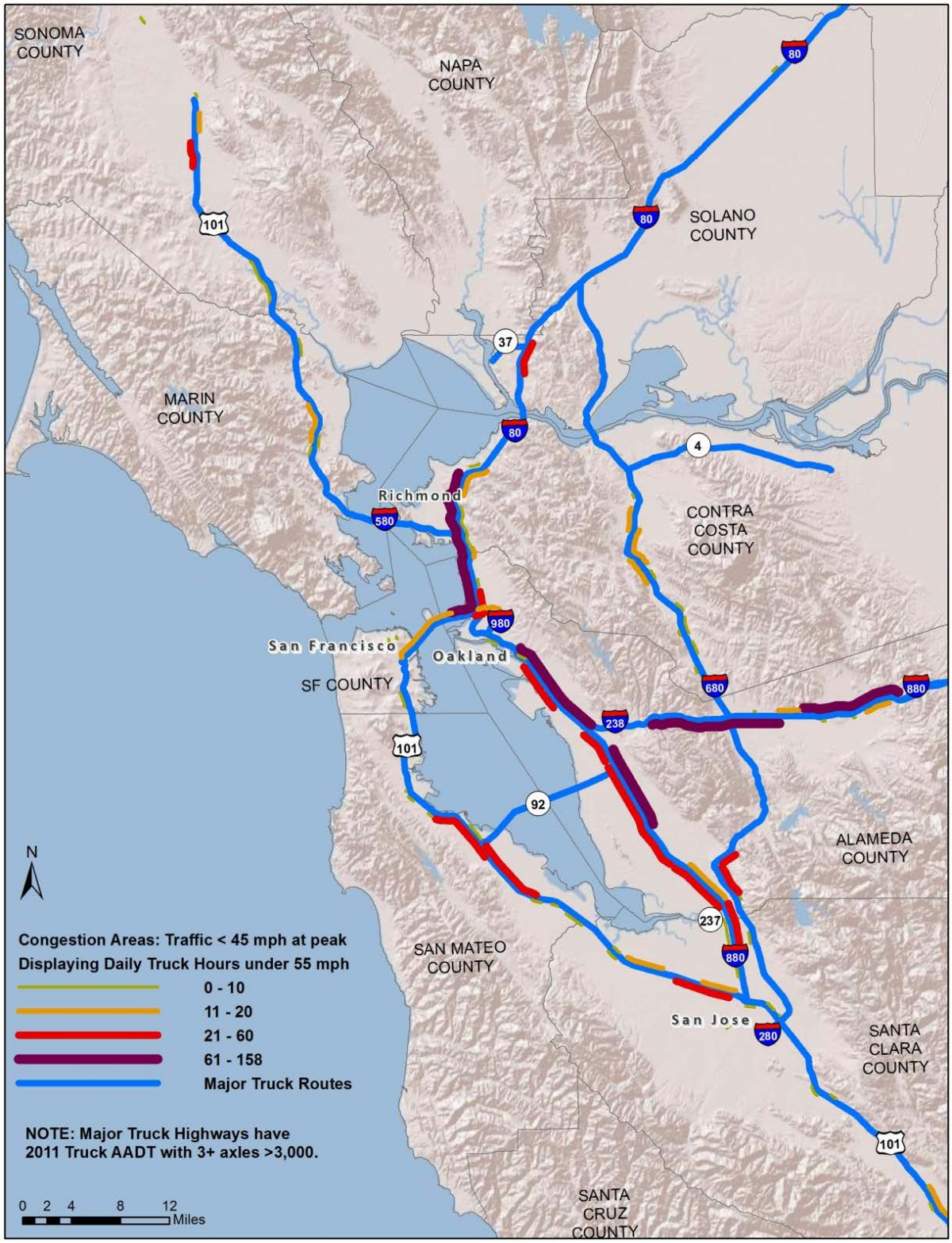
Santa Clarita
LOS ANGELES
Glendale
Los Angeles
Torrance
KERN
LOS ANGELES
1
2
Bottleneck Rank
Bottleneck Location and Direction
Congestion
Route
Urban Area
County Line
Miles
0 2 4 8
Caltrans
Mobility Performance Report 2010
Bottlenecks and Congestion
District 7, PM Peak (3 PM to 8 PM) Map 1



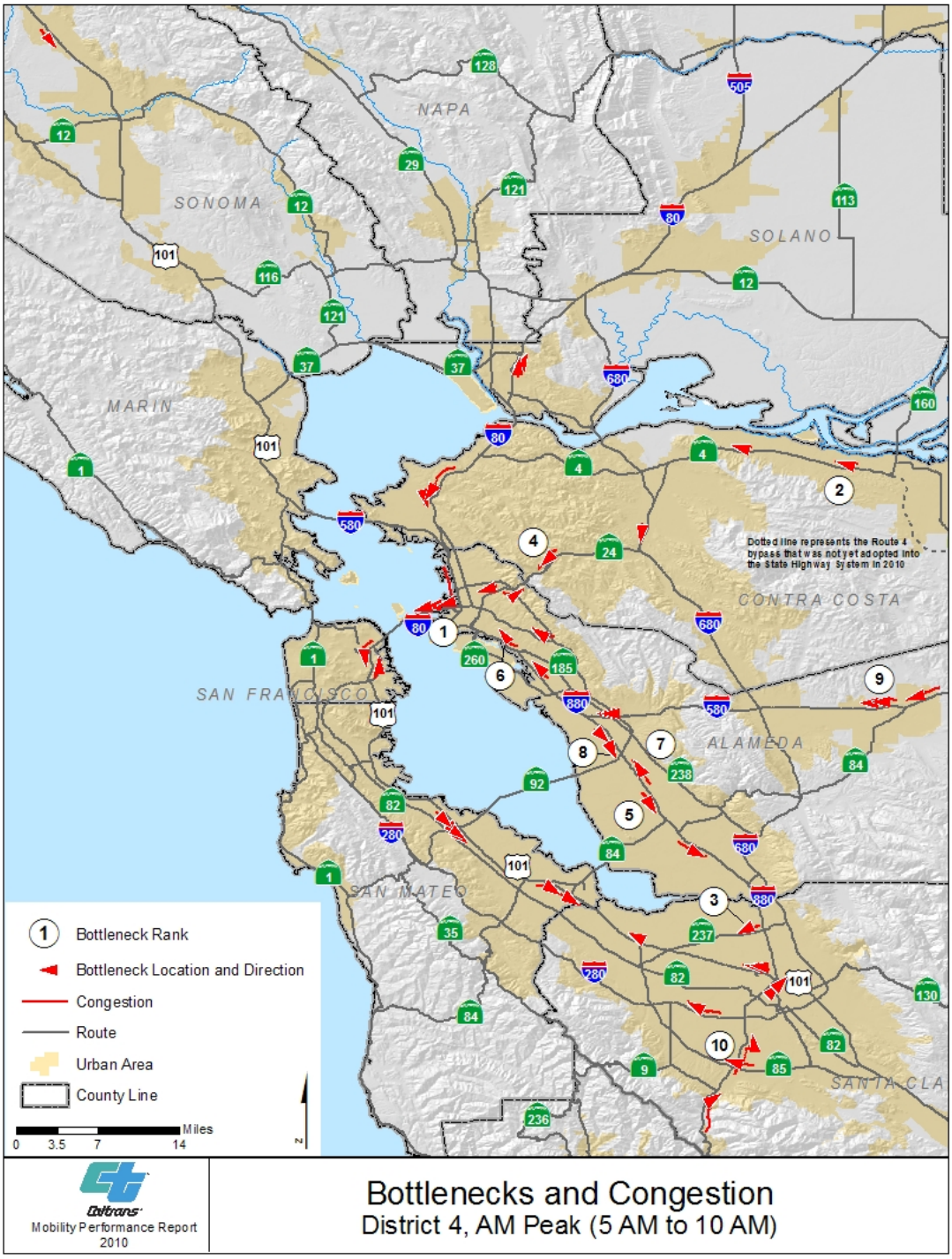
Caltrans
Mobility Performance Report 2010

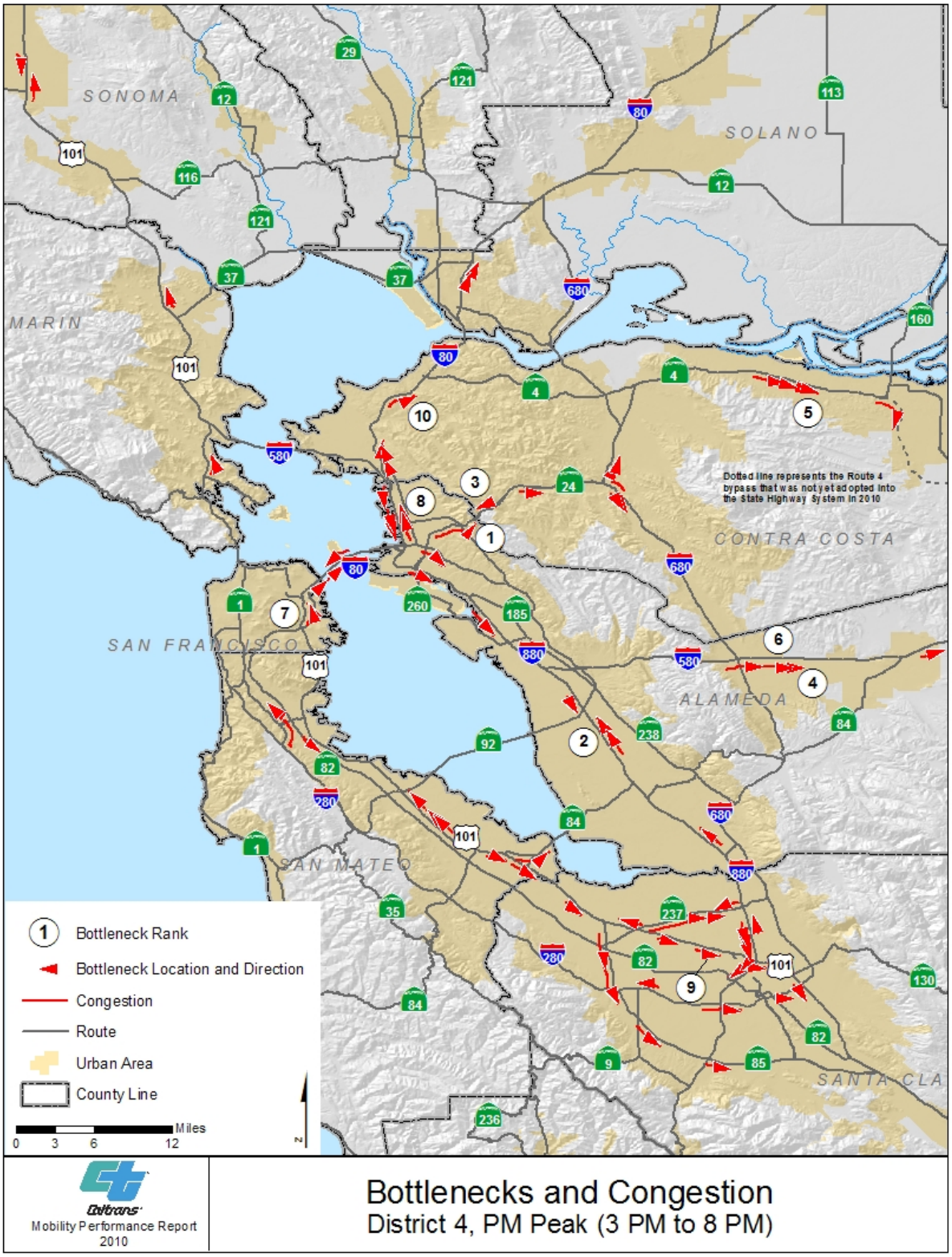
Bottlenecks and Congestion
District 7, PM Peak (3 PM to 8 PM) Map 2

San Francisco Bay Area



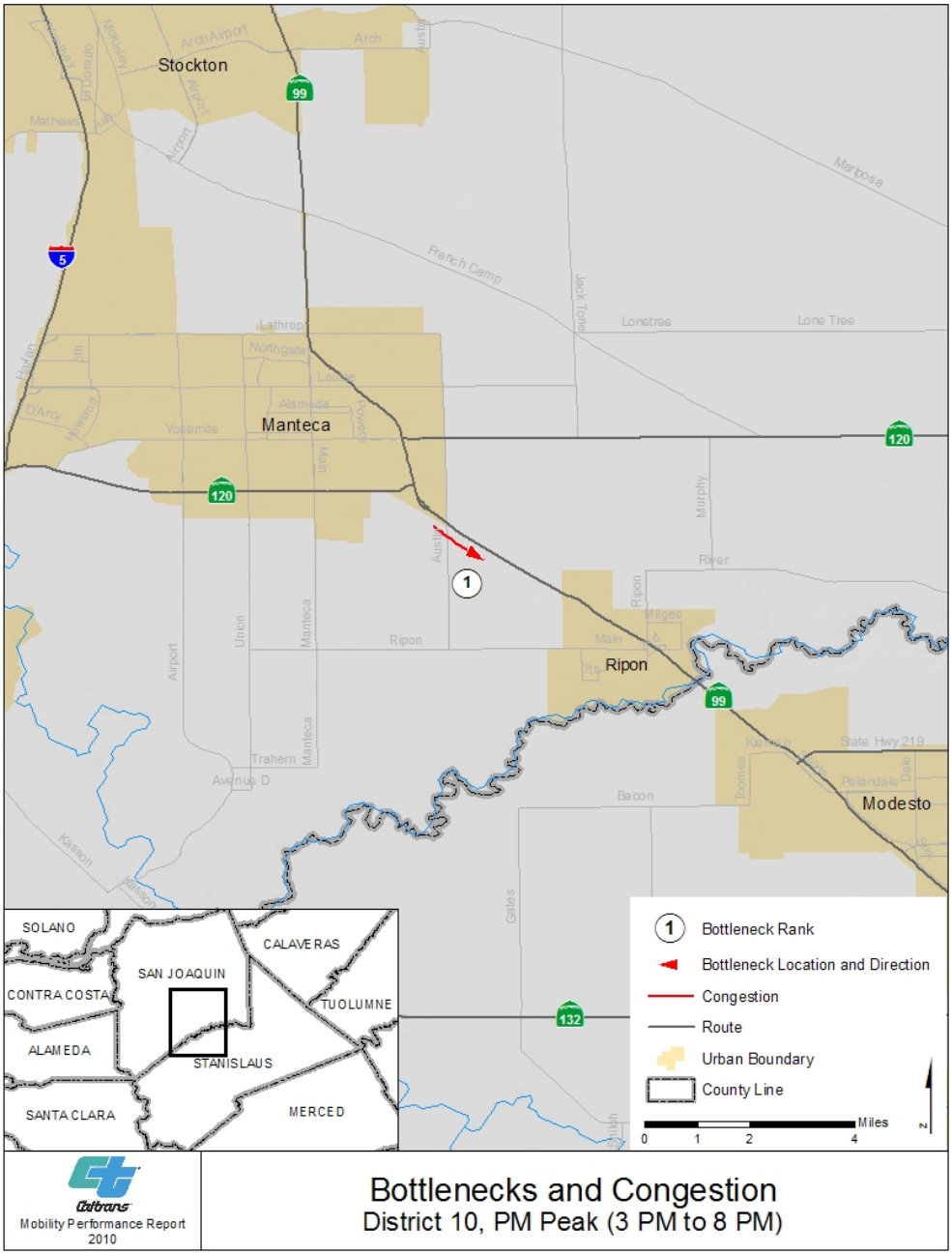
The most congested areas for trucks in the San Francisco Bay Area were depicted on the previous map taken from the *San Francisco Bay Area Freight Mobility Study* developed for Caltrans by Cambridge Systematics. The Port of Oakland is constructing the Outer Harbor Intermodal Terminal (OHIT) at the former Oakland Army Base site to try and resolve several intermodal terminal capacity and access issues. The two current terminals, BNSF's Oakand International Gateway (OIG) and UP's Railport, currently have significant access bottlenecks at the port.

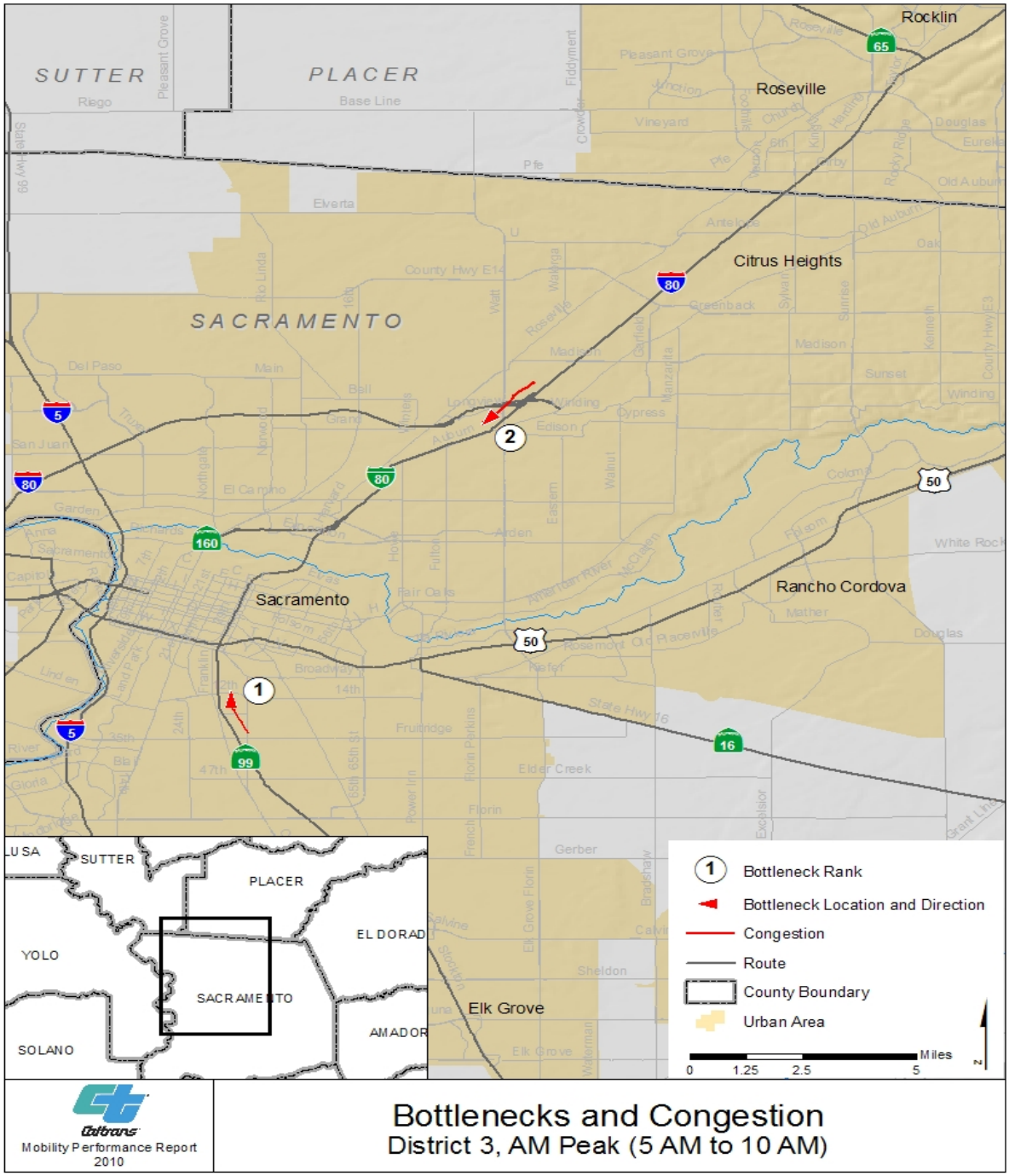


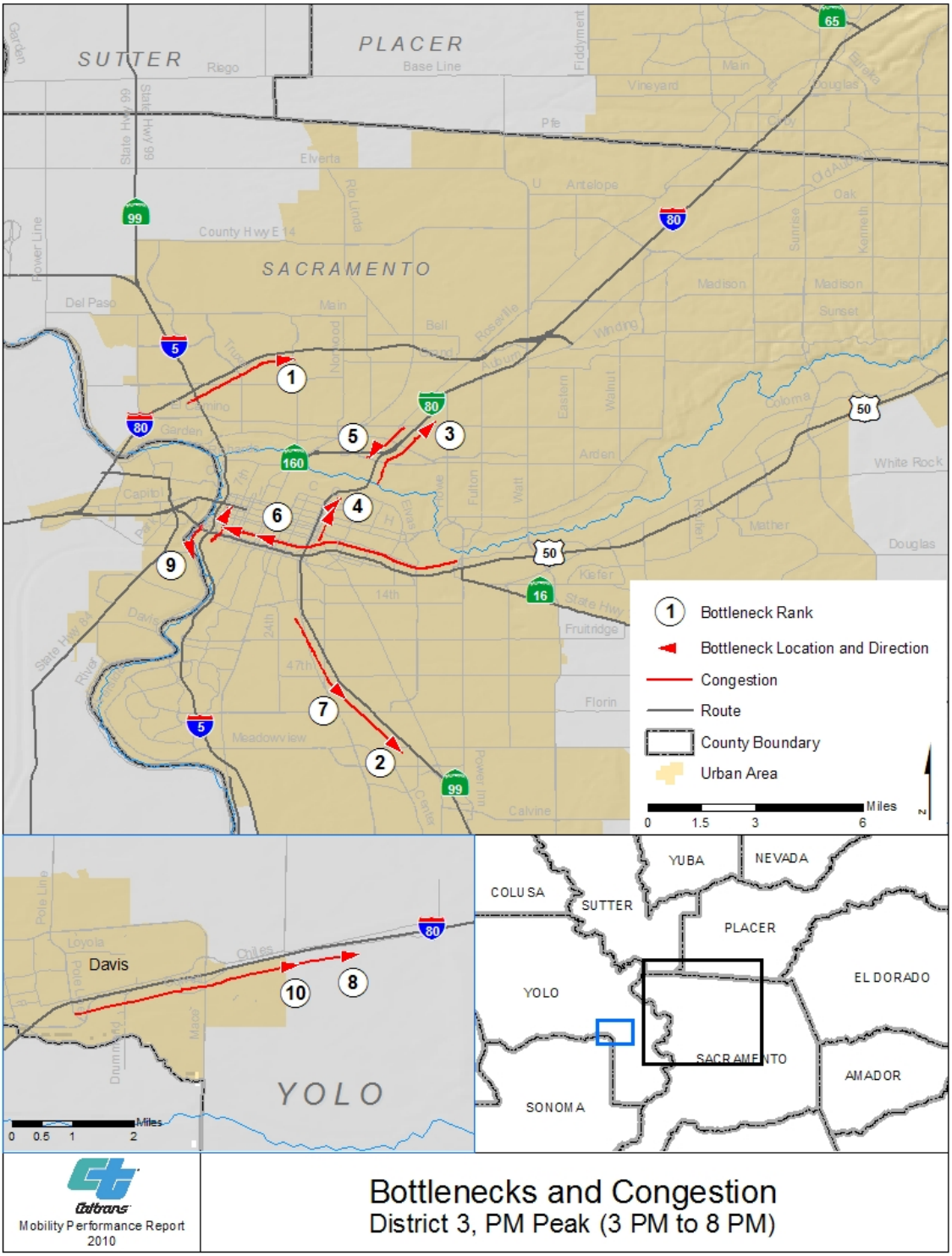

SONOMA
SOLANO
MARIN
CONTRA COSTA
SAN FRANCISCO
ALAMEDA
SAN MATEO
SANTA CLA
Dotted line represents the Route 4 bypass that was not yet adopted into the State Highway System in 2010
Bottleneck Rank
Bottleneck Location and Direction
Congestion
Route
Urban Area
County Line
Miles
0 3 6 12
Caltrans
Mobility Performance Report 2010
Bottlenecks and Congestion
District 4, PM Peak (3 PM to 8 PM)

Central/Sacramento Valley

Although not well depicted on the following map, SR 99 is one of the busiest goods movement corridors in the State, and it is flanked throughout its alignment by goods movement-dependent industries. According to the *San Joaquin Valley Goods Movement Plan* (Cambridge, August 2013), existing congestion (especially in urban areas like Stockton, Modesto, Madera, and Fresno) will worsen, which will hinder the efficient movement of goods to, from, and within the San Joaquin Valley. In recent years, many miles of additional lanes have been added to SR 99, but congestion persists due to increases in average daily traffic, increases in traffic merging on and off the freeway, and a high truck traffic percentage.




SUTTER
PLACER
SACRAMENTO
Rocklin
Roseville
Citrus Heights
Sacramento
Rancho Cordova
Elk Grove
1
2
Bottleneck Rank
Bottleneck Location and Direction
Congestion
Route
County Boundary
Urban Area
Miles
0 1.25 2.5 5
SUTTER
PLACER
YOLO
EL DORADO
SACRAMENTO
SOLANO
AMADOR
Caltrans
Mobility Performance Report 2010
Bottlenecks and Congestion
District 3, AM Peak (5 AM to 10 AM)



Among remedies for congestion ailments are: capacity increases (passing lanes, intersection improvements, turn pockets, and turnouts), reduced demand, mode separations (rail grade crossing separations), minimizing incident clearance times, accident prevention (interchange/geometry improvements), improving pavement quality, operational improvements, and policy changes.

Rail

Similar to reasons for reduced track speed, rail bottlenecks and chokepoints are mainly caused by track capacity limitations, track structural strength, steep grades, track geometry, conflicts with passenger service, rail yard capacity, track class, and double-stack height limitations. The 2013 CSRP identified the following main line and intermodal bottlenecks and chokepoints, also depicted on the following maps (Figure 2-2.3).

1. UPRR Mojave Subdivision, Kern Junction to Mojave (Tehachapi Trade Corridor)
2. BNSF San Bernardino Subdivision
3. BNSF Cajon Subdivision (Barstow to Keenbrook)
4. UPRR Sunset Route (Yuma Subdivision)
5. UPRR Alhambra and Los Angeles Subdivisions
6. UPRR Mojave Subdivision, Rancho to Keenbrook (Cajon Area)
7. San Diego and Arizona Eastern Railroad
8. Colton Crossing (crossed tracks have since been fixed through a TCIF project)
9. UPRR Martinez Subdivision (Oakland to Martinez)
10. UPRR Oakland Subdivision
11. BNSF Mainline Stockton to Bakersfield (San Joaquin Corridor)

Figure 2-2.3
California Railroad Congestion Points

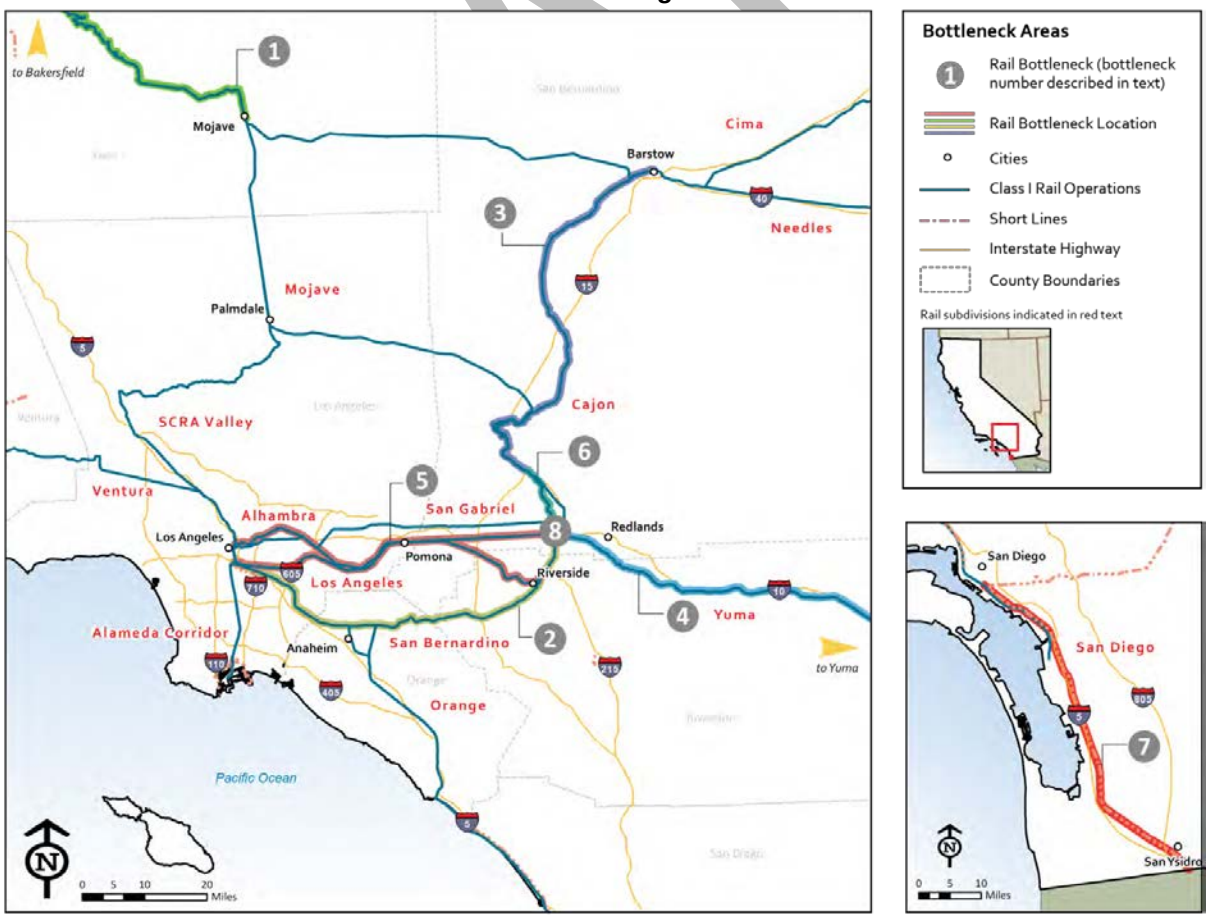
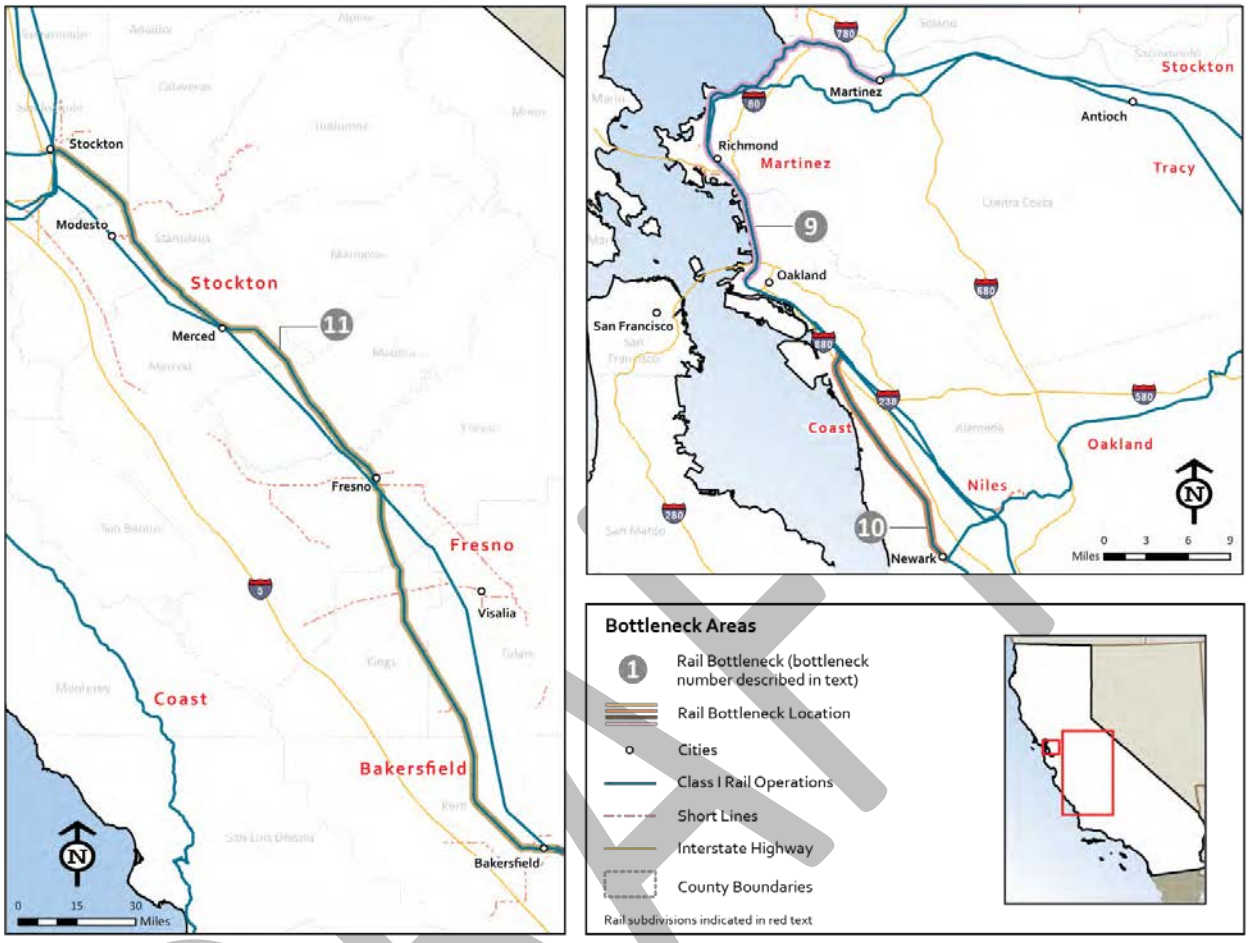


Figure 2-2.3 (continued)



Reliability Buffer Index

Average travel time does not directly translate into expected delays. Truckers, who may lose a competitive edge if shipments are late, would appreciate more arrival time consistency. By deriving a reliable, corridor-specific "buffer index" for use to calculate specific extra time to add to average travel time, the chances of arriving on time increase dramatically. This "buffer index" comes from the collection of travel time data on heaviest traffic days and comparing those to average travel time. For example, if it usually takes 20 minutes for a trip, and the buffer index is 40 percent, an additional eight minutes (20 minutes x 0.4 = 8 minutes, or 28 minutes total) should be allowed for that stretch to ensure on-time arrival over 90 percent of the time.

Appendix B of the *Caltrans Mobility Performance Report 2010* (dated July 2013) discusses Corridor Travel Time Reliability along most of the Corridor Mobility Improvement Account (CMIA) freeway segments throughout the State. The report considers travel time (the time it takes to go from one end of a defined corridor to the other) as an important measurement tool used to monitor corridor congestion. Travel time reliability is concerned with the consistency or dependability of travel times, either measured day-to-day or across different times of day. The 2010 report analyzed travel time reliability day-to-day, across all weekdays in the calendar year.

The least reliable CMIA corridors in 2010, as measured by the buffer time index (BTI) during peak congestion, were:

1. Westbound I–80, Alameda County, BTI: 79 percent in the AM Peak.
2. Westbound SR–22, Orange County, BTI: 75 percent in the AM Peak.
3. Eastbound SR–91, Orange County, BTI: 74 percent in the PM Peak.
4. Northbound SR–57, Orange County, BTI: 70 percent in the PM Peak.
5. Southbound SR–57, Orange County, BTI: 67 percent in the PM Peak.

Safety

Safety is important for the entire transportation system, not just freight. Although Caltrans cannot prevent many human error crashes, identifying incident trends can shed light on potential infrastructure and possible operational adjustments. In addition, improved technology can eliminate or reduce the severity of certain accidents, but the cost-benefits must also be weighed. California's freight system is generally safe, but when collisions do occur, the consequences can be extreme because of the large mass of freight vehicles and their loads. For more detailed discussion of safety and security, please see Chapter 1-7.

Fatalities and Injuries

Highway

According to the California Highway Patrol (CHP) *2011 Annual Report of Fatal and Injury Motor Vehicle Traffic Collisions*, there were 57 fatal and 2,257 injury involved truck collisions where the truck driver was at fault by primary collision factor. Of the total 2,314 incidents, 938 were due to unsafe speed and 731 due to unsafe lane changes or improper turning. A more relevant ratio of casualty/injury per truck usage would be to use the number of truck miles traveled on an annual basis; however, this information is not currently readily available and would need to be collected and reported.

Rail

According to the U.S. Department of Transportation, Federal Railroad Administration, *Railroad Safety Statistics Preliminary Annual Report* (dated May 8, 2013), California had 9,296 grade crossings in 2011. In 2012, there were 32 casualties and 126 non-fatal (injuries) at highway-rail grade crossings. The report does not separate the number of freight and passenger train incidents.

Positive Train Control (PTC)

PTC is a technology-based system for monitoring and controlling train movements designed to increase safety by automatically stopping or slowing a train before certain accidents occur. The Rail Safety Improvement Act of 2008 (RSIA) requires Class I railroads to install PTC systems on tracks that handle regularly scheduled passenger trains or toxic-by-inhalation (TIH) materials by the December 31, 2015 implementation deadline. Although substantial progress has been made, complications, including estimated industry-wide costs of over $10 billion, make it uncertain that the deadline will be met. Of the total California Class I inventory, very few track

miles are currently operating under PTC. BNSF and Union Pacific are implementing the systems incrementally, starting with demonstration projects along shared passenger routes.

Although most of the nation's short lines will not require PTC installation; they may incur PTC-related costs if their locomotives operate over Class I lines with PTC installed. On-board hardware installation costs are expected to be at least $50,000 per locomotive (for a retrofit of existing locomotives) and considerably more for older units that lack microprocessor control systems, which many short lines still operate. Several California short lines will be impacted by this requirement, including the San Joaquin Valley Railroad, the Pacific Sun Railroad, and the San Diego and Imperial Valley Railroad.

Other Performance Measures

Although less tangible, the remaining economic, technological, and environmental goals are also important to track and measure. Without innovative improvements to keep ahead of the technology curve and reducing barriers to entice businesses to thrive here, California will lose its competitive edge – ultimately negatively impacting our economy. In addition, a healthy, sustainable environment is needed to improve quality of life.

Economic Competitiveness

The State's economic well-being depends upon safe, well maintained, uncongested freight infrastructure; therefore, the first three national freight goals also affect the economy. The cost and reliability of moving freight can and does heavily impact the efficiency, productivity, and economic competiveness of the State. For example, regulatory fee increases and labor strikes at California ports result in shippers considering the feasibility of using other ports such as Prince Rupert or Vancouver in British Columbia, Seattle in Washington, and Lazaro Cardenas in Mexico.

Service and infrastructure improvements that allow the system to operate more safely and efficiently will reduce freight transportation costs. The CSRP states that rail grade separation projects, double-track projects, and freight facility improvements are examples of projects that will improve the reliability and economic competitiveness of freight rail travel.

According to the Federal Highway Administration (FHWA), the Bureau of Labor Statistics (BLS) calculates productivity indices for the different modes, but does not make adjustments for variations such as the quality of service value. Because economic objectives are very diverse, it would be difficult to meaningfully measure competitiveness on a local, state, national, or global scale. One way to measure performance in this category would be to track the California share of the national freight market by value and volume of imports and exports, but numbers at such a broad level would not be very insightful for planning purposes. Other measures such as freight cost per ton-mile would be costly and difficult to collect, due to its proprietary and extensive nature.

Innovative Technology

Technology and innovation are keys to global leadership; however, this category is difficult to measure. Chapter 1-8 on Intelligent Transportation System (ITS) Freight Technologies presents

current and projected ITS deployments (by public and private entities involved in freight operations) that will maximize and increase the safety and efficiency of California's freight transportation system. Likely, the initial national freight performance measures in this category will include lists of innovative best practices and emerging or visionary possibilities.

Following are examples of how technology is already making an impact on freight movement. More locomotives that meet or exceed the cleanest EPA Tier 4 standards are being deployed in California. Zero and near-zero emission vehicle and equipment use in freight logistics fleets is on the rise. Use of shore-side power for docked ships and cleaner technology vessel engines are reducing the amount of emissions impacting nearby communities. Mobile applications that inform drivers of available truck parking areas and/or upcoming severe weather are reducing safety and congestion problems. However, to truly gauge effectiveness of the innovative technology category, a way to measure and track freight travel speed, reliability, and turn time (trip) improvements before and after technology project implementation would be needed.

Environmental Stewardship

Meeting the needs of the present without compromising the ability of future generations to meet their own needs is a way to achieve sustainability and demonstrate environmental stewardship. According to the Environmental Protection Agency (EPA), this thinking leads to the realization that improving the environment can lead to a higher quality of life and new products and markets that boost economic competitiveness. As demonstrated in Chapter 1-4, California is a recognized leader when it comes to improving environmental quality. However, a balance must be struck, because raising costs too high could diminish a competitive edge and lead to the decline of the freight industry and loss of numerous jobs.

Each freight mode is taking remarkable steps to improve emission performance. With laws requiring less-polluting fuels, greener fleets, and cleaner operating procedures, the air breathed is already dramatically cleaner; however, much more work is needed. The following pollutants (typically products of fossil fuel combustion or industrial processes) are considered by the EPA as "criteria pollutants" or ones that cause smog, acid rain, and other health hazards.

- Ozone (O_3)
- Respirable particulate matter (PM10)
- Fine particulate matter (PM2.5)
- Carbon monoxide (CO)
- Nitrogen dioxide (NO_2)
- Sulfur dioxide (SO_2)
- Lead

Some emission concentrations are measured in parts per million (ppm) and others are in parts per cubic meter (m^3). One part per million is equivalent to one drop of water diluted into about 13 gallons of liquid (roughly the fuel tank of a compact car). Emission standards for criteria and other pollutants are more stringent in California than for the nation, as can be seen in the following chart from the California Air Resources Board (CARB) website (http://www.arb.ca.gov/research/aaqs/aaqs2.pdf).

Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards		National Standards		
		Concentration	Method	Primary	Secondary	Method
Ozone (O_3)	1 Hour	0.09 ppm (180 µg/m^3)	Ultraviolet Photometry	—	Same as Primary Standard	Ultraviolet Photometry
	8 Hour	0.070 ppm (137 µg/m^3)		0.075 ppm (147 µg/m^3)		
Respirable Particulate Matter (PM10)	24 Hour	50 µg/m^3	Gravimetric or Beta Attenuation	150 µg/m^3	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	20 µg/m^3		—		
Fine Particulate Matter (PM2.5)	24 Hour	—	—	35 µg/m^3	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	12 µg/m^3	Gravimetric or Beta Attenuation	12.0 µg/m^3	15 µg/m$_3$	
Carbon Monoxide (CO)	1 Hour	20 ppm (23 mg/m^3)	Non-Dispersive Infrared Photometry (NDIR)	35 ppm (40 mg/m^3)	—	Non-Dispersive Infrared Photometry (NDIR)
	8 Hour	9.0 ppm (10 mg/m^3)		9 ppm (10 mg/m^3)	—	
	8 Hour (Lake Tahoe)	6 ppm (7 mg/m^3)		—	—	
Nitrogen Dioxide (NO_2)	1 Hour	0.18 ppm (339 µg/m^3)	Gas Phase Chemiluminescence	100 ppb (188 µg/m^3)	—	Gas Phase Chemiluminescence
	Annual Arithmetic Mean	0.030 ppm (57 µg/m^3)		0.053 ppm (100 µg/m^3)	Same as Primary Standard	
Sulfur Dioxide (SO_2)	1 Hour	0.25 ppm (655 µg/m^3)	Ultraviolet Fluorescence	75 ppb (196 µg/m^3)	—	Ultraviolet Flourescence; Spectrophotometry (Pararosaniline Method)
	3 Hour	—		—	0.5 ppm (1300 µg/m^3)	
	24 Hour	0.04 ppm (105 µg/m^3)		0.14 ppm (for certain areas)	—	
	Annual Arithmetic Mean	—		0.030 ppm (for certain areas)	—	
Lead	30 Day Average	1.5 µg/m^3	Atomic Absorption	—	—	High Volume Sampler and Atomic Absorption
	Calendar Quarter	—		1.5 µg/m^3 (for certain areas)	Same as Primary Standard	
	Rolling 3-Month Average	—		0.15 µg/m^3		
Visibility Reducing Particles	8 Hour	--	Beta Attenuation and Transmittance through Filter Tape	**No National Standards**		
Sulfates	24 Hour	25 µg/m^3	Ion Chromatography			
Hydrogen Sulfide	1 Hour	0.03 ppm (42 µg/m^3)	Ultraviolet Fluorescence			
Vinyl Chloride	24 Hour	0.01 ppm (26 µg/m^3)	Gas Chromatography			

In 2006, Assembly Bill (AB) 32 recognized that global warming will have wide-spread detrimental statewide effects, thereby requiring reduction in the following greenhouse gases (GHG) that trap heat in the atmosphere to 1990 levels by 2020. For the long term, California has a goal to emit 80 percent fewer emissions than 1990 levels by 2050.

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (NO_2)
- Fluorinated gases [including sulfur hexaflouride (SF_6), nitrogen triflouride (NF_3), Hydrocarbons (HFC), and perfluorocarbons (PFC)]

According to the CARB, the transportation sector was the largest source of GHG emissions in 2011, with 37.6 percent of the inventory. The largest emissions category within the transportation sector is "on-road", which consists of passenger vehicles (cars, motorcycles, and light-duty trucks), heavy duty trucks, and buses. As mentioned in Chapter 1-4, heavy-duty vehicles are responsible for 20 percent of California's global warming pollution from transportation sources. The various emissions from freight transportation modes in million tonnes (a metric tonne equals 2,204.6 pounds) of CO_2 equivalent were generated in 2000 as compared to 2011:

	2000	2011
• Heavy Duty Trucks	32.80	36.08
• Ships and Commercial Boats	3.39	3.81
• Intrastate Aviation	4.15	3.74
• Rail	1.88	2.49

As can be seen from these numbers, more effort to reduce freight-produced GHG is required. CARB recognizes the need to transition to zero- and near-zero emission technologies over the next several decades. This transition will likely include widespread use of alternative transportation fuels such as grid-based electricity, hydrogen, and renewable fuels.

In order to ensure reductions in release of harmful criteria pollutants and GHG emissions, processes to measure and track changes to their levels are necessary. The many existing state and national air quality standards specify designated areas which vary in size depending on the pollutant, location of contributing emission sources, meteorology, and topographic features. There are currently 15 designated air basins in the State, which are used when tracking ozone, nitrogen dioxide, PM10, sulfates, and visibility reducing particles. Counties (or portions of) are the designated areas for carbon monoxide, sulfur dioxide, lead, and hydrogen sulfide. As a note, some counties are in more than one air basin.

In 2013, CARB announced a sustainable freight transportation effort that would identify needs and steps to transform California's system into one that is more efficient and sustainable. Goals for this strategy include:

- Move goods more efficiently and with zero/near zero emissions;
- Transition to cleaner, renewable transportation energy sources;

- Provide reliable velocity and expanded system capacity;
- Integrate with national and international freight transportation system; and
- Support healthy, livable communities.

The CARB, through various air pollution control districts and other agencies, tracks how each designated area measures up to state standards. The chart on the following page represents the status of criteria pollutants for all California counties and their associated air basins.

As of 2013, all designated areas are in attainment for nitrogen oxide (NO_2), sulfur dioxide (SO_2), and lead. For ozone (O_3), ten of the State's 58 counties have attained the standard and 40 are in nonattainment (the remaining are unclassified, nonattainment-transitional, or have a combined status). In the fine particulate matter (PM2.5) category, 22 counties are in attainment and 17 in nonattainment (the remaining are unclassified or a combination). Only four counties are in attainment for respirable particulate matter (PM10) – all but a few are in nonattainment. In the carbon monoxide (CO) category, 32 counties are in attainment, and the remaining 26 are unclassified or straddle between the two if within more than one air basin. The following counties (with their associated air basins) are in nonattainment for O_3, PM2.5, and PM10:

- Alameda (San Francisco Bay Area)
- Butte (Sacramento Valley)
- Fresno (San Joaquin Valley)
- Kings (San Joaquin Valley)
- Madera (San Joaquin Valley)
- Marin (San Francisco Bay Area)
- Merced (San Joaquin Valley)
- Napa (San Francisco Bay Area)
- Orange (South Coast)
- San Diego (San Diego)
- San Francisco (San Francisco Bay Area)
- San Joaquin (San Joaquin Valley)
- San Mateo (San Francisco Bay Area)
- Santa Clara (San Francisco Bay Area)
- Stanislaus (San Joaquin Valley)
- Tulare (San Joaquin Valley)

Although this discussion is concentrated on air emissions, freight transportation environmental issues also include, but are not limited to: storm water quality, ballast water standards, noise pollution and other community impacts, and marine mammal ship strikes.

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Air Quality Designations (2013)

Counties/Air Basins				Ozone	Particulate Matter (PM) 2.5	PM10	Carbon Monoxide	Nitrogen Oxides	Sulfur Dioxide	Lead
Alameda				N	N	N	A	A	A	A
Alpine				U	A	N	U	A	A	A
Amador				N	U	U	U	A	A	A
Butte				N	N	N	A	A	A	A
Calaveras				N	U	N	U	A	A	A
Colusa				A	A	N	U	A	A	A
Contra Costa				N	N	N	A	A	A	A
Del Norte				A	A	A	U	A	A	A
El Dorado				T/N	A/U	N/N	A/U	A	A	A
Fresno				N	N	N	A	A	A	A
Glenn				A	A	N	U	A	A	A
Humboldt				A	A	N	A	A	A	A
Imperial				N	N PART/A	N	**A**	A	A	A
Inyo				N	A	N	A	A	A	A
Kern				N/N	U/N	N/N	U/A	A	A	A
Kings				N	N	N	U	A	A	A
Lake				A	A	A	A	A	A	A
Lassen				A	A	N	U	A	A	A
Los Angeles				N/N	U/N	N/N	A/A	A	A	A
Madera				N	N	N	U	A	A	A
Marin				N	N	N	A	A	A	A
Mariposa				N	U	U PART	U	A	A	A
Mendocino				A	A	N	A	A	A	A
Merced				N	N	N	U	A	A	A
Modoc				A	A	N	U	A	A	A
Mono				N	A	N	A	A	A	A
Monterey				N	A	N	A	A	A	A
Napa				N	N	N	A	A	A	A
Nevada				N	U	N	U	A	A	A
Orange				N	N	N	A	A	A	A
Placer				T/N/N	A/U/A PART	N/N/N	A/U/A	A	A	A
Plumas				U	N PART/U	N	A	A	A	A
Riverside				N/N/N	U/A/N	N/N/N	U/A/A	A	A	A
Sacramento				N	A	N	A	A	A	A
San Benito				N	A	N	U	A	A	A
San Bernardino				N/N	U/N	N/N	A/A	A	A	A
San Diego				N	N	N	A	A	A	A
San Francisco				N	N	N	A	A	A	A
San Joaquin				N	N	N	A	A	A	A
San Luis Obispo				N	A	N	A	A	A	A
San Mateo				N	N	N	A	A	A	A
Santa Barbara				N	U	N	A	A	A	A
Santa Clara				N	N	N	A	A	A	A
Santa Cruz				N	A	N	U	A	A	A
Shasta				N	A	N	U	A	A	A
Sierra				U	U	N	U	A	A	A
Siskiyou				A	A	A	U	A	A	A
Solano				N/N	U/N	N/N	A/A	A	A	A
Sonoma				A/N	A/N	A/N	U/A	A	A	A
Stanislaus				N	N	N	A	A	A	A
Sutter				T	A	N	A	A	A	A
Tehama				N	U	N	U	A	A	A
Trinity				A	A	A	U	A	A	A
Tulare				N	N	N	A	A	A	A
Tuolumne				N	U	U	A	A	A	A
Ventura				N	A	N	A	A	A	A
Yolo				N	U	N	A	A	A	A
Yuba				T	A	N	U	A	A	A

KEY

Designations:

- N = Nonattainment
- T = Nonattainment-Transitional
- A = Attainment
- U = Unclassified

PART = Portion

Air Basins:

- Great Basin Valleys
- Lake County
- Lake Tahoe
- Mojave Desert
- Mountain Counties
- North Central Coast
- North Coast
- Northeast Plateau
- Sacramento Valley
- Salton Sea
- San Diego
- San Francisco Bay Area
- San Joaquin Valley
- South Central Coast
- South Coast

[i] Foreign Trade Through California Ports: http://www.dof.ca.gov/html/fs_data/latestecondata/FS_Trade.htm

[ii] Caltrans Traffic Operations, Office of Traffic Engineering, Weight Limitations: http://www.dot.ca.gov/hq/traffops/trucks/trucksize/weight.htm

[iii] San Joaquin Valley Goods Movement Plan page 2-27: http://www.sacog.org/mtp/pdf/mtp2035/issue%20briefs/road%20maintenance.pdf

[iv] Caltrans 2013 Five-Year Maintenance Plan, March 2013

[v] Caltrans 2011 State of the Pavement Report: http://onramp.dot.ca.gov/hq/maint/pavement/docs/2011_SOP.pdf

[vi] Self-Help Counties *Focus on the Future* speech by Caltrans Director Malcolm Dougherty, November 2013

[vii] California State Rail Plan (CSRP), AECOM, page 129: http://californiastaterailplan.dot.ca.gov/docs/csrp_public-draft_main_2013-02-09.pdf

[viii] Mean Lower Low Water (MLLW) is the average of the lowest low tides per day over a specified 19-year period.

[ix] American Transportation Research Institute (ATRI) and FHWA: http://atri-online.org/2011/10/01/fpm-congestion-monitoring-at-250-freight-significant-highway-locations/

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