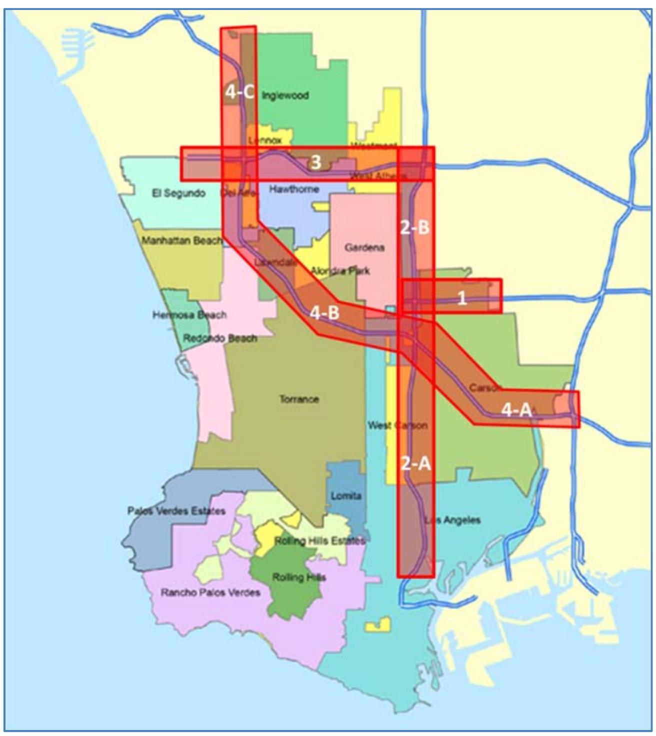
South Bay Corridor Study and Evaluation for Dynamic Corridor Congestion Management (DCCM)

Contract No. 07A3227

Task 2: Corridor Study and Recommendations Report

Final



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SOUTH BAY CITIES COUNCIL OF GOVERNMENTS

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September 13, 2013

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

Executive Summary

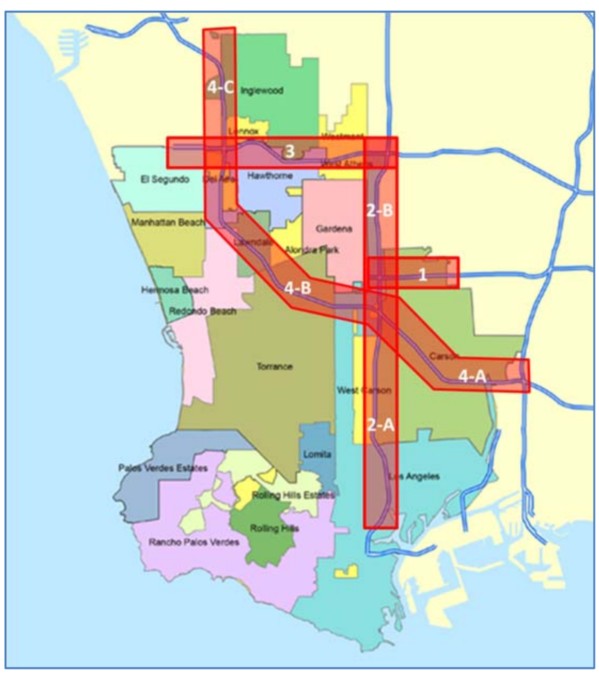
Background

The purpose of this Measure R project—South Bay Corridor Study and Evaluation for Dynamic Corridor Congestion Management (DCCM)—is to identify and evaluate proactive congestion management concepts that make fullest use of all system capacity to address the certain congestion increase the District and the South Bay region will face over the next 10-20 years. In particular, this project is concerned with the congestion improvement potential from the coordination of freeway ramp metering systems with State's and Cities' arterial traffic signal systems.

The Corridors

This Corridor Study Report—the first task of the DCCM project—presents a ranking of the seven primary corridors within the South Bay region in terms of their readiness and suitability for DCCM implementation. These corridors are:

- Corridor 1: SR-91, from I-110 to Central Ave
- Corridor 2-A: I-110, from SR-47 to I-405
- Corridor 2-B: I-110, from I-405 to Imperial Hwy
- Corridor 3: I-105, from Sepulveda Blvd to Central Ave
- Corridor 4-A: I-405, from I-710 to I-110
- Corridor 4-B: I-405, from I-110 to I-105
- Corridor 4-C: I-405, from I-105 to La Tijera Blvd



A note about the selection of only a single corridor

Although this report recommends only a single corridor for the DCCM pilot—the I-110 corridor from I-405 to Imperial Hwy—it must be emphasized that all seven corridors would benefit from DCCM. The selected pilot corridor is intended to serve as a test case and as a model for the implementation of DCCM concepts on the other regional corridors.

Because ramp meter-arterial signal system coordination is a relatively untested concept, achievability was a key concern in the evaluation of the corridors. For example, a corridor suffering from severe freeway and arterial congestion could argue a greater need for congestion management solutions, but this very oversaturation may overwhelm the ability of DCCM to balance demand effectively. Likewise, a corridor with poor arterial-freeway connectivity or that lacks a robust parallel arterial network will impose friction on a DCCM system as it attempts to redistribute demand between facilities. While these challenges can certainly be overcome, it was considered important for the initial pilot DCCM corridor to be tested with a minimum of barriers, so that success could be demonstrated early and lessons learned could be established and more easily applied to other more complex corridors.

Evaluation Criteria

Five categories of criteria, equally weighted, were used to evaluate the readiness and suitability of the corridors for DCCM implementation. For each criterion, corridors received a score from 1 to 5, with 1 indicating poor DCCM suitability and 5 indicating excellent DCCM suitability. All five criterion scores were then averaged to obtain a final overall score.

The following are the five criteria used in the evaluation of the corridors:

1. *System demand*—the level and distribution of demand throughout the corridor and the ability of the infrastructure to support it
2. *Potential of physical infrastructure to support demand coordination*—the suitability of the road network for supporting coordinated dynamic congestion response strategies
3. *Potential of ITS infrastructure to support demand coordination*— the condition or availability of systems that may be relied upon to implement coordinated dynamic congestion response strategies
4. *Institutional coordination challenges*—inter-agency or other institutional issues that may impact the ability to implement DCCM strategies for a specific corridor
5. *Potential to support future Integrated Corridor Management (ICM)*—the prevalence of infrastructure and systems that can be readily adopted by an ICM system to manage and balance multi-modal corridor-wide throughput

Performance Measures

This report recommends the following key performance measures to be used to assess the performance of the DCCM pilot system in terms of its ability to reduce congestion and maximize the use of the available infrastructure capacity:

Highway

- Delay per mile
- Volume (average daily traffic [ADT])
- Volume (peak period and peak hour)
- Throughput (vehicles/lane/hour)
- Average speed
- Travel time
- Travel time reliability (buffer index)
- Number of incidents or collisions
- Hours of delay experienced (congestion period)

Arterial

- Intersection level of service (LOS)
- Volume (ADT)
- Volume (peak period and peak hour)
- Average speed
- Travel time

Final Corridor Rankings

Based on the evaluation criteria outlined above, I-110 (from I-405 to Imperial Hwy) emerged as the top ranked corridor for initial DCCM readiness, and is recommended by this report for DCCM pilot deployment.

The rank order of the seven corridors is as follows:

1. ***I-110, from I-405 to Imperial Hwy (Corridor 2-B***)
2. I-105, from Sepulveda Blvd to Central Ave (Corridor 3)
3. I-110, from SR 47 to I-405 (Corridor 2-A)
4. I-405, from I-710 to I-110 (Corridor 4-A)
5. I-405, from I-105 to La Tijera Blvd (Corridor 4-C)
6. SR-91, from I-110 to Central Ave (Corridor 1)
7. I-405, from I-110 to I-105 (Corridor 4-B)

A high-level summary of how each of the corridors scored on the evaluation criteria is shown in Table 1 on the following page.

Table 1. All corridors evaluation summary

Evaluation Criterion	Assessment Rating (1 poor - 5 excellent)						
	Corridor 1 SR-91	Corridor 2-A I-110 (south)	Corridor 2-B I-110 (north)	Corridor 3 I-105	Corridor 4-A I-405 (south)	Corridor 4-B I-405 (mid)	Corridor 4-C I-405 (north)
System Demand	**2.0**	**2.0**	**4.5**	**3.5**	**4.5**	**3.0**	**3.5**
Peak Hour congestion levels	2	2	5	2	5	1	3
Congestion variability	2	2	4	5	4	5	4
Physical Infrastructure	**2.9**	**3.9**	**4.3**	**4.5**	**2.5**	**3.0**	**3.3**
Corridor length	1	4	3	5	3	5	3
Highway-arterial accessibility	3	5	5	5	1	1	2
Highway capacity	4	3	5	2	2	3	5
Arterial capacity	3	4	5	5	2	3	3
Ramp/arterial storage	4	3	4	5	4	3	4
ITS Infrastructure	**3.2**	**1.7**	**3.3**	**3.2**	**3.2**	**3.5**	**3.2**
Hwy detection/surveillance capability	4	2	4	5	4	5	4
Arterial detection/surveillance capability	1	1	1	1	1	1	1
Ramp metering capability	5	2	5	4	5	5	5
Traveler info dissemination capability	2	2	3	2	2	2	2
Institutional Coordination	**5.0**	**3.0**	**3.5**	**2.5**	**4.0**	**2.0**	**3.0**
Agency coordination required	5	3	3	2	5	1	3
Arterial controller integration effort	5	3	4	3	3	3	3
ICM Readiness	**2.0**	**1.5**	**5.0**	**4.0**	**2.0**	**3.0**	**2.0**
Lane management	3	1	5	3	3	3	3
Transit capabilities	1	2	5	5	1	3	1
Overall Potential Improvement Opportunity	**3.0**	**2.4**	**4.1**	**3.6**	**3.2**	**2.9**	**3.0**

1. Introduction

Caltrans District 7 is arguably one of the most congested urban areas in the United States. The Southern California Association of Governments (SCAG) has projected an increase of over six million people in the region over the next 25 years, a 32% increase in the existing 17 million people living in the metropolitan six-county area. This would suggest that 2.4 million people could be added to the region in the next ten years alone. The increasing demand associated with travel and goods movement with such potential increases over the next ten years focuses attention on the need to maximize the productivity of the freeway and arterial systems through all of the tools available, in particular in most heavily congestion travel corridors.

In 2008, voters in Los Angeles County approved Measure R, a one-half percent sales tax dedicated to transportation. Part of the funds is dedicated to funding freeway operational improvements on state freeways/highways and adjacent arterials in the South Bay region of Los Angeles County.

Measure R funds are administered by Los Angeles County Metropolitan Transportation Authority (Metro). Listed as "I-405, I-105, I-110, SR-91 ramp and interchange improvements", the South Bay subregion is expected to receive approximately $906 million in 2008 dollars (or $1.5 billion escalated to year of expenditure dollars) over the 30-year life of Measure R. Funding allocations are recommended by the South Bay Cities Council of Governments (SBCCOG) Board for approval by the Metro Board in five-year increments. The program allocations will be updated annually to program projects for funding.

The South Bay Measure R Highway Program (SBHP) was initiated to allow the SBCCOG to actively manage dedicated resources and leverage these resources to fund and implement highway improvement projects through a regional collaborative process. The SBCCOG, a joint powers authority representing the local jurisdictions in this sub-region in Los Angeles County, serves as the program manager to help guide and oversee the SBHP. Building on previous transportation study recommendations and needed mobility gap closures, the SBCCOG has developed a prioritized program of projects and oversees project implementation in partnership with each lead agency, Metro and Caltrans.

Caltrans District 7, in conjunction with Metro (the project sponsor) and SBCCOG, initiated the South Bay Dynamic Corridor Congestion Management (DCCM) Project to investigate the most effective and vibrant methods to address the certain congestion increase the District and the South Bay region will face over the next 10-20 years. The DCCM project will identify and evaluate proactive congestion management concepts that make fullest use of all system capacity for selected highway corridor(s) in the SBCCOG region.

1.1 Purpose

The scope of work for the DCCM project relates to performing a corridor study within the SBCCOG region, selecting a corridor or corridors that will allow freeway ramp metering system coordination with State's and Cities' arterial traffic signal system to achieve corridor congestion relief, developing a concept of operations and Memorandums of Understanding (MOUs) among all involved stakeholders, and conducting a system evaluation for the initial pilot project.

This Corridor Study Report—the first task of the DCCM project—seeks to assess where and how the DCCM system should be tested and evaluated, develop a list of strategies to evaluate the candidate corridors, recommend a corridor for a pilot implementation, and develop performance measures to be used to evaluate the pilot.

1.2 DCCM Approaches

The Smart Corridor Statewide Study completed in the 1990s, identified 17 corridors within the District with positive cost-benefit ratios associated with smart corridor management strategies. Furthermore, the United States Department of Transportation (USDOT) has recently promoted and actively funded projects that are designed to dynamically and proactively manage traffic corridors, for example the Integrated Corridor Management (ICM) projects in San Diego and Dallas. These are in addition to several other dynamic corridor management projects already being implemented in California, which include the I-80, I-880, and Route 101 projects in northern California.

The primary DCCM concept that will be investigated as part of this project is Freeway Ramp Meter/Arterial Traffic Signal Coordination. Additional active traffic and demand management strategies will be investigated as part of the Concept of Operations task, including:

- Improved Dynamic Corridor Ramp Metering Algorithms
- Develop DCCM coordination with Arterial Traffic Signal System
- Queue End Warning (QEW)
- Speed Harmonization/Variable Speed Limits (VSL)
- Traffic Signal Control, including adaptive
- Junction Control
- Smart Signals
- Traffic Demand Management
- Improved Decision Support Systems (DSS)/Response Plans
- Multimodal DSS
- Predictive travel time calculations
- Integration of Online Micro-Simulation Tools
- Accident response strategy assessments
- Urban and interurban congestion management
- ITS Transit Management Strategies
- Active Transit Management (ATM) Strategies
- Active Transportation Demand Management (ATDM) Strategies
- Performance Measurement

These concepts will be discussed in detail in the Concept of Operations report.

1.3 Corridor Study Report Structure

The South Bay Corridor study begins in Section 2 (Corridor Alternatives) by analyzing existing and anticipated future transportation conditions for each of the corridor areas, including descriptions of the existing highway facilities, arterial connections, transit, local jurisdictions, congestion levels, system capabilities, programmed and planned future roadway improvements, and other factors that may impact the consideration and selection of the preferred study corridor.

Section 3 (Corridor Evaluation Strategies and Prioritization) presents the key evaluation criteria to be used to prioritize the candidate corridors, including arterial connections, freeway and arterial congestion levels, local agency coordination/partnership requirements, detection instrumentation, and system capabilities. Additionally, it presents the evaluation framework used to perform the ranking and prioritization of the corridor alternatives.

The data needs, data collection requirements, and key performance measures to be used in the evaluation of the pilot deployment are detailed in Section 4 (Performance Measures and Evaluation Plan).

Section 5 (Corridor Recommendation) presents the recommendation for corridor selection for evaluation, based on the analysis provided in the previous sections.

1.4 References

Caltrans District 7, *Caltrans District 7 10-Year Urban Congestion Relief Master Plan*, 2006.

Federal Highway Administration (FHWA), *ATDM Analysis Brief: Highway Capacity Manual (HCM)-ATDM Project Overview (FHWA-HOP-12-047)*, August 2012.

FHWA, *ATDM Program Brief: Active Parking Management (FHWA-HOP-12-033)*, June 2012.

FHWA, *ATDM Program Brief: An Introduction to Active Transportation and Demand Management (FHWA-HOP-12-032)*, June 2012.

FHWA, *ATDM Program Brief: The International Influence on ATDM in the United States (FHWA-HOP-12-048)*, August 2012.

FHWA, *Integrated Corridor Management (ICM) Initiative ICMS Surveillance and Detection Requirements for Arterial and Transit Networks*, November 2009.

FHWA, *Integrated Corridor Management Analysis Results for the I-880 Test Corridor*, June 2008.

South Bay Cities Council of Governments (SBCCOG), *Measure R Highway Program ITS Operational Concept Report (Final)*, May 2013.

South Bay Cities Council of Governments (SBCCOG), *South Bay Measure R Highway Program Strategic Transportation Element*, May 2013.

Urbanik et al., *Coordinated Freeway and Arterial Operations Handbook*, 2006.

USDOT, *Concept of Operations for the I-15 Corridor in San Diego, California*, March 2008.

2. Corridor Alternatives

This section provides an analysis of the existing and anticipated future transportation conditions for each of the corridor alternatives, including descriptions of the existing highway facilities, arterial connections, transit, local jurisdictions, congestion levels, system capabilities, programmed and planned future roadway improvements, and other factors that may impact the consideration and selection of the preferred study corridor.

2.1 Study Area Location

Figure 1 shows a map of the South Bay Cities Council of Governments (SBCCOG) region, which comprises the following jurisdictions:

- Carson
- El Segundo
- Gardena
- Hawthorne
- Hermosa Beach
- Inglewood
- Lawndale
- Lomita
- City of Los Angeles, including all or portions of the following areas:
  - Harbor City
  - San Pedro
  - Wilmington
- County of Los Angeles, including portions of the following unincorporated areas:
  - Harbor Gateway
  - West Athens
  - Willowbrook
- Manhattan Beach
- Palos Verdes Estates
- Rancho Palos Verdes
- Redondo Beach
- Rolling Hills
- Rolling Hills Estates
- Torrance

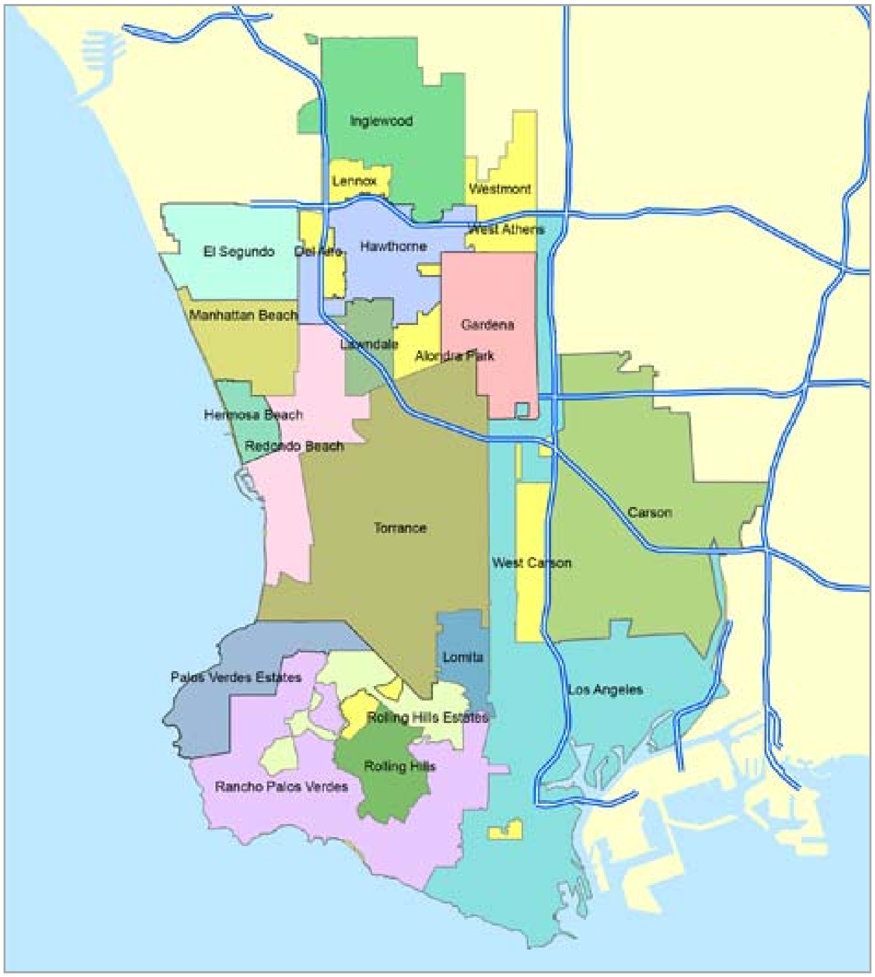


Figure 1. South Bay Cities Council of Governments Region. Source: SBCCOG

Figure 2 below identifies the seven key highway corridors within the SBCCOG study region that will be assessed for their ability to support DCCM strategies:

- Corridor 1: SR-91, from I-110 to Central Ave
- Corridor 2-A: I-110, from SR-47 to I-405
- Corridor 2-B: I-110, from I-405 to Imperial Hwy
- Corridor 3: I-105, from Sepulveda Blvd to Central Ave
- Corridor 4-A: I-405, from I-710 to I-110
- Corridor 4-B: I-405, from I-110 to I-105
- Corridor 4-C: I-405, from I-105 to SR-90

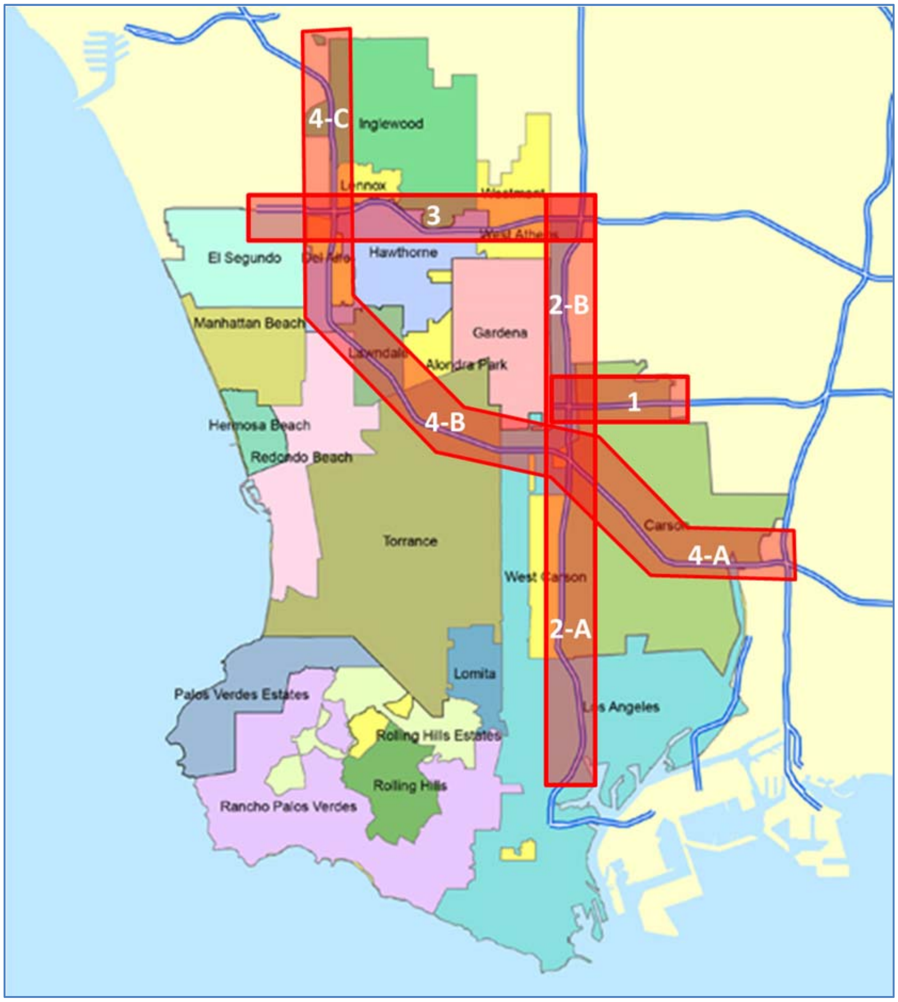
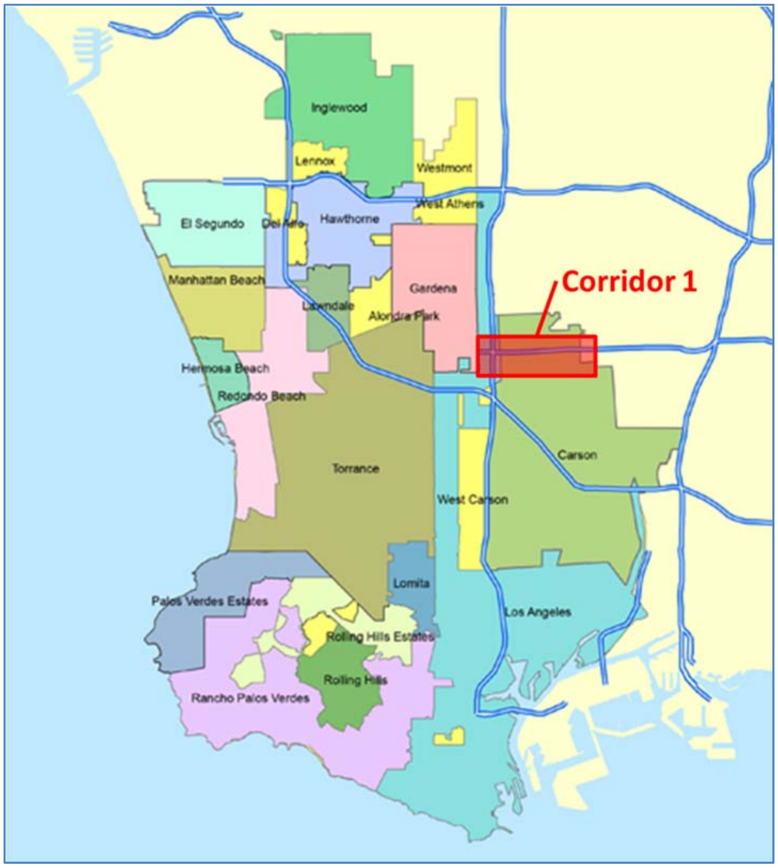


Figure 2. Primary Highway Corridors in the SBCCOG Region

2.2 Corridor 1: SR-91 (from I-110 to Central Ave)

2.2.1 Overview

The SR-91 corridor, from I-110 at the west to Central Avenue at the east, is 2.1 miles in length and extends primarily through Carson.



2.2.2 Highway

2.2.2.1 Highway ITS

Vehicle detection along the corridor is accomplished via embedded pavement loops, with 5 eastbound vehicle detection system (VDS) sensors and 5 westbound VDS sensors, providing eastbound detection coverage of 2.4 VDS per mile and westbound detection coverage of 2.4 VDS per mile (see Figure 3 on the following page). In addition, 3 closed-circuit television (CCTV) cameras are deployed along the corridor, positioned near each of the major intersecting arterials.

One changeable message sign (CMS) displaying travel times and other information is located near Central Avenue on the westbound.

Figure 3. Corridor 1 (SR-91) Overview

2.2.2.2 On-Ramps and On-Ramp Intersections

As depicted in Figure 3 above, all 3 eastbound on-ramps and 2 of the 3 westbound on-ramps along the 2.1-mile SR-91 corridor are metered, providing an average density of 1.4 ramps per mile in the eastbound direction and 1.0 ramps per mile in the westbound.

The eastbound on-ramps (from west to east) are:

- Albertoni St/Main St
- Albertoni St/Avalon Blvd
- Central Ave

The westbound on-ramps (from west to east) are:

- Main St
- Avalon Blvd
- Central Ave

Table 2 on the following page provides additional detail about the configurations and storage capacities of the ramps and adjoining intersections.

Table 2. Ramp/Arterial Intersection Configurations and Storage Capacities

SR-91 On-Ramp	Fwy Dir	Ramp			Arterial							
		Metered/ Lanes	Unmetered HOV	Ramp Storage (ft)	Turn Pocket Storage		NB Lane Geom.			SB Lane Geom.		
					LT (ft)	RT (ft)	Left	Thru	Right	Left	Thru	Right
Main St	WB	1/1*	0	1275*	150	0	1	2	0	1	2	0
Albertoni St/Main St	EB	2/2	0	1250	400	0	2†	2	0	0†	2	0
Avalon Blvd	WB	2/2	0	550	625	400	0	3	1	2	3	0
EB Albertoni St/Avalon Blvd	EB	1/1	0	750	N/A‡	N/A	1†	2	0	N/A	N/A	N/A
Central Ave	WB	1/1	0	650	225	0	1	2	0	0	3	0
Central Ave	EB	2/3	1	1800	575	300	0	2	2	2	2	0

* Westbound Main St on-ramp has two lanes that merge into a single lane upon approaching the ramp meter. The ramp storage value reflects the total lane feet of both lanes of the full ramp, pre- and post-merge.

† Frontage Rd/Main St and Eastbound Albertoni St/Avalon Blvd, run east-west, parallel to SR-91. Eastbound lane geometries are shown in the section labeled “NB Lane Geom” and westbound lane geometries are shown in the section labeled “SB Lane Geom”.

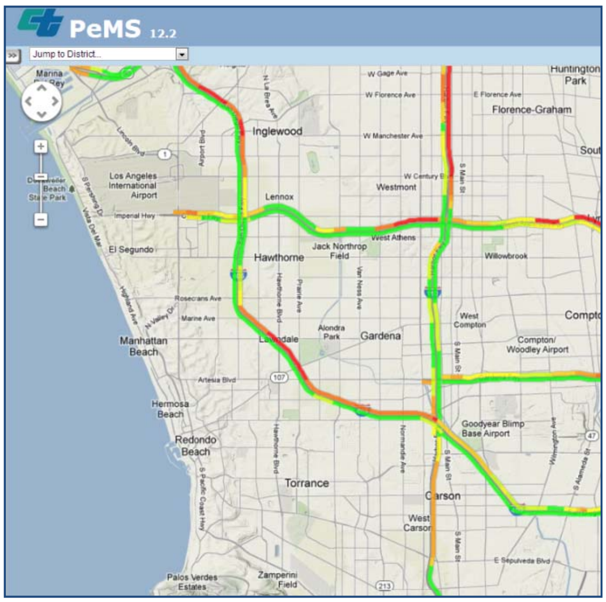
‡ There is no arterial signalization at the Eastbound Albertoni St/Avalon Blvd on-ramp location.

2.2.2.3 Congestion Levels

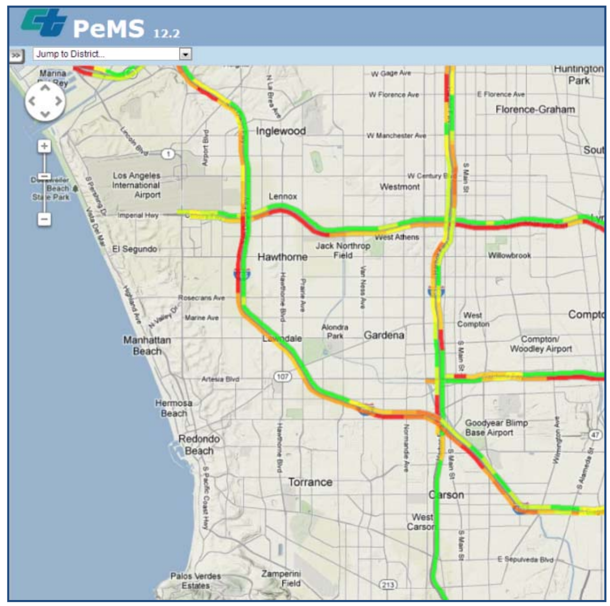
SR-91, 2.1 miles from I-110 to Central Avenue, experiences moderate levels of congestion in the westbound direction during the A.M. peak and very high levels of congestion in the eastbound direction during the P.M. peak due primarily to very high downstream congestion (outside the scope of this study). See figures below.

Based on the levels and distribution of congestion along this corridor segment during the eastbound P.M. peak and the fact that the bottleneck location is outside the scope of this project, any DCCM system deployed on this corridor segment is not expected to have a significant mobility improvement impact.

A.M. Peak



P.M. Peak



Lane-by-Lane Speed Profiles

The figures below (Figure 4 and Figure 5) show the lane-by-lane speeds for the SR-91 during the typical weekday P.M. peak (5 P.M.) for the westbound and for eastbound directions.

As indicated, the westbound P.M. peak period speeds are at free flow levels.

The significant eastbound P.M. peak period congestion and slow speeds stem from a bottleneck downstream of this corridor segment, with average speeds well below 40 MPH from postmile 1, on.

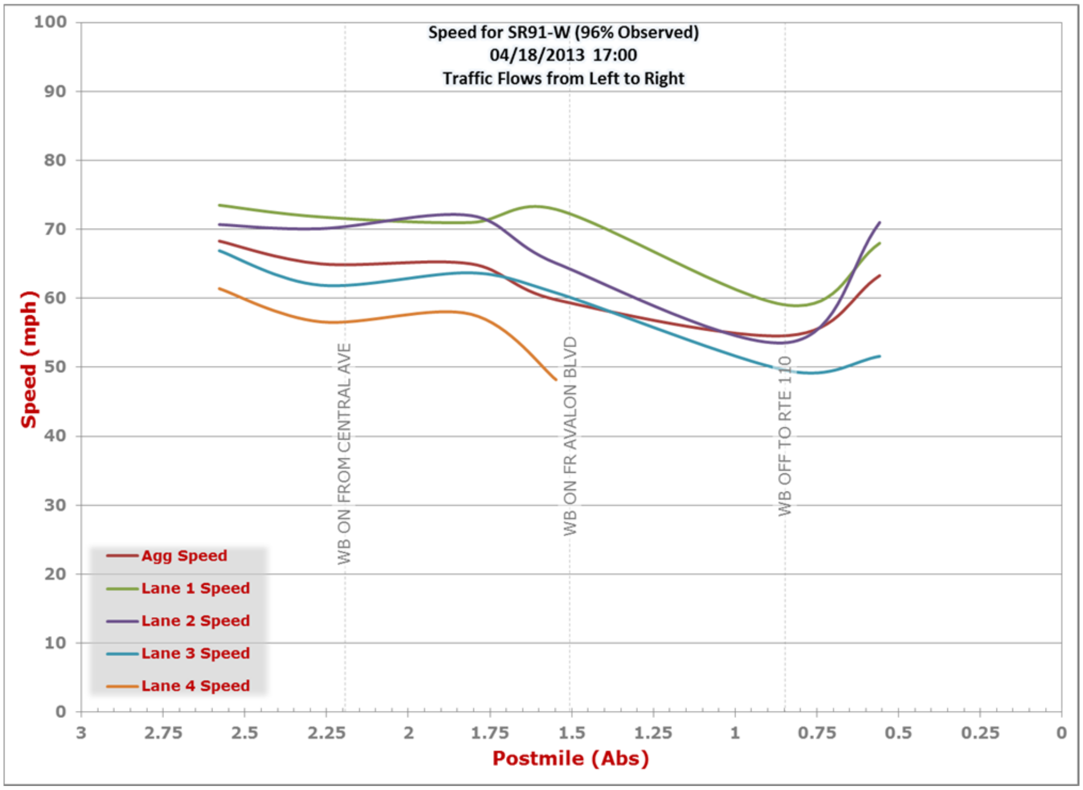


Figure 4. Lane-by-Lane Speed Profile for SR-91 WB (P.M. Peak)

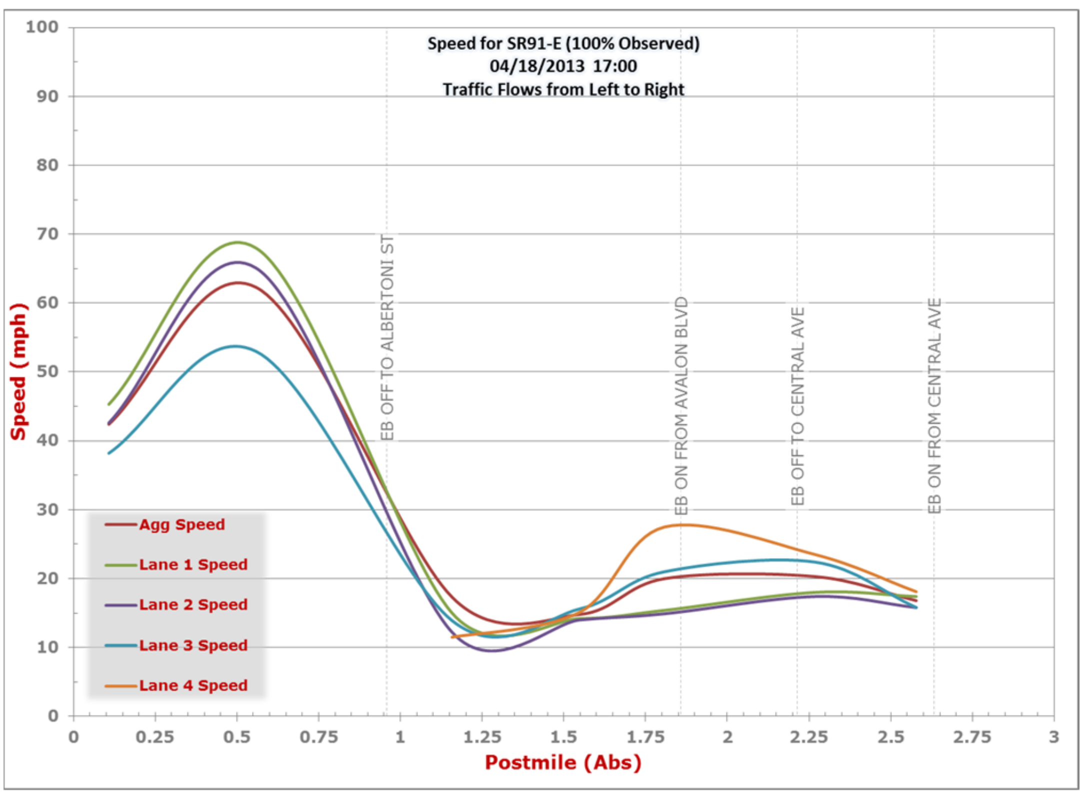


Figure 5. Lane-by-Lane Speed Profile for SR-91 EB (P.M. Peak)

Travel Times and Travel Time Delay

The figures below (Figure 6 and Figure 7) illustrate the actual travel times at peak times, as measured during representative sample weeks in January 2013.

SR-91 Westbound (2.1 mi) – P.M. Peak

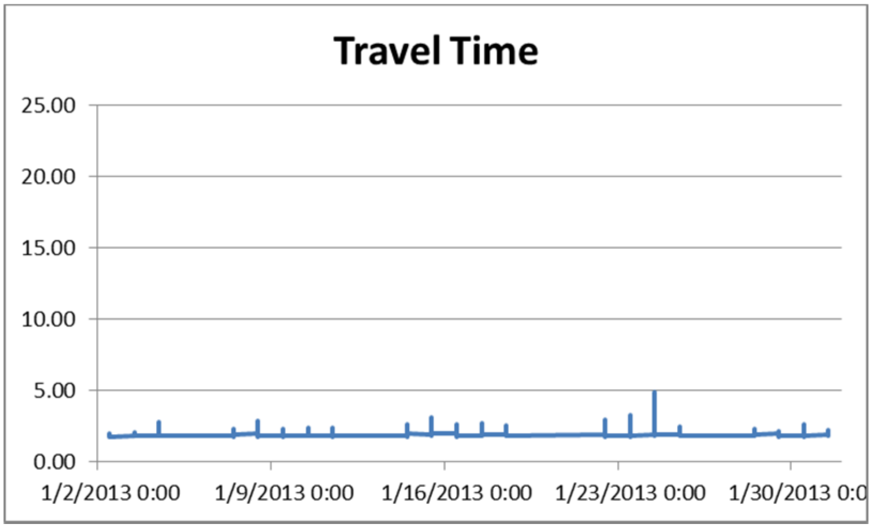


Figure 6. Travel Times and Travel Time Delay for SR-91 Westbound (P.M. Peak)

As indicated, the typical westbound P.M. peak travel times are 3 to 5 minutes. For the 2.1 mile corridor, travel time delay typically is limited to about one minute more than free flow travel time.

SR-91 Eastbound (2.6 mi) – P.M. Peak

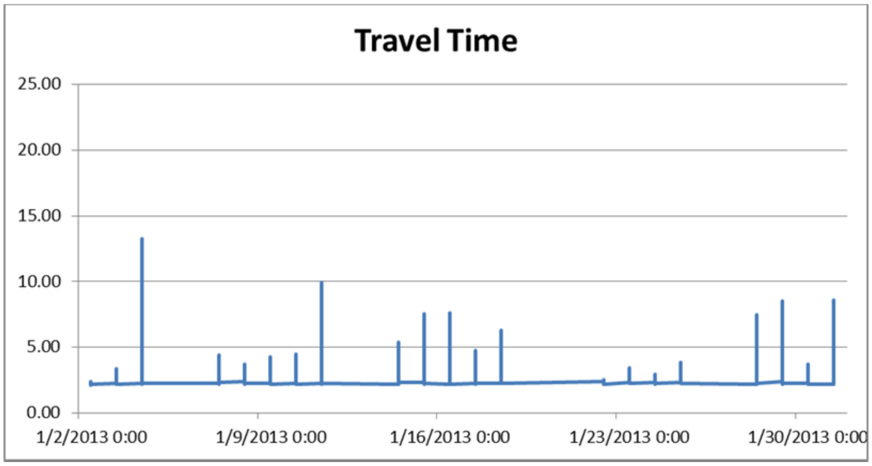


Figure 7. Travel Times and Travel Time Delay for SR-91 Eastbound (P.M. Peak)

Travel time delay in the eastbound direction during the P.M. peak is much more significant. Typical peak hour travel time is roughly 8 minutes for the 2.6 mile corridor. Travel time delay exceeds 5 minutes during peak times.

2.2.2.4 Programmed and Planned Highway Improvements

The adopted SBCCOG South Bay Measure R Highway Program Strategic Transportation Element (STE) has identified several planned highway projects identified by various previous planning efforts that were determined to have an operational nexus to the State Highway System for regional mobility. The STE also performed a mobility benefit analysis on each of these projects to estimate the reduction in delay associated with the implementation of the projects.

The two planned highway projects in the SR-91 corridor are shown in the table below.

Caltrans Priority*	Type	Dir	Facility	Location Limits	City/ County	Description	Delay Reduc.†
3	Auxiliary lane	SB	I-110	SR-91 to Del Amo Bl UC	County	Auxiliary lane on SB-110 from WB SR-91 to Torrance Bl off-ramp & possible new flyover ramp from NB I-405 to SB I-110 Connector	252
17	Interchange	NB	I-110	at SR-91 IC	County	Add new HOV connectors for NB/SB I-110 to EB SR-91 and from WB SR-91 to NB I-110	55

* Caltrans-assigned priorities for SBCCOG region projects range from 1 to 25.

† The STE calculated delay reduction as follows: Estimated future 2035 A.M. and P.M. weekday peak hour (2 hours) delay reduction in veh-hrs. As an example, 200 veh-hrs reduction translates to about 200,000 annual veh-hrs savings.

2.2.3 Arterials

Victoria Street is the primary parallel arterial in the SR-91 corridor, running 1.9 miles from Figueroa Street in the west to Central Avenue in the east (see Table 3 below). Victoria Street is a major regional arterial, with four through lanes (two southbound and two northbound) for the length of the corridor and protected single-lane left turn pockets and dedicated left turn phases at each of the arterial intersections. Victoria Street parallels SR-91 to the south (see Figure 3 above) at a distance of roughly 0.5 miles from the highway for the length of the corridor.

The City of Carson conducted a traffic count for Victoria Street in May 2010 (http://carson.ca.us/content/department/dev_service/traffic_engineering.asp) and measured total weekday counts:

Street	Segment		Date	Daily Traffic Counts		
				Directional		Total
	From	To		EB	WB	
Victoria St	Figueroa	Main	5/17/2012	9,831	10,956	20,787
Victoria St	Main	Avalon	5/17/2012	9,080	9,224	18,304
Victoria St	Avalon	Tamcliff	5/21/2012	6,498	6,482	12,980
Victoria St	Tamcliff	Central	5/21/2012	5,260	5,253	10,513
Victoria St	Central	Wilmington	5/21/2012	4,442	5,056	9,498

Very little up-to-date performance data is available for these arterials due to a lack of arterial data collection and performance measurement systems.

2.2.3.1 Arterial ITS

There are 9 signalized intersections, including 3 major cross streets with direct connections to SR-91 on-ramps, and one primary controller system—KITS—with operation and maintenance by County of Los Angeles. Arterial system detection (capable of determining speed and throughput) is not currently available at any intersection along Victoria Street (see Programmed and Planned Arterial Improvements discussion below).

Table 3. Victoria Street Arterial ITS

Cross Street	Operating Jurisdiction	System	Controller	Firmware	Detection Type	Arterial Detection?
Figueroa St.	LA County	KITS	170E	LACO-4E	loops	No
Broadway	LA County	future KITS	ASC/2-2100	ASC/2-2100		No
Main St.	LA County	KITS	170E	LACO-4E	loops	No
Wall St.	LA County	future KITS	ASC/2-2100	ASC/2-2100		No
Avalon Bl.	LA County	future KITS	ASC/2S-2100	ASC/2S-2100		No
Fire Signal	LA County	KITS	170E	LACO-4E		No
Tamcliff Av.	LA County	future KITS	ASC/2S-2100	ASC/2S-2100		No
Birchknoll Dr.	LA County	future KITS	ASC/2S-2100	ASC/2S-2100		No
Central Av.	LA County	KITS	170E	LACO-4E		No

* Note: **Bolded** cross streets indicate direct freeway connections.

2.2.3.2 Programmed and Planned Arterial Improvements

The adopted SBCCOG South Bay Measure R Highway Program Strategic Transportation Element (STE) has identified several intersections along Victoria Street at which to install new system detection technology. The Los Angeles County Draft ITS Plan has also identified Victoria Street candidate intersections for system detection deployment (see Figure 8 below). Note, however, that no final decision has been made yet as to the location or schedule of detection installation. In addition, there are currently no funded projects to install system detection.

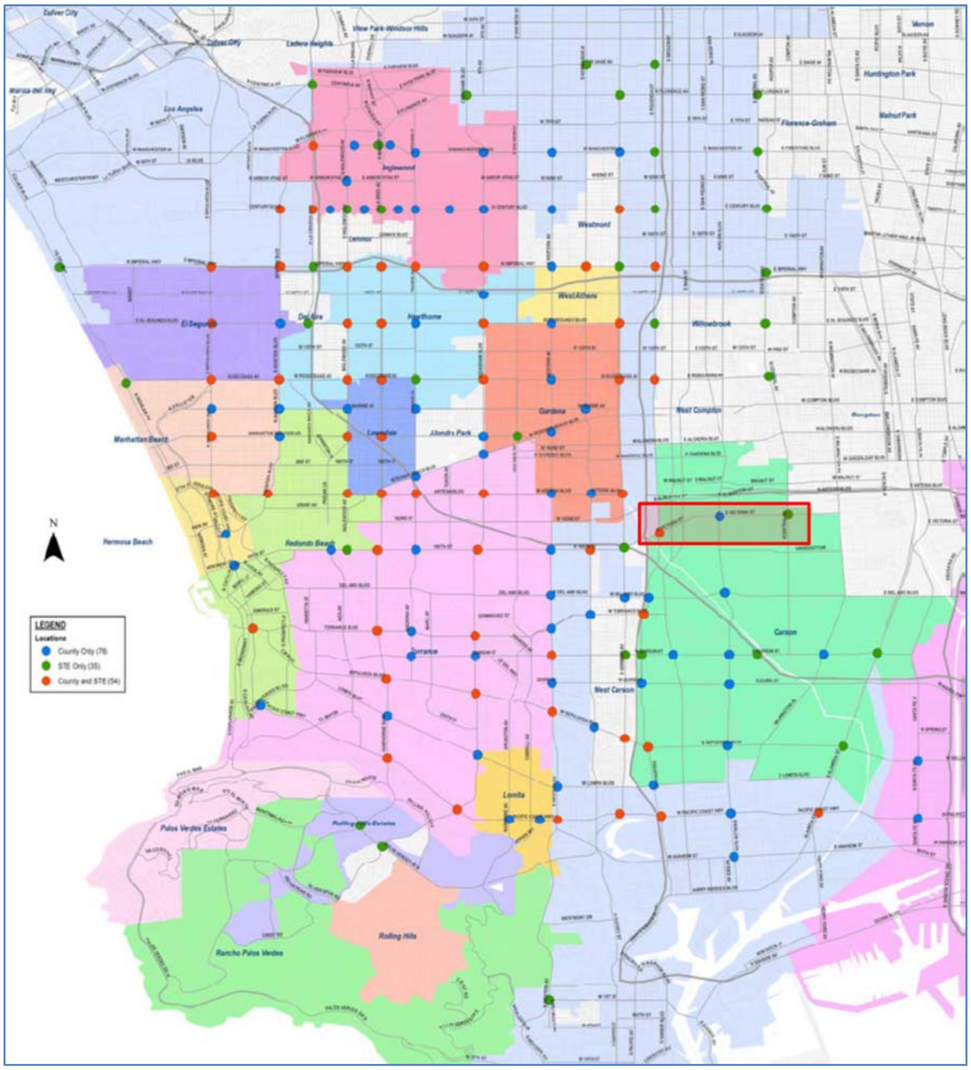


Figure 8. SBCCOG STE and LA County ITS Master Plan Arterial Detection Sites for Victoria St

In total, 3 intersections along Victoria Street have been identified as top candidates for arterial system detection by SBCCOG and Los Angeles County:

Victoria Street Intersection	Identified in SBCCOG STE	Identified in LA County ITS Plan
Figueroa St	X	X
Avalon Blvd		X
Central Ave	X	X

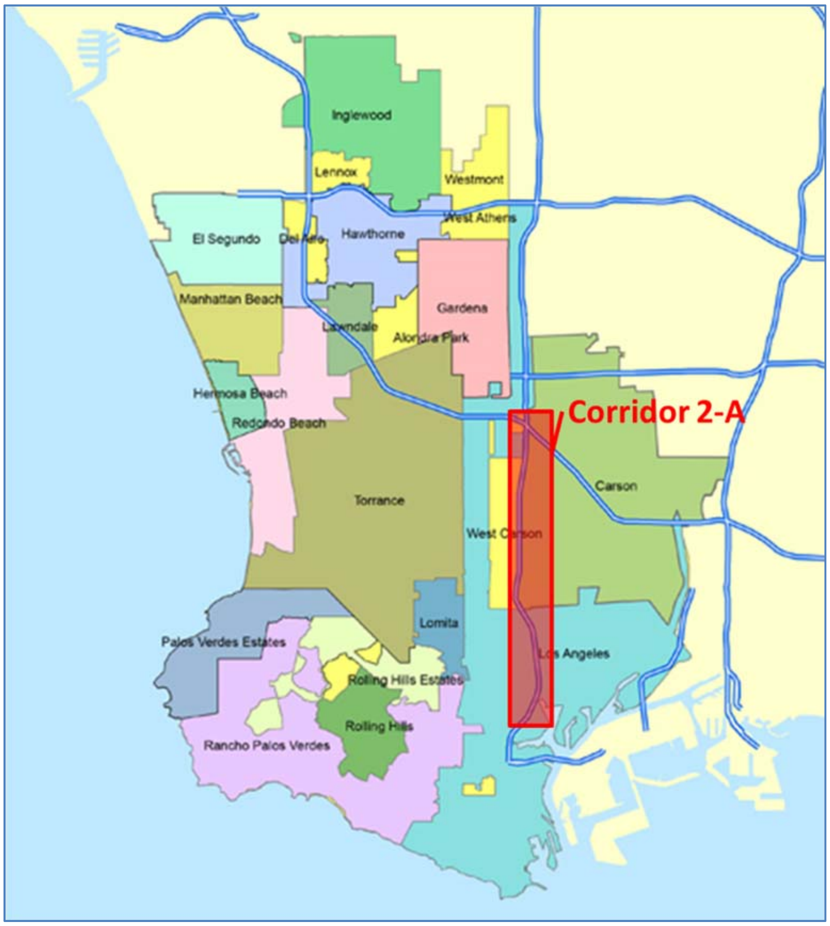
2.2.4 Transit

There is no high-frequency (every 15 minutes or less) east/west rapid transit service that operates with stops within the SR-91 corridor.

2.3 Corridor 2-A: I-110 (from SR-47 to I-405)

2.3.1 Overview

This I-110 corridor, from SR-47 (Vincent Thomas Bridge) at the south to I-405 at the north, is 7.7 miles in length and extends primarily through portions of City of Los Angeles, Carson, and portions of Los Angeles County unincorporated areas (West Carson).



2.3.2 Highway

2.3.2.1 Highway ITS

Vehicle detection along the corridor is accomplished via embedded pavement loops. Along the northbound, there are 9 VDS sensors, providing detection coverage of 1.2 VDS per mile. Along the southbound, however, vehicle detection is significantly lacking. Only one VDS sensor exists in the southbound, near the I-405 interchange, resulting in very little southbound vehicle detection for the majority of the corridor. Additionally, there is no CCTV camera coverage along the corridor. See Figure 9 on the following page.

One Caltrans CMS is located along I-110 northbound, positioned near the ramp for Carson St.

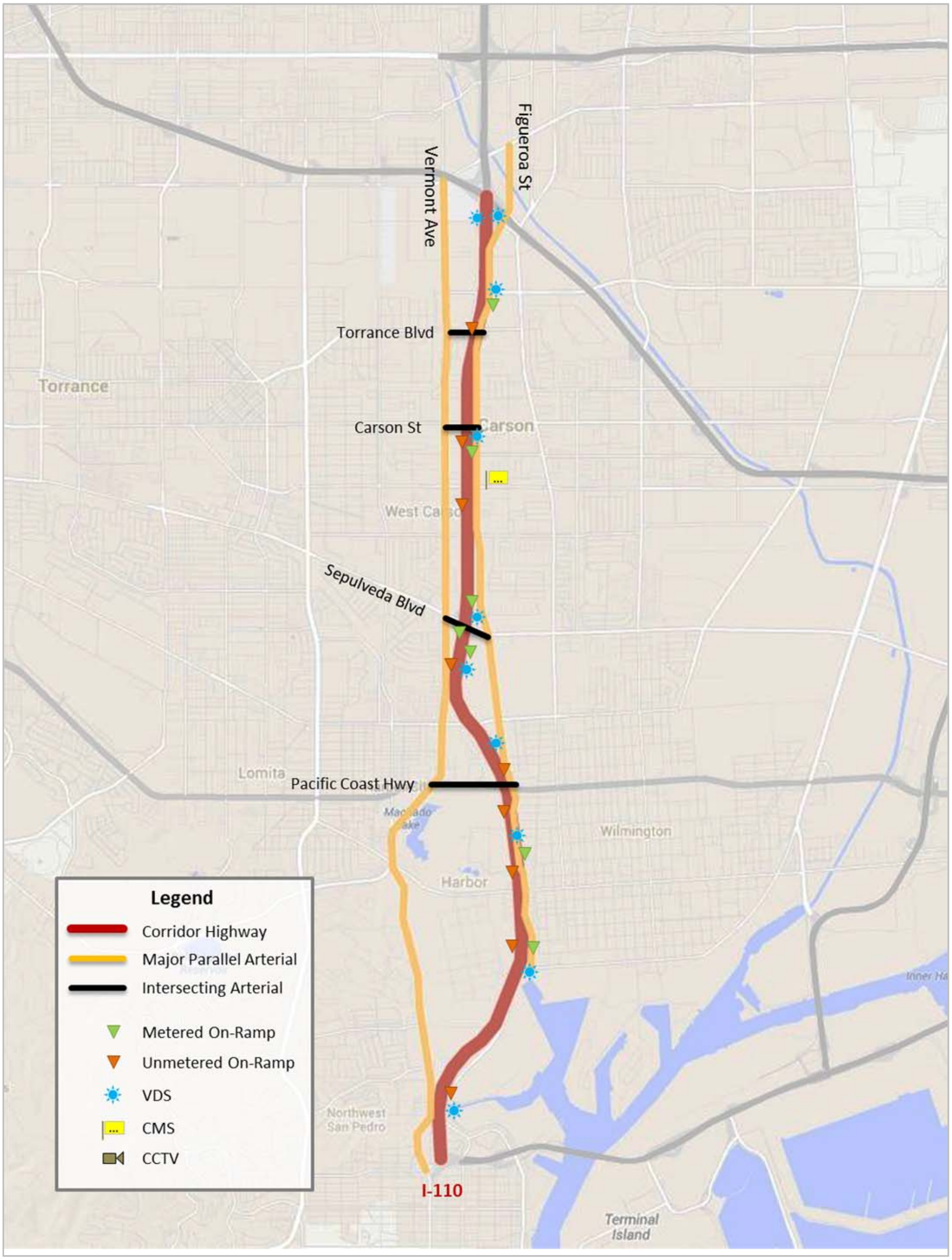


Figure 9. Corridor 2-A (I-110 South) Overview

2.3.2.2 On-Ramps and On-Ramp Intersections

As depicted in Figure 9 above, 6 of the 8 northbound on-ramps along the 7.7-mile I-110 corridor are metered, providing an average density of 0.75 ramps per mile. On the southbound, however, only 1 of the 8 on-ramps are metered (at Sepulveda Blvd), providing minimal ability to actively manage the flow of traffic onto the freeway facility.

The northbound on-ramps (from south to north) are:

- Pacific Ave *(unmetered)*
- Figueroa St and C St
- Anaheim St and Figueroa St
- Pacific Coast Hwy *(unmetered)*
- Sepulveda Blvd (separate eastbound and westbound ramps)
- 220th St and Figueroa St
- Torrance Blvd and Figueroa St

The southbound on-ramps (from south to north) are:

- Figueroa St and C St *(unmetered)*
- Anaheim St and Figueroa Pl *(unmetered)*
- Pacific Coast Hwy *(unmetered)*
- Sepulveda Blvd (separate eastbound and westbound ramps)
- 223rd St *(unmetered)*
- Carson St *(unmetered)*
- Torrance Blvd and Hamilton Ave *(unmetered)*

Table 4 on the following page provides additional detail about the configurations and storage capacities of the ramps and adjoining intersections.

Table 4. Corridor 2-A (I-110 South) Ramp/Arterial Intersection Configurations and Storage Capacities

I-110 On-Ramp	Fwy Dir	Ramp			Arterial							
		Metered/ Lanes	Unmetered HOV	Ramp Storage (ft)	Turn Pocket Storage		NB/EB Lane Geom.			SB/WB Lane Geom.		
					LT (ft)	RT (ft)	Left	Thru	Right	Left	Thru	Right
Pacific Ave	NB	0/2	0	575	650	0	2	2	0	1	2	0
Figueroa St and C St	NB	1/2	1	900	175	0	1	2	0	0	2	0
Figueroa St and C St	SB	0/1	0	1000	175*	0*	1	2	0	0	2	0
Anaheim St and Figueroa Pl	SB	0/2	0	550	100	0	1	2	0	1	2	0
Anaheim St and Figueroa St	NB	2/2	0	800	125	0	1	2	0	1	2	0
Pacific Coast Hwy	SB	0/2	0	750	250	0	0	4	0	1	3	0
Pacific Coast Hwy	NB	0/2	0	1000	1450	0	2	2	0	1	3	0
Sepulveda Blvd (WB)	NB	1/2	1	800	N/A	0	N/A	N/A	N/A	0	3	0
Sepulveda Blvd (WB)	SB	1/2	1	650	N/A	0	N/A	N/A	N/A	0	3	0
Sepulveda Blvd (EB)	SB	0/2	0	1100	N/A	0	0	3	0	N/A	N/A	N/A
Sepulveda Blvd (EB)	NB	2/2	0	1400	N/A	275	0	2	1	N/A	N/A	N/A
223rd St	SB	0/2	0	1000	150	0	0	2	0	1	2	0
220th St and Figueroa St	NB	1/2	1	950	300	0	1	2	0	1	2	0
Carson St	SB	0/2	0	700	150	0	0	3	0	1	2	0
Torrance Blvd and Hamilton Ave	SB	0/2	0	650	0†	275†	0	1	1	0	2	0
Torrance Blvd and Figueroa St	NB	1/1	0	775	500	150	2	2	0	0	2	1

* Southbound I-110 On-Ramp shares the same intersection and entry as the northbound on-ramp at this location.

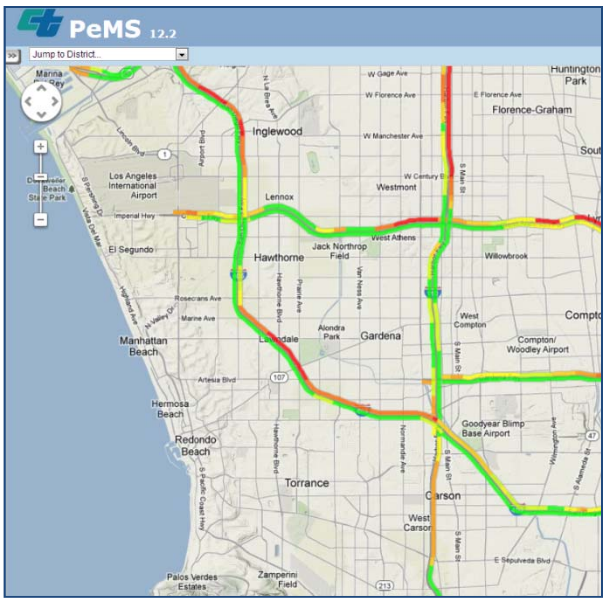
†There is no signal control at the Hamilton Ave ramp intersection.

2.3.2.3 Congestion Levels

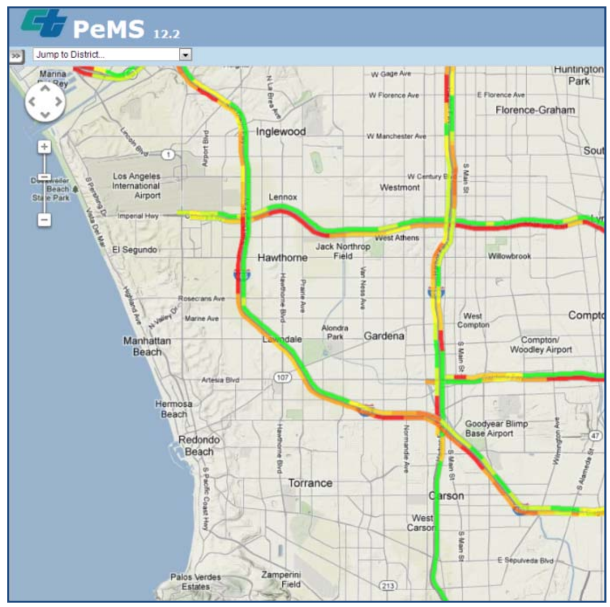
Based on limited detection data available for this corridor, the only direction and time in which any congestion of note occurs is during the northbound A.M. peak. Outside this time and direction, in which commuters and port traffic generate moderate congestion levels, traffic generally flows at free-flow levels.

Based on the current levels and distribution of congestion along this corridor segment, a DCCM system would have limited positive impact on corridor mobility. However, due to the corridor's critical importance for port connectivity and with the likely significant traffic generation impacts of the planned City of Carson Outlet Mall (adjacent to I-405 near Main St), congestion levels will likely increase to a point where DCCM can show a benefit.

A.M. Peak



P.M. Peak



2.3.2.4 Programmed and Planned Highway Improvements

Caltrans has approved an $8.1 million project to address the ITS infrastructure deficiencies noted above. The 2007 Caltrans Route 110 ITS Improvement Plan Project Report identifies the construction of a Traffic Congestion Relief Management System (TCRMS) along I-110 between Route 47 and I-405, consisting of installing a fiber optic network, CMS, CCTV cameras, ramp metering stations, traffic monitoring stations, and automatic irrigation systems. The contract for this work is scheduled to be awarded on April 14, 2014 with a completion date of October 27, 2017.

The adopted SBCCOG South Bay Measure R Highway Program STE has identified several planned highway projects identified by various previous planning efforts that were determined to have an operational nexus to the State Highway System for regional mobility. The STE also performed a mobility benefit analysis on each of these projects to estimate the reduction in delay associated with the implementation of the projects.

The four planned highway projects in the I-110 corridor are shown in the table below.

Caltrans Priority*	Type	Dir	Facility	Location Limits	City/ County	Description	Delay Reduc.†
1	Interchange	SB	I-110	at I-405	County	Construct new NB I-405 to SB I-110 connector, flyover ramp	204
13	Interchange	SB	I-110	at I-405	LA	Widen from 3 to 4 lanes through IC	196
3	Auxiliary lane	SB	I-110	SR-91 to Del Amo Bl UC	County	Auxiliary lane on SB-110 from WB SR-91 to Torrance Bl off-ramp & possible new flyover ramp from NB I-405 to SB I-110 Connector	252
17	Interchange	NB	I-110	at SR-91 IC	County	Add new HOV connectors for NB/SB I-110 to EB SR-91 and from WB SR-91 to NB I-110	55

* Caltrans-assigned priorities for SBCCOG region projects range from 1 to 25.

† The STE calculated delay reduction as follows: Estimated future 2035 A.M. and P.M. weekday peak hour (2 hours) delay reduction in veh-hrs. As an example, 200 veh-hrs reduction translates to about 200,000 annual veh-hrs savings.

2.3.3 Arterials

Figueroa Street is the primary parallel arterial in the I-110 corridor, running 5.3 miles from Harry Bridges Blvd in the south to Del Amo Blvd in the north (see Table 7 below). Figueroa St is a major regional arterial, accommodating 40,000 average daily trips within the corridor. It has four through lanes (two southbound and two northbound) for the length of the corridor and protected single-lane left turn pockets and dedicated left turn phases at each of the arterial intersections. Figueroa St parallels I-110 to the east (see Figure 9 above) at a distance of no more than 0.2 miles from the highway.

Vermont Avenue is also a major regional arterial, accommodating 25,000 average daily trips within the corridor and parallels I-110 (as well as Figueroa St) to the west for the length of the corridor at a distance of about 0.5 miles from the freeway.

Very little up-to-date performance data is available for these arterials due to a lack of arterial data collection and performance measurement systems.

2.3.3.1 Arterial ITS

There are 17 signalized intersections, including 4 major cross streets with direct connections to I-110 on-ramps. Arterial system detection (capable of determining speed and throughput) is not currently available at any of the intersections along Figueroa Street (see Programmed and Planned Arterial Improvements discussion below).

Table 5. Figueroa Street Arterial ITS

Cross Street	Operating Jurisdiction	System	Controller	Firmware	Detection Type	Arterial Detection?
Harry Bridges Blvd						No
Anaheim St						No
L St						No
Pacific Coast Hwy						No
Lomita Blvd						No
Sepulveda Blvd						No
Carriagedale Dr						No
234th St						No
228th St						No
Shadwell St						No
223rd St						No
220th St						No
Carson St						No
Carson Town Ctr						No
Torrance Blvd						No
Figueroa St/NB On-Ramp						No
Del Amo Blvd						No

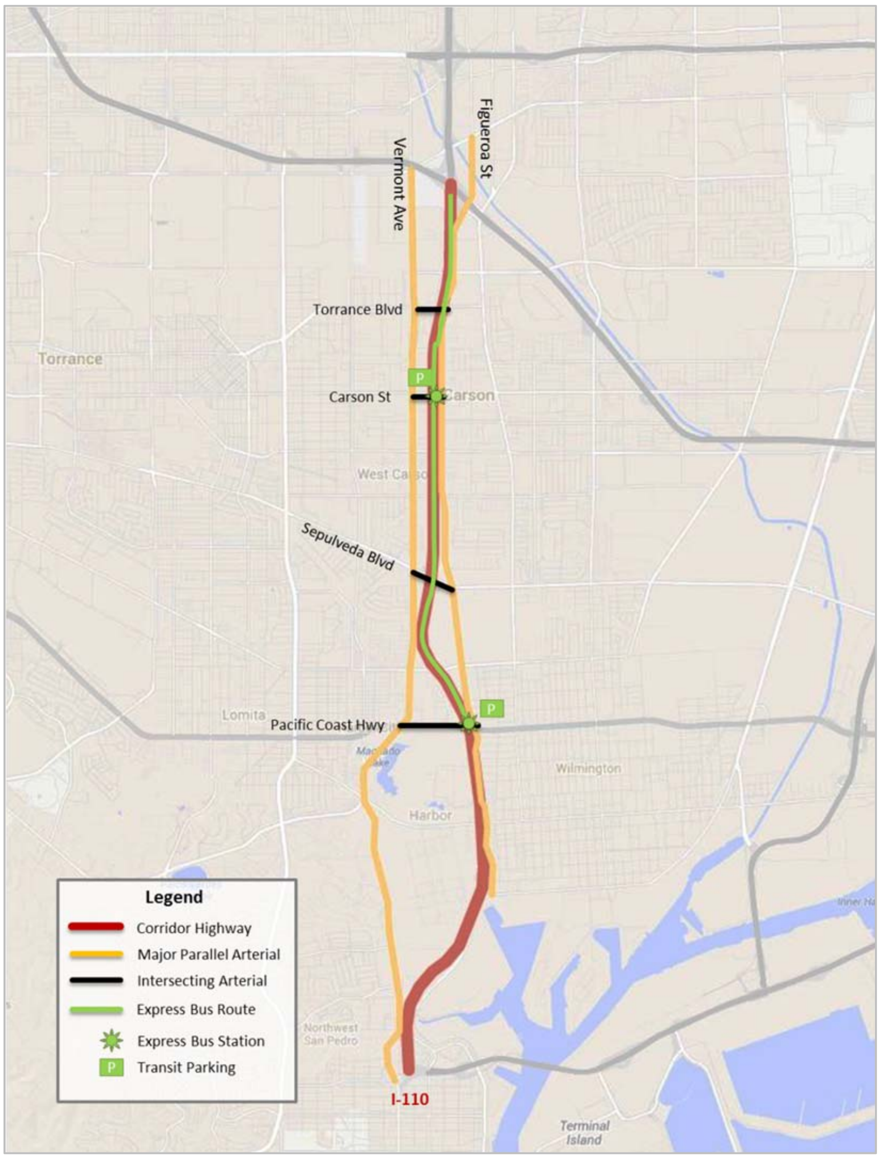
* Note: **Bolded** cross streets indicate direct freeway connection.

2.3.3.2 Programmed and Planned Arterial Improvements

As part of Caltrans' State Arterial ITS Improvement Project, which will occur along Pacific Coast Highway (SR-1), Western Ave (SR-213), and Hawthorne Blvd (SR-107), two intersections along the I-110 South corridor are expected to receive upgraded communications and detection capabilities. These intersections are Figueroa St/Pacific Coast Hwy and Vermont Ave/Pacific Coast Hwy.

2.3.4 Transit

The primary transit line that operates with stops within the I-110 corridor is the Metro 450 Express Bus, which provides corridor service between Pacific Coast Highway Freeway Station Stop, Carson Street Freeway Station Stop, and downtown via the I-110 general purpose lanes (and then via the median-running Harbor Transitway shared-use bus corridor north of I-405). This service is not high-frequency, however, with only one or two buses arriving per hour.



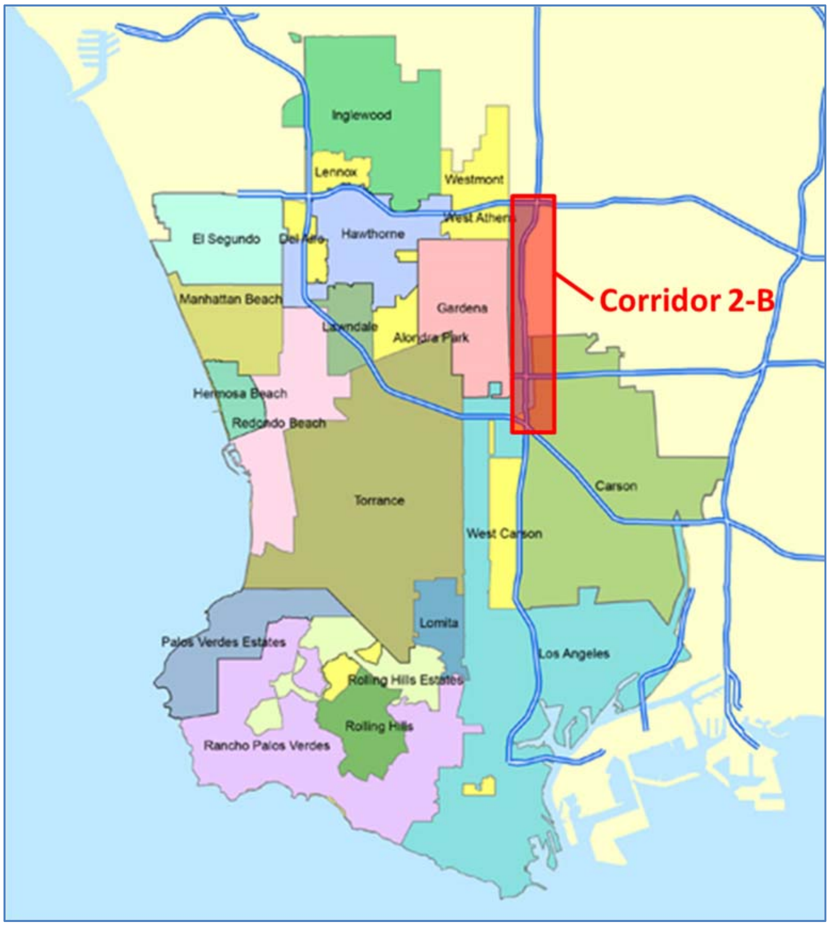
Free Metro-operated parking facilities are located at the following stations (also see map above):

- Pacific Coast Highway Station (244 spaces)
- Carson Street Station (140 spaces)

2.4 Corridor 2-B: I-110 (from I-405 to Imperial Hwy)

2.4.1 Overview

This I-110 corridor, from I-405 at the south to Imperial Highway at the north, is 5.2 miles in length and extends primarily through the cities of Los Angeles (Harbor Gateway North), Carson, Gardena and portions of unincorporated Los Angeles County (West Compton).



2.4.2 Highway

2.4.2.1 Highway ITS

Vehicle detection along the corridor is accomplished via embedded pavement loops, with 10 northbound VDS sensors and 11 southbound VDS sensors, providing northbound detection coverage of 1.9 VDS per mile and southbound detection coverage of 2.1 VDS per mile (see Figure 10 on the following page). In addition, six CCTV cameras are deployed along the corridor, positioned near each of the major intersecting arterials.

Three Caltrans CMS are located along I-110 northbound and positioned near the ramps for 190^{th} St, Redondo Beach Blvd, and Rosecrans Ave.

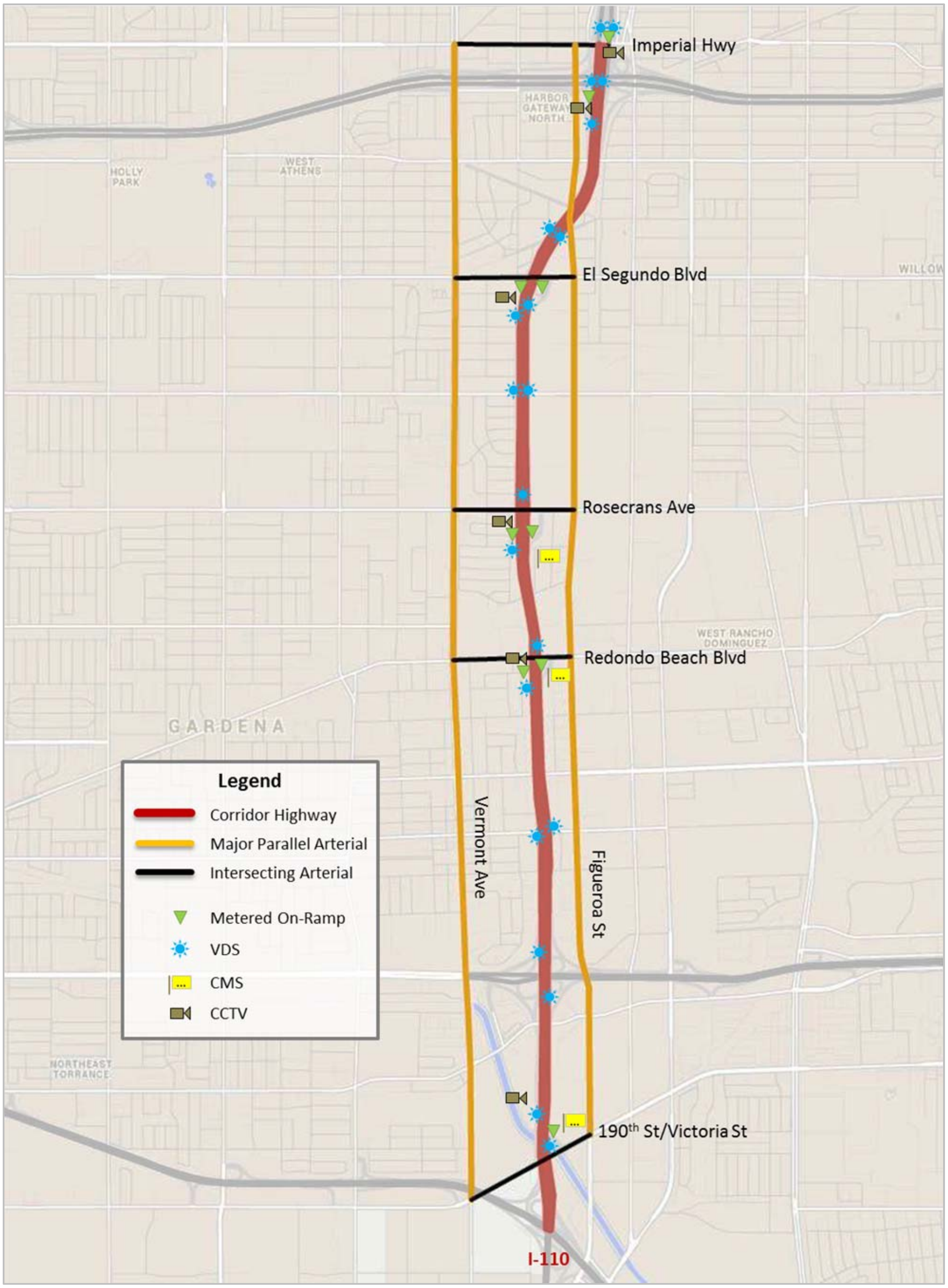


Figure 10. Corridor 2-B (I-110 North) Overview

2.4.2.2 On-Ramps and On-Ramp Intersections

As depicted in Figure 10 above, all 5 northbound on-ramps and 4 southbound on-ramps along the 5.2-mile I-110 corridor are metered, providing an average density of 1.0 ramps per mile in the northbound direction and 0.8 ramps per mile in the southbound.

The northbound on-ramps (from south to north) are:

- 190th St
- Redondo Beach Blvd
- Rosecrans Ave (separate eastbound and westbound ramps)
- El Segundo Blvd
- Imperial Hwy

The southbound on-ramps (from south to north) are:

- Redondo Beach Blvd
- Rosecrans Ave
- El Segundo Blvd
- Imperial Hwy

Table 6 on the following page provides additional detail about the configurations and storage capacities of the ramps and adjoining intersections.

Table 6. Ramp/Arterial Intersection Configurations and Storage Capacities

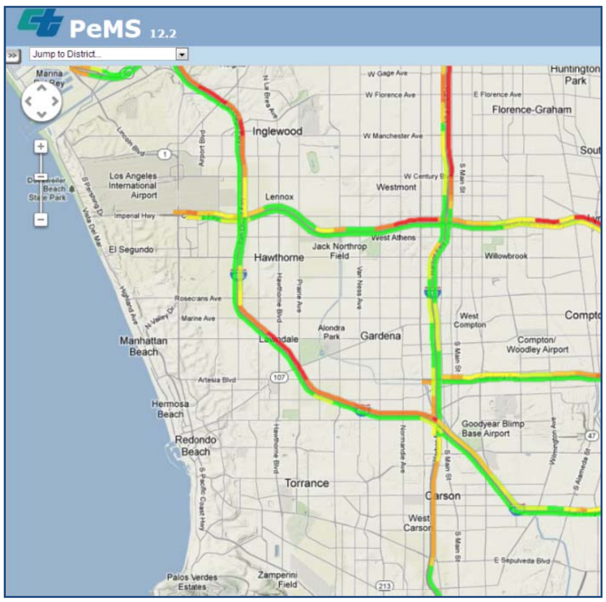
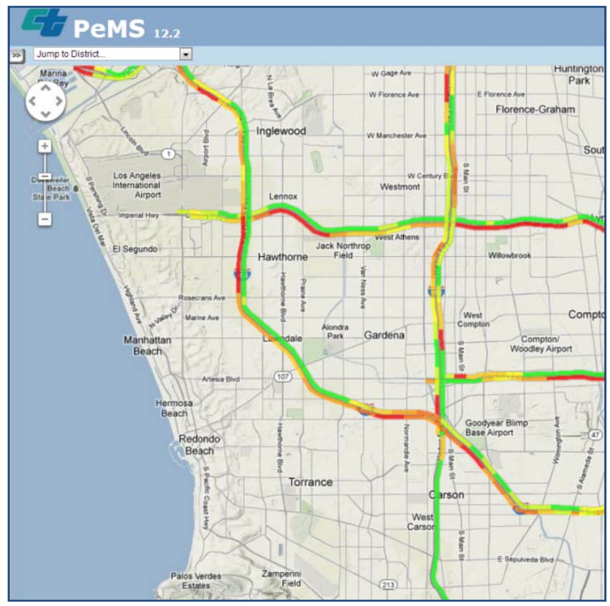
I-110 On-Ramp	Fwy Dir	Ramp			Arterial							
		Metered/ Lanes	Unmetered HOV	Ramp Storage (ft)	Turn Pocket Storage		EB Lane Geom.			WB Lane Geom.		
					LT (ft)	RT (ft)	Left	Thru	Right	Left	Thru	Right
190th St	NB	1/2	1	700	700*	200	2*	2	0	1	2	1
Redondo Beach Blvd	SB	1/2	1	1450	240	340	0	2	1	1	3	0
Redondo Beach Blvd	NB	2/2	0	900	200	270	1	2	1	1	3	0
Rosecrans Ave	SB	2/2	0	1200	270	0	0	3	0	1	3	0
Rosecrans Ave (EB)	NB	1/2	1	850	N/A	110	0	3	1	N/A	N/A	N/A
Rosecrans Ave (WB)	NB	1/2	1	2150	N/A	0	N/A	N/A	N/A	0	3	0
El Segundo Blvd	SB	2/2	0	1300	175	0	0	3	0	1	3	0
El Segundo Blvd	NB	2/2	0	1300	292	135	0	2	1	1	1	3
Imperial Hwy	SB	1/2	1	2300	125	0	0	3	0	1	3	0
Imperial Hwy (111th Pl via Olive St)	NB	1/2	1	1800								

*Eastbound 190th St approaching the northbound I-110 On-Ramp has one left turn pocket that begins 450 feet before the ramp intersection and one HOV/bus-only left turn pocket that begins 250 feet before the ramp intersection.

2.4.2.3 Congestion Levels

I-110, from I-405 to I-105, experiences moderate congestion in the northbound direction during the A.M. peak. From I-105 to Gage Avenue, I-110 experiences high levels of congestion in the northbound direction during the A.M. peak. Both the northbound and southbound direction during the P.M. peak experience moderate congestion.

Based on the levels and distribution of congestion along this corridor segment, a DCCM system could impact the corridor mobility improvements significantly.

A.M. Peak	**P.M. Peak**
	

Lane-by-Lane Speed Profiles

The figures below (Figure 11 and Figure 12) show the lane-by-lane speeds for the I-110 northbound during the typical weekday A.M. peak and for the I-110 southbound during the typical weekday P.M. peak.

As indicated, northbound A.M. peak hour speeds drop between absolute post mile 10 and 11.5 (south of Redondo Beach Blvd) and from 15 and beyond (north of Century Blvd).

Southbound P.M. peak hour speeds show significant drops at various locations throughout the corridor segment as well as significant inter-lane speed variability. However, minimum average speed north of the I-110/SR-91 interchange remains at 40 mph or higher.

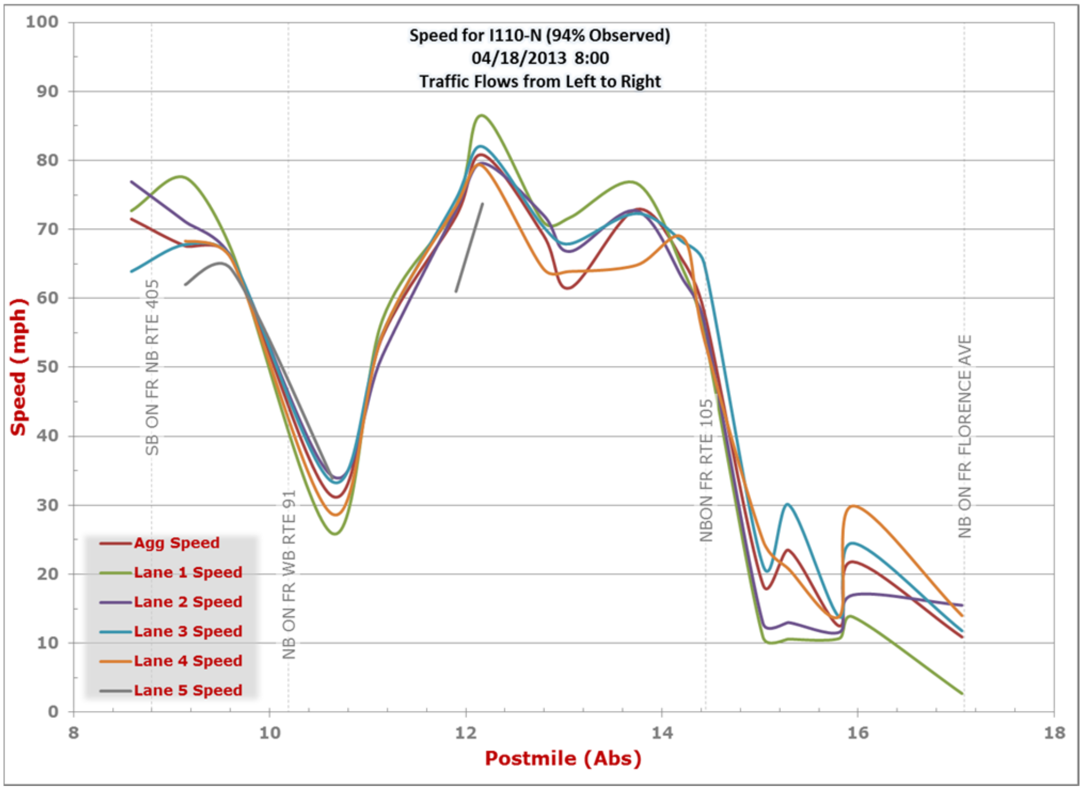


Figure 11. Lane-by-Lane Speed Profile for I-110 NB (A.M. Peak)

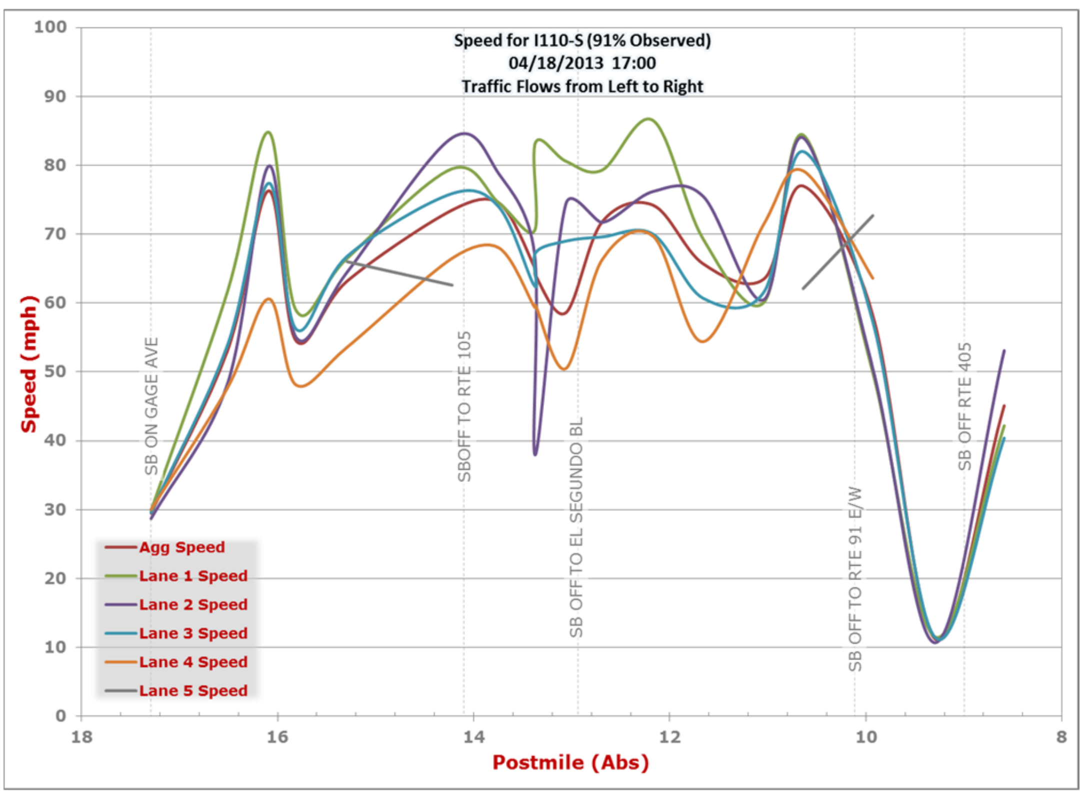


Figure 12. Lane-by-Lane Speed Profile for I-110 SB (P.M. Peak)

Travel Times and Travel Time Delay

The figures below (Figure 13 and Figure 14) illustrate the actual travel times at peak times, as measured during representative sample weeks in January 2013.

I-110 Northbound (9.5 mi) – A.M. Peak

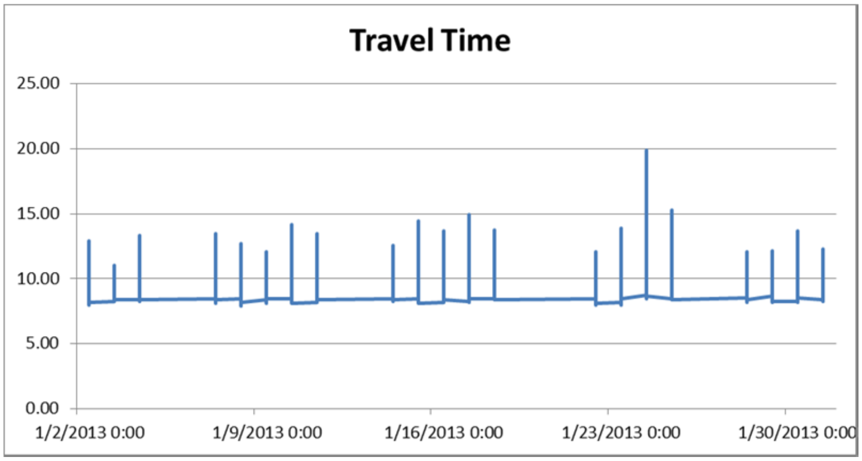


Figure 13. Travel Times and Travel Time Delay for I-110 Northbound (A.M. Peak)

As indicated, the typical A.M. peak hour travel time for the northbound 9.5-mile segment is approximately 15 minutes (38 mph average speed), with travel time delay of 5 to 7 minutes over free flow travel time.

I-110 Southbound (8.92 mi) – P.M. Peak

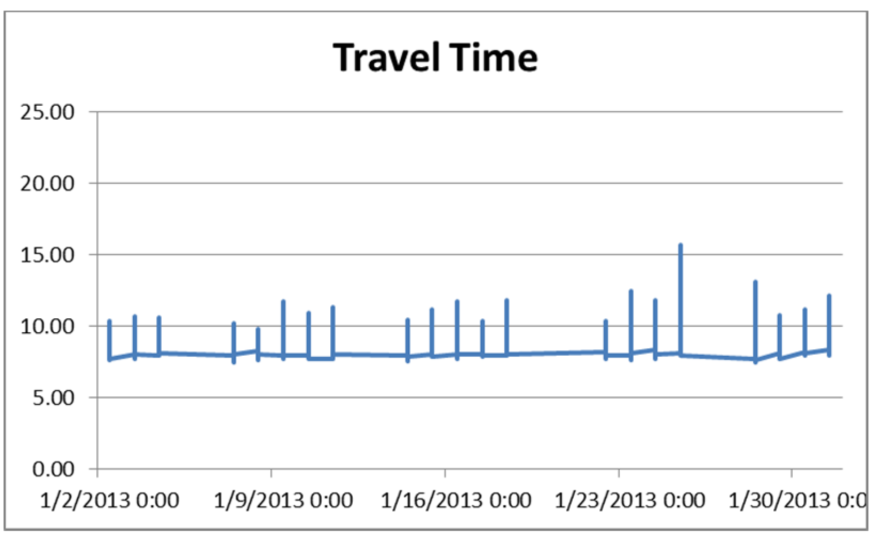


Figure 14. Travel Times and Travel Time Delay for I-110 Southbound (P.M. Peak)

Typical P.M. peak hour travel time in the southbound 8.9-mile segment is approximately 13 minutes (40 mph average speed), with travel time delay similar to the A.M. peak of 5 to 7 minutes.

2.4.2.4 Programmed and Planned Highway Improvements

The adopted SBCCOG South Bay Measure R Highway Program STE has identified several planned highway projects identified by various previous planning efforts that were determined to have an operational nexus to the State Highway System for regional mobility. The STE also performed a mobility benefit analysis on each of these projects to estimate the reduction in delay associated with the implementation of the projects.

The four planned highway projects in the I-110 corridor are shown in the table below.

Caltrans Priority*	Type	Dir	Facility	Location Limits	City/ County	Description	Delay Reduc.†
1	Interchange	SB	I-110	at I-405	County	Construct new NB I-405 to SB I-110 connector, flyover ramp	204
13	Interchange	SB	I-110	at I-405	LA	Widen from 3 to 4 lanes through IC	196
3	Auxiliary lane	SB	I-110	SR-91 to Del Amo Bl UC	County	Auxiliary lane on SB-110 from WB SR-91 to Torrance Bl off-ramp & possible new flyover ramp from NB I-405 to SB I-110 Connector	252
17	Interchange	NB	I-110	at SR-91 IC	County	Add new HOV connectors for NB/SB I-110 to EB SR-91 and from WB SR-91 to NB I-110	55

* Caltrans-assigned priorities for SBCCOG region projects range from 1 to 25.

† The STE calculated delay reduction as follows: Estimated future 2035 A.M. and P.M. weekday peak hour (2 hours) delay reduction in veh-hrs. As an example, 200 veh-hrs reduction translates to about 200,000 annual veh-hrs savings.

2.4.3 Arterials

Figueroa Street is the primary parallel arterial in the I-110 corridor, running 5.2 miles from 190th Street in the south to Imperial Highway in the north (see Table 7 below). Figueroa St is a major regional arterial, accommodating 40,000 average daily trips within the corridor. It has four or six through lanes (two southbound and two northbound or three southbound and three northbound) for the length of the corridor and protected single-lane left turn pockets and dedicated left turn phases at each of the arterial intersections. South of El Segundo Blvd, Figueroa St parallels I-110 to the east (see Figure 10 above) at a distance of no more than 0.20 miles from the highway. North of El Segundo Blvd, Figueroa St runs west of I-110 at a distance of no more than 0.15 miles from the highway.

Vermont Ave, though not the corridor's primary parallel arterial, is also a major regional arterial, accommodating 25,000 average daily trips within the corridor. It parallels I-110 (as well as Figueroa St) to the west for the length of the corridor at a distance between 0.25 and 0.65 miles from the freeway.

Very little up-to-date performance data is available for these arterials due to a lack of arterial data collection and performance measurement systems. However, the SBCCOG STE noted that the intersection of Vermont Ave and Artesia Blvd received an LOS of E for the A.M. peak and a D for the P.M. peak in 2009.

2.4.3.1 Arterial ITS

There are 25 signalized intersections, including 9 major cross streets with direct connections to I-110 on-ramps, and two primary controller systems—KITS and LADOT (Harbor Gateway 1B/2)—with operation divided between the City of Los Angeles and Carson. Arterial system detection (capable of determining speed and throughput) is not currently available at any of the intersections along Figueroa Street (see Programmed and Planned Arterial Improvements discussion below).

Table 7. Figueroa Street Arterial ITS

Cross Street	Operating Jurisdiction	System	Controller	Firmware	Detection Type	Arterial Detection?
190th St./ Victoria St	Carson	KITS	170E	LACO-4E	loops	No
182nd St.	Los Angeles	Harbor Gateway 2	2070	TSCP	Fully-Actuated	No
Gardena Bl.	Los Angeles	Harbor Gateway 2	2070	TSCP	Semi-Actuated	No
Alondra Bl.	Los Angeles	Harbor Gateway 2	2070	TSCP	Fully- Actuated	No
Redondo Beach Bl.	Los Angeles	Harbor Gateway 2	2070	TSCP	Semi-Actuated	No
Rosecrans Av.	Los Angeles	Harbor Gateway 2	2070	TSCP	Semi-Actuated	No
135th St.	Los Angeles	Harbor Gateway 2	2070	TSCP	Pre-Timed	No
El Segundo Bl.	Los Angeles	Harbor Gateway 2	2070	TSCP	Pre-Timed	No
120th St.	Los Angeles	Harbor Gateway 1B	2070	TSCP	Pre-Timed	No
Imperial Hwy.	Los Angeles	Harbor Gateway 1B	2070	TSCP	Semi-Actated	No

* Note: **Bolded** cross streets indicate direct freeway connection.

2.4.3.2 Programmed and Planned Arterial Improvements

The adopted SBCCOG South Bay Measure R Highway Program Strategic Transportation Element (STE) has identified several intersections along Figueroa Street at which to install new system detection technology. The Los Angeles County Draft ITS Plan has also identified Figueroa Street candidate intersections for system detection deployment (see Figure 15 below). Note, however, that County of Los Angeles has determined that it will not be installing detection within the boundaries of City of Los Angeles. In addition, there are currently no funded projects to install system detection.

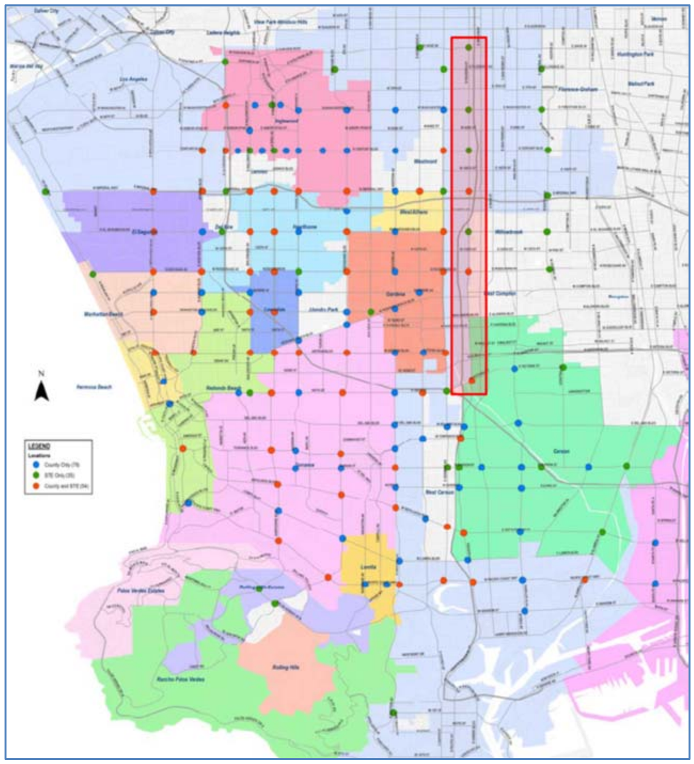


Figure 15. SBCCOG STE and LA County ITS Master Plan Arterial Detection Sites for Figueroa St

In total, 7 intersections along Figueroa Street have been identified as top candidates for arterial system detection by SBCCOG and Los Angeles County:

Figueroa Street Intersection	Identified in SBCCOG STE	Identified in LA County ITS Plan
190th St / Victoria St	X	X
Rosecrans Ave	X	X
El Segundo Blvd	X	
Imperial Hwy	X	X
Century Blvd	X	
Manchester Blvd	X	
Gage Ave	X	

2.4.4 Transit

The primary high-frequency (every 15 minutes or less) rapid transit line that operates with stops within the I-110 corridor is the Metro Silver Line Bus Rapid Transit (BRT), which provides corridor service between Harbor/Gateway Transit Center and downtown via the median-running Harbor Transitway shared-use bus corridor.

Free Metro-operated parking facilities for the Metro Silver Line that serve the SBCCOG region are located at the following stations (also see map above):

- Harbor/Gateway Transit Center (980 spaces)
- Rosecrans Station (338 spaces)
- Harbor Freeway Station (at I-105 interchange) (253 spaces)

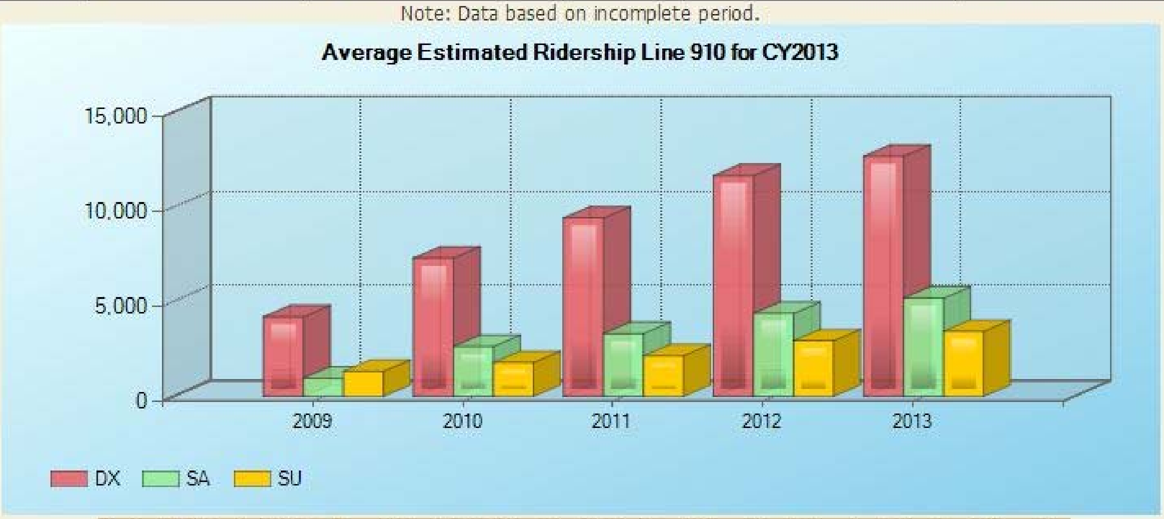
Ridership

As part of the 2013 Express Lanes Demonstration Project, Metro has increased the number of transit vehicles in service on the I-110 corridor. As a result, ridership has made steady gains in the first few months of 2013. April 2013 saw 12,873 average weekday boardings, 5,367 average Saturday boardings, and 3,484 average Sunday/holiday boardings.

Annual ridership has also been steadily increasing over the past five years, as shown in the figure below.

Day Type	Estimated Ridership	Average Passenger Miles	Day Count	Total Estimated Ridership	Total Passenger Miles
DX	12,678	144,580	85	1,077,632	12,289,287
SA	5,194	62,397	17	88,299	1,060,751
SU	3,437	41,570	18	61,872	748,265

Note: Data based on incomplete period.



Period	Estimated Weekday Ridership	Estimated Saturday Ridership	Estimated Sunday Ridership
2009	4,208	969	1,335
2010	7,302	2,641	1,795
2011	9,422	3,324	2,148
2012	11,658	4,385	2,941
2013	12,678	5,194	3,437

Figure 16. Metro Silver Line Average Daily Ridership (source: Metro *http://isotp.metro.net/MetroRidership/Index.aspx*)

Service Frequency

The Silver Line currently operates on the following headway schedule:

Weekday Service Frequency

Time of Day / Direction	Early morning (5-6am)	A.M. Peak (6-9am)	Off-Peak (9am-3pm)	P.M. Peak (3-7pm)	Night (7-9pm)	Late Night (9pm-2am)
Northbound	20 min	7 min	15 min	8 min	15 min	40 min
Southbound	20 min	5 min	15 min	10 min	20 min	40 min

Saturday Service Frequency

Time of Day / Direction	Early morning (5-7am)	Day (7am-7pm)	Night (7pm-12am)	Late Night (12am-2am)
Northbound	40 min	20 min	40 min	60 min
Southbound	30 min	20 min	30 min	60 min

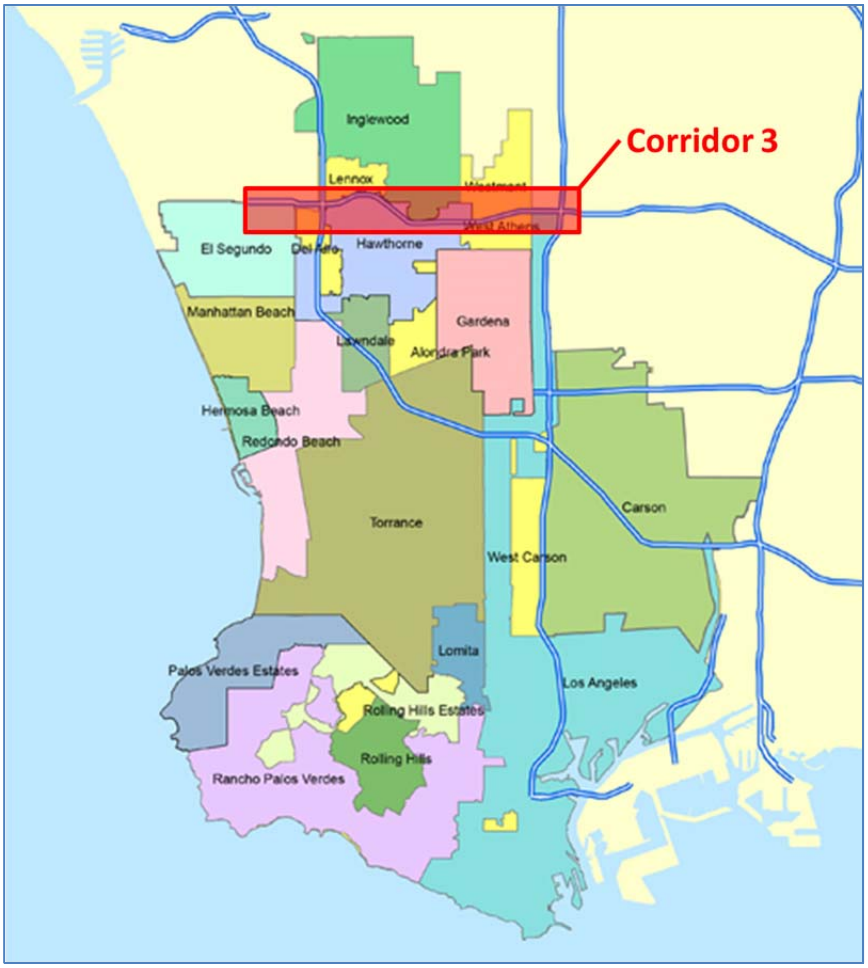
Sunday and Holiday Service Frequency

Time of Day / Direction	All day (5am-1am)
Northbound	30 min
Southbound	30 min

2.5 Corridor 3: I-105 (from Sepulveda Blvd to Central Ave)

2.5.1 Overview

The I-105 corridor, from Sepulveda Blvd at the west to Central Ave at the east, is 8.5 miles in length and extends primarily through portions of City of Los Angeles and portions of Los Angeles County unincorporated areas (West Athens), as well as Hawthorne, Inglewood, and El Segundo.



2.5.2 Highway

2.5.2.1 Highway ITS

Vehicle detection along the corridor is accomplished via embedded pavement loops, with 15 eastbound VDS sensors and 17 westbound VDS sensors, providing eastbound detection coverage of 1.8 VDS per mile and westbound detection coverage of 2.0 VDS per mile (see Figure 17 on the following page). In addition, nine CCTV cameras are deployed along the corridor, positioned near each of the major intersecting arterials. Four Caltrans CMS are located along the corridor: two westbound (near Central Ave and Crenshaw Blvd ramps) and two eastbound (near Sepulveda Blvd and Aviation Blvd ramps).

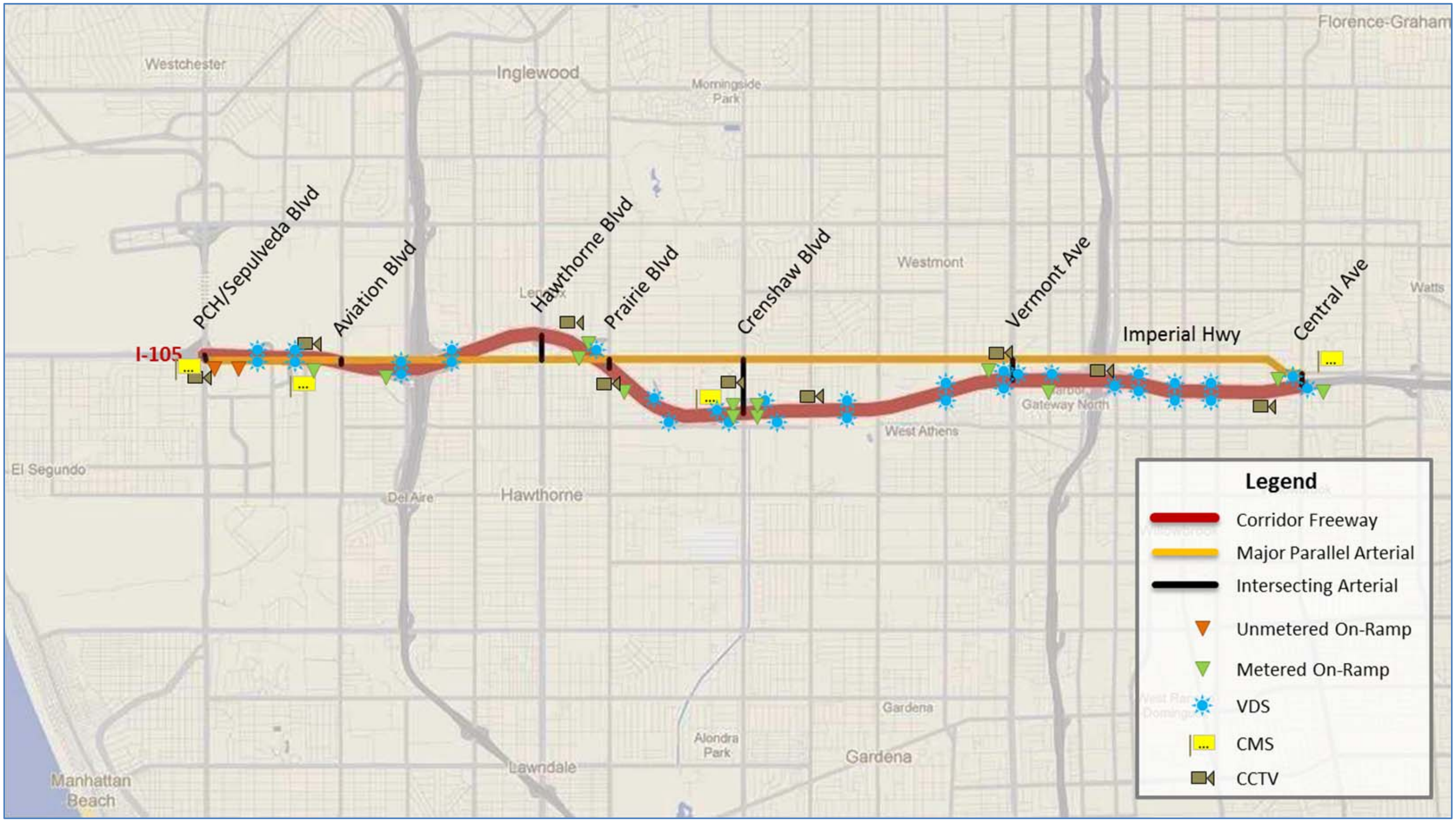


Figure 17. Corridor 3 (I-105) Overview

2.5.2.2 On-Ramps and On-Ramp Intersections

As depicted in Figure 17 above, 10 of the 12 eastbound on-ramps and all 5 westbound on-ramps along the 8.5-mile I-105 corridor are metered, providing an average density of 1.2 metered ramps per mile in the eastbound direction and 0.6 ramps per mile in the westbound.

The eastbound on-ramps (from west to east) are:

- Sepulveda Blvd (southbound)
- Imperial Hwy (near Hughes Way)
- Atwood Way (via Nash St)
- Imperial Hwy (near Aviation Blvd)
- Hawthorne Blvd (southbound)
- Imperial Hwy (near Prairie Ave)
- 120^{th} St (near Crenshaw Blvd)
- Crenshaw Blvd (northbound)
- Hoover St (via 116th Pl)
- Central Ave

The westbound on-ramps (from west to east) are:

- Prairie Ave
- Crenshaw Blvd (northbound)
- Crenshaw Blvd (southbound)
- Vermont Ave
- Central Ave

Table 8 on the following page provides additional detail about the configurations and storage capacities of the ramps and adjoining intersections.

Table 8. I-105 On-Ramp/Arterial Intersection Configurations and Storage Capacities

I-105 On-Ramp	Fwy Dir	Ramp			Arterial							
		Metered/ Lanes	Unmetered HOV	Ramp Storage (ft)	Turn Pocket Storage		NB Lane Geom.			SB Lane Geom.		
					LT (ft)	RT (ft)	Left	Thru	Right	Left	Thru	Right
Sepulveda Blvd (southbound)	EB	0/2	0	2200	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Imperial Hwy (near Hughes Way)	EB	0/1	0	900	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Atwood Way (via Nash St)	EB	2/2	0	900	250	250	1*	1	1	0*	1	1
Imperial Hwy (near Aviation Blvd)	EB	2/3	1	2250	450	250	0*	3	1	2*	2	0
Hawthorne Blvd (southbound)	EB	1/2	1	3350	N/A	475	N/A	N/A	N/A	1†	3	1
Imperial Hwy (near Prairie Ave)	EB	1/2	1	2000	300	900	1*	3	0	1*	3	1
Prairie Ave	WB	1/2	1	1350	500	400	2	3	1	2	2	2
120th St (near Crenshaw Blvd)	EB	1/2	1	1450	100	450	0*	2	1	1*	2	0
Crenshaw Blvd (northbound)	EB	1/2	1	2200	N/A	0	0†	3	1	N/A	N/A	N/A
Crenshaw Blvd (northbound)	WB	1/2	1	1100	N/A	0	0†	3	1	N/A	N/A	N/A
Crenshaw Blvd (southbound)	WB	1/2	1	1950	N/A	0	N/A	N/A	N/A	0†	3	1
Vermont Ave	WB	1/2	1	1350	225	0	1	3	0	0	3	0
Hoover St (via 116th Pl)	EB	1/2	1	1550	300	0	0†	2	0	1†	1	0
Central Ave	EB	2/3	1	1920	400	100	0	3	1	2	2	0
Central Ave	WB	2/3	1	850	500	100	2	2	0	0	2	1

*Atwood Way (proximate to Nash St), Imperial Blvd (proximate to Aviation Blvd), Imperial Hwy (near Prairie Ave), and 120th St (near Crenshaw Blvd), run east-west, parallel to I-105. Eastbound lane geometries are shown in the section labeled "NB Lane Geom." and westbound lane geometries are shown in the section labeled "SB Lane Geom."

† There is no arterial signalization at these I-105 on-ramp locations.

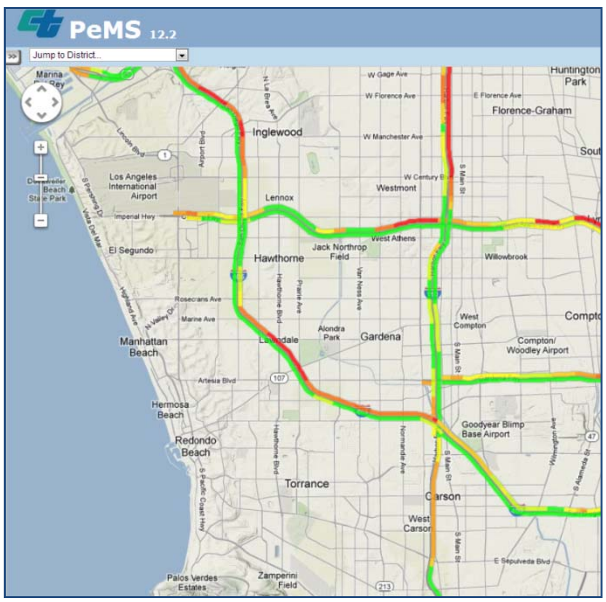
2.5.2.3 Congestion Levels

I-105, from Pacific Coast Highway at the west to Central Avenue at the east, experiences high levels of congestion in the westbound direction during the A.M. peak and very high levels of congestion in the eastbound direction during the P.M. peak (see figure below). A.M. eastbound and P.M. westbound generally enjoy free flow speeds of 45 mph or more.

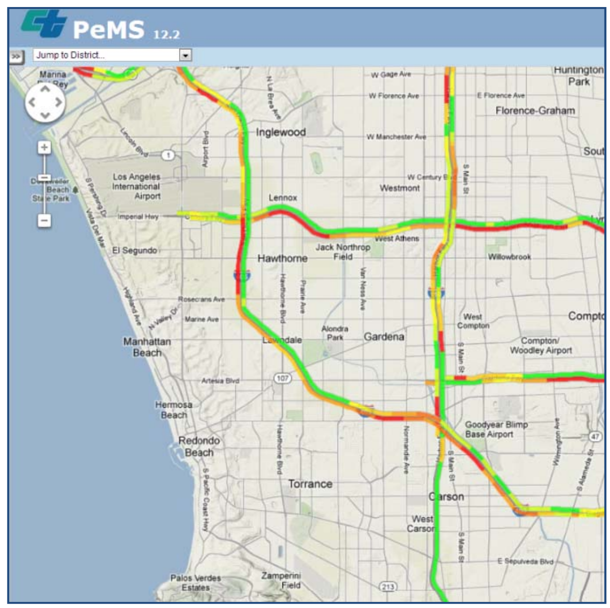
In addition, due to east-west orientation of freeway, eastbound A.M. and westbound P.M. traffic may be seasonally impacted by sun glare caused by the rising and setting sun.

Based on the levels and distribution of congestion along this corridor segment, a DCCM system could impact the corridor mobility improvements significantly.

A.M. Peak



P.M. Peak



Lane-by-Lane Speed Profiles

The figures below (Figure 10 and Figure 11) show the lane-by-lane speeds for the I-105 westbound during the typical weekday A.M. peak and for the I-105 eastbound during the typical weekday P.M. peak.

As indicated, westbound A.M. peak hour speeds are low throughout the corridor segment, particularly from postmile 3 to 7. Significant inter-lane speed variations occur between postmile 1 and 3, in particular for lane 2. This is likely due to the lane drops that occur regularly throughout the corridor.

Eastbound P.M. peak hour speeds are low throughout the corridor segment and in particular from postmile 2 to 3. The heavy congestion in this direction stems from heavy commuter traffic demand headed home from the employment centers along the I-405 corridor.

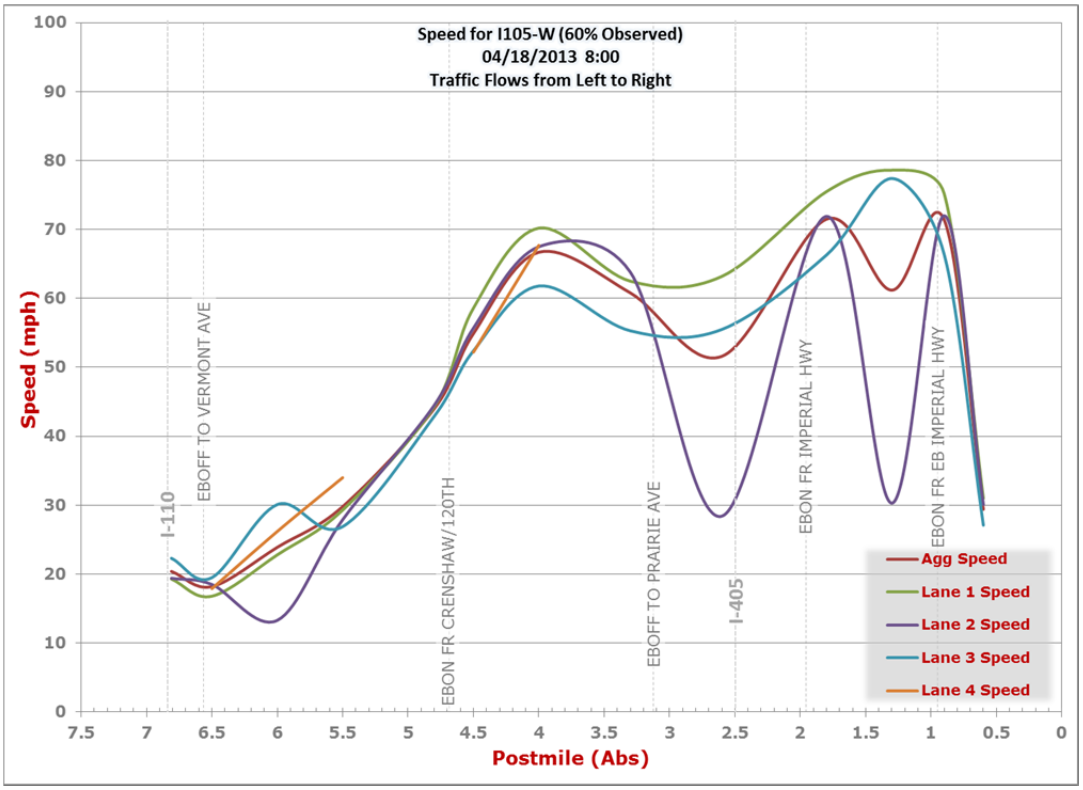


Figure 18. Lane-by-Lane Speed Profile for I-105 WB (A.M. Peak)

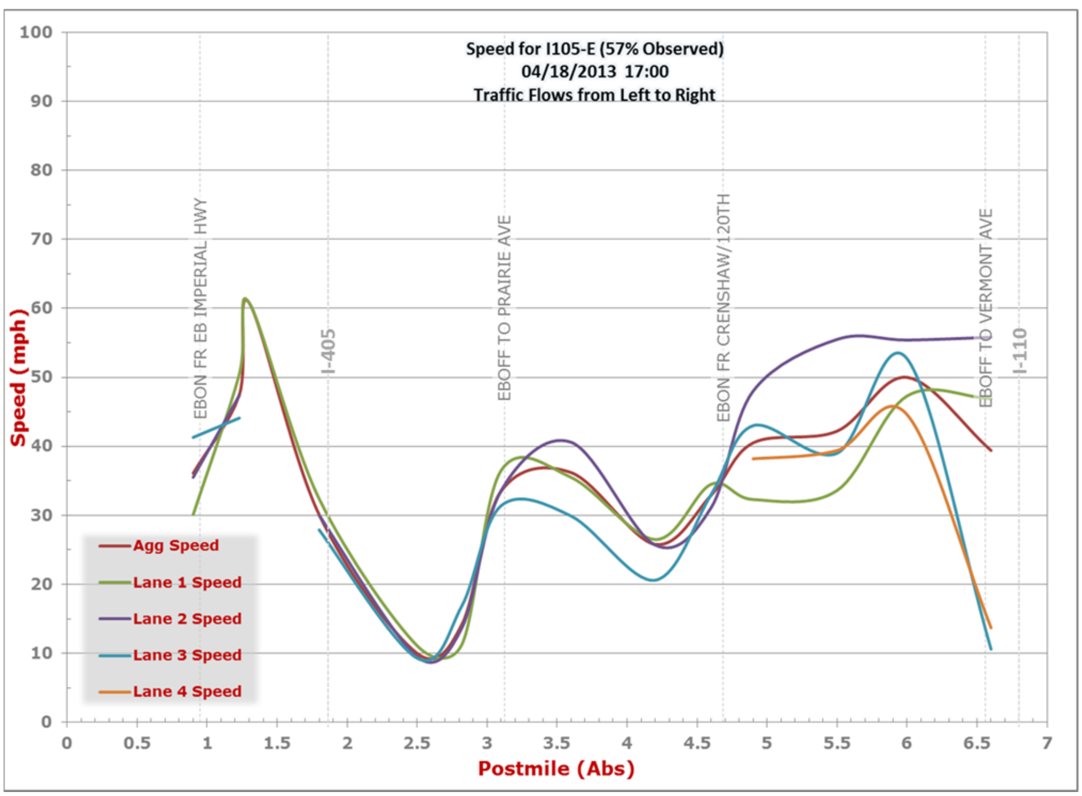


Figure 19. Lane-by-Lane Speed Profile for I-105 EB (P.M. Peak)

Travel Times and Travel Time Delay

The figures below (Figure 20 and Figure 21) illustrate the actual travel times at peak times, as measured during representative sample weeks in January 2013.

I-105 Westbound (6.4 mi) – A.M. Peak

As indicated, the typical A.M. peak hour travel time for the westbound 6.4-mile segment is approximately 10 minutes, with travel time delay of 4 to 7 minutes over free flow travel time.

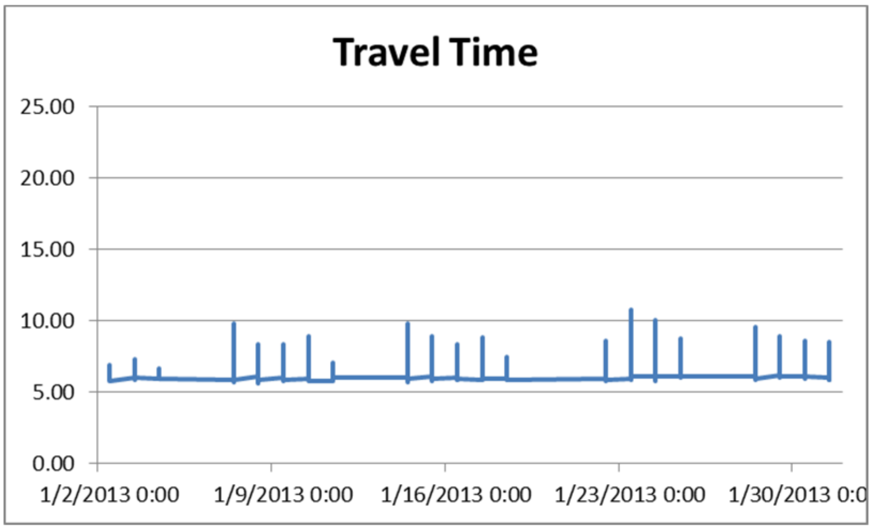


Figure 20. Travel Times and Travel Time Delay for I-105 Westbound (A.M. Peak)

I-105 Eastbound (6.4 mi) – P.M. Peak

Typical P.M. peak hour travel time in the eastbound 6.5-mile segment is 10 to 13 minutes, with travel time delay similar to the A.M. peak of 4 to 7 minutes over free flow travel time.

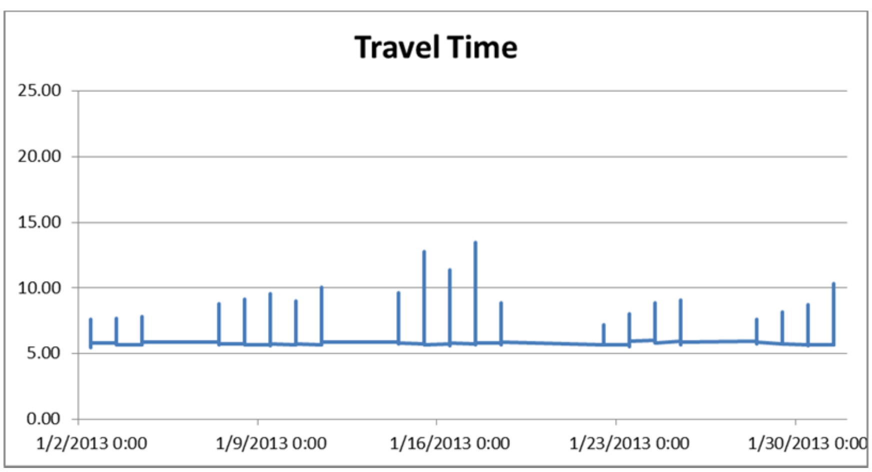


Figure 21. Travel Times and Travel Time Delay for I-105 Eastbound (P.M. Peak)

2.5.2.4 Programmed and Planned Improvements

The adopted SBCCOG South Bay Measure R Highway Program STE has identified several planned highway projects identified by various previous planning efforts that were determined to have an operational nexus to the State Highway System for regional mobility. The STE also performed a mobility benefit analysis on each of these projects to estimate the reduction in delay associated with the implementation of the projects.

The four planned highway projects in the I-105 corridor are shown in the table below.

Caltrans Priority*	Type	Dir	Facility	Location Limits	City/ County	Description	Delay Reduc.†
5	Auxiliary lane	WB	I-105	Prairie Av to I-405	HAW	Add WB auxiliary lane	184
7	Auxiliary lane	WB	I-105	Crenshaw on-ramp to off-ramp	HAW	Add WB auxiliary lane Crenshaw off-ramp to Crenshaw on-ramp.	103
15	Auxiliary lane	EB	I-105	Yukon to Crenshaw	HAW	Add EB auxiliary lane	84
20	Interchange	SB	I-405	at I-405	HAW	Add HOV connector from westbound I-105 to southbound I-405	23
		NB	I-405	at I-405	HAW	Add HOV connector from westbound I-105 to northbound I-405	
		NB / SB	I-405	I-105 / I-405 HOV Connectors	HAW	Add HOV connectors from WB I-105 to NB and SB I-405	

* Caltrans-assigned priorities for SBCCOG region projects range from 1 to 25.

† The STE calculated delay reduction as follows: Estimated future 2035 A.M. and P.M. weekday peak hour (2 hours) delay reduction in veh-hrs. As an example, 200 veh-hrs reduction translates to about 200,000 annual veh-hrs savings.

2.5.3 Arterials

Imperial Highway is the primary parallel arterial in the I-105 corridor, running 8.2 miles from Sepulveda Boulevard in the west to Central Avenue in the east (see Table 9 below). Imperial Highway is a major regional arterial, accommodating 30,000 average daily trips within the corridor. It has four or six through lanes (two eastbound and two westbound or three eastbound and three westbound) for the length of the corridor and protected single-lane left turn pockets and dedicated left turn phases at each of the arterial intersections. East of Prairie Avenue, Imperial Highway parallels I-105 to the north (see Figure 17 above) at a distance of no more than 0.35 miles from the freeway. West of Prairie Avenue, Imperial Highway bisects I-105 twice and then runs directly underneath the freeway until they merge at Sepulveda Boulevard.

Very little up-to-date performance data is available for these arterials due to a lack of arterial data collection and performance measurement systems.

2.5.3.1 Arterial ITS

There are 33 signalized intersections, including 10 major cross streets with direct connections to I-105 on-ramps, and three primary controller systems—LADOT (Weschester, Airport, Harbor Gateway 1/1B), KITS, and QuickNet Pro—with operation divided between the City of Los Angeles, Hawthorne, Inglewood, Los Angeles County, and Caltrans. Arterial system detection (capable of determining speed and throughput) is not currently available at any intersection along Imperial Highway (see Programmed and Planned Arterial Improvements discussion below).

Table 9. Imperial Highway Arterial ITS

Cross Street	Operating Jurisdiction	System	Controller	Firmware	Detection Type	Arterial Detection?
Sepulveda Blvd	Caltrans	N/A				No
Hughes Way	Los Angeles	Westchester	2070	TSCP	Fully-Actuated	No
Nash St.	Los Angeles	N/A				No
Klroy Center Rd.	Los Angeles	N/A				No
Douglas St.	Los Angeles	Airport	170	TSCP	Semi-Actuated	No
Aviation Bl.	Los Angeles	Airport	2070	TSCP	Semi-Actuated	No
105 Fwy.	Los Angeles	N/A				No
La Cienega Bl.	Los Angeles	Airport	170	TSCP	Semi-Actuated	No
405 Fwy.	Caltrans					No
Sundale Av.	Hawthorne	Future KITS	ASC-8000	ASC-8000		No
Inglewood Av.	Hawthorne	Future KITS	ASC-8000	ASC-8000		No
Firmona Av./Ramona Av.	Hawthorne	Future KITS	ASC-2	ASC-2		No
Hawthorne Bl.	Hawthorne	Future KITS	ASC-8000	ASC-8000		No
Freeman Av.	Hawthorne	Future KITS	ASC-8000	ASC-8000		No
Prairie Av.	Inglewood	QuicNet Pro	170	Bitran 200SA		No
Doty Av.	Inglewood	QuicNet Pro	170	Bitran 200C		No
Yukon Av.	Inglewood	QuicNet Pro	170	Bitran 200C		No
Simms Av.	Inglewood	QuicNet Pro	170	Bitran 200C		No
Crenshaw Bl.	Inglewood	QuicNet Pro	170E	Bitran 233		No
Ardath Av.	Inglewood	QuicNet Pro	170	Bitran 200SA		No
Van Ness Av.	County	KITS	170E	LACO-4E	loops	No
Wilton Pl.	County	KITS	170E	LACO-4E	loops	No
Western Av.	County	KITS	170E	LACO-4E	loops	No
Denker Av.	County	KITS	170E	LACO-4E	loops	No
Normandie Av.	County	KITS	170E	LACO-4E	video	No
Budlong Av.	County	KITS	170E	LACO-4E	loops	No
Vermont Av.	Los Angeles	Harbor Gateway 1B	2070	TSCP	Semi-Actuated	No

Cross Street	Operating Jurisdiction	System	Controller	Firmware	Detection Type	Arterial Detection?
Hoover St.	Los Angeles	Harbor Gateway 1B	2070	TSCP	Semi-Actuated	No
Figueroa St.	Los Angeles	Harbor Gateway 1B	2070	TSCP	Semi-Actuated	No
Grand/110 Fwy.	Caltrans	Harbor Gateway	2070	TSCP	Semi-Actuated	No
Broadway	Los Angeles	Harbor Gateway 1B	2070	TSCP	Semi-Actuated	No
Main St.	Los Angeles					No
San Pedro St.	Los Angeles	Harbor Gateway 1B	2070	TSCP	Semi-Actuated	No
Avalon Bl.	Los Angeles	Harbor Gateway 1	2070	TSCP	Semi-Actuated	No
Central Av.	Los Angeles	Harbor Gateway 1B	2070	TSCP	Semi-Actuated	No

* Note: **Bolded** cross streets indicate direct freeway connection.

2.5.3.2 Programmed and Planned Arterial Improvements

The adopted SBCCOG South Bay Measure R Highway Program Strategic Transportation Element (STE) has identified several intersections along Imperial Highway at which to install new system detection technology. The Los Angeles County ITS Plan has also identified Imperial Highway candidate intersections for system detection deployment (see Figure 22 below). Note, however, that County of Los Angeles has determined that it will not be installing detection within the boundaries of City of Los Angeles. In addition, there are currently no funded projects to install system detection.

In total, 12 intersections along Imperial Highway have been identified as top candidates for arterial system detection by SBCCOG and Los Angeles County:

Imperial Highway Intersection	Identified in SBCCOG STE	Identified in LA County ITS Plan
Sepulveda Blvd	X	
Aviation Blvd	X	
La Cienega Blvd	X	
Inglewood Ave	X	X
Hawthorne Blvd	X	X
Prairie Ave	X	X
Crenshaw Blvd	X	X
Western Ave		X
Normandie Ave	X	X
Vermont Ave	X	
Figueroa St	X	
Central Ave	X	

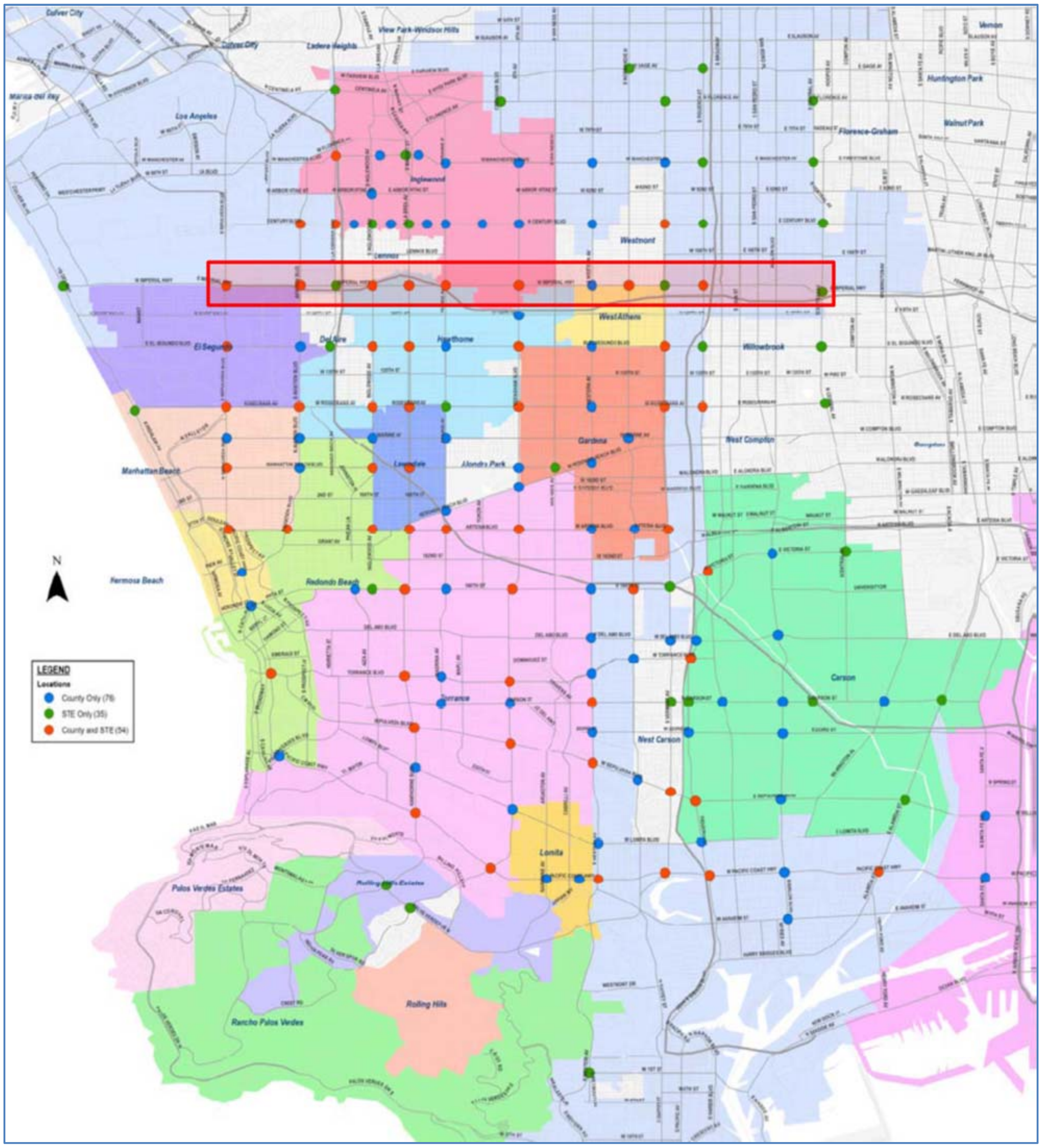
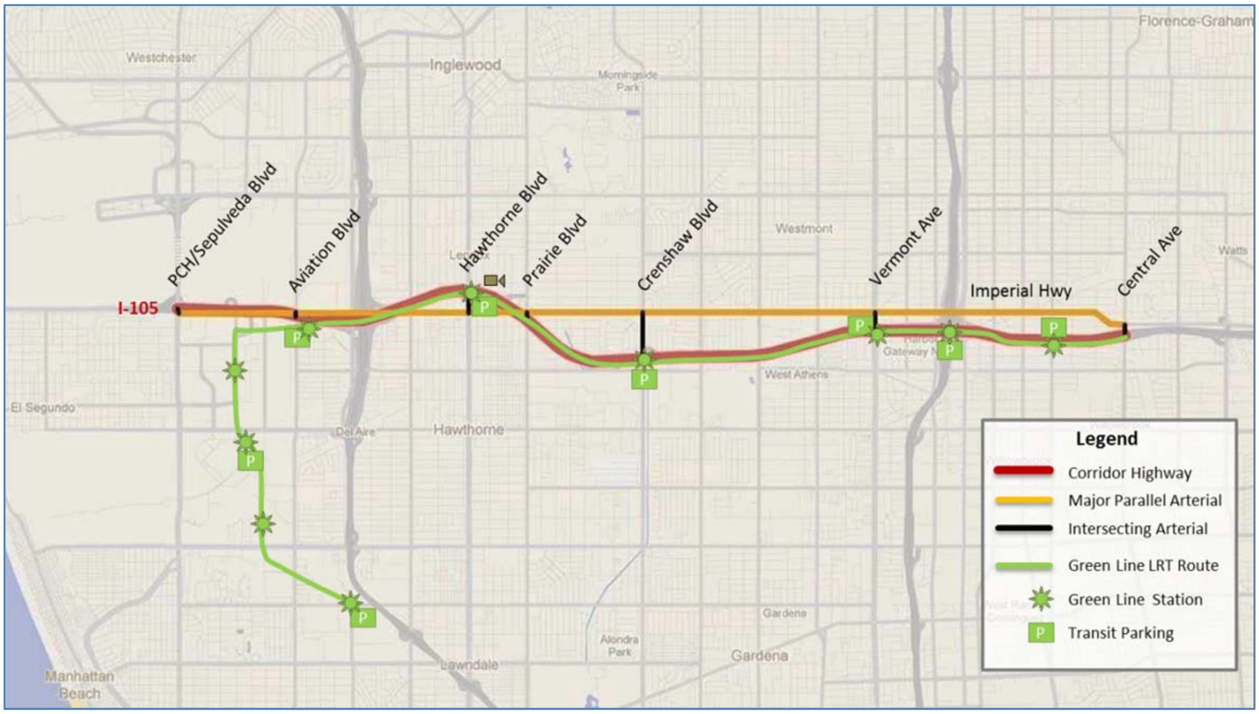


Figure 22. SBCCOG STE and LA County ITS Master Plan Arterial Detection Sites for Imperial Hwy

2.5.4 Transit

The primary high-frequency (every 15 minutes or less) transit line that operates with stops within the I-105 corridor is the Metro Green Line Light Rail Transit (LRT), which provides corridor service between Aviation/LAX and Harbor Freeway Station via grade-separated track along the I-105 median.



Free Metro-operated parking facilities for the Metro Green Line that serve the SBCCOG region are located at the following stations (also see map above):

- El Segundo Station (91 spaces)
- Aviation/LAX Station (390 spaces)
- Hawthorne/Lennox Station (623 spaces)
- Crenshaw Station (513 spaces)
- Vermont/Athens Station (155 spaces)
- Harbor Freeway Station (253 spaces)
- Avalon Station (158 spaces)

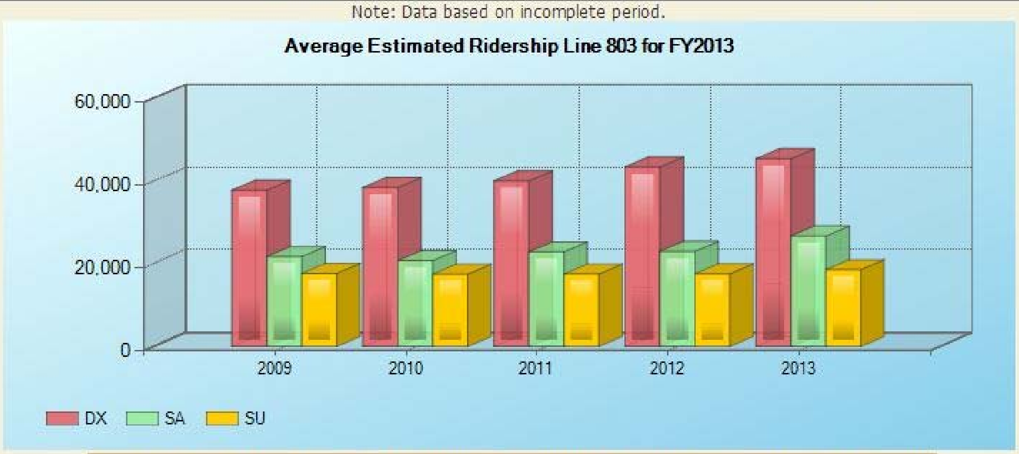
Ridership

Average weekday ridership for the Metro Green Line for the most recent month end (April 2013) was 42,416 boardings, making the Green Line the third most traveled light rail line in the county after the Blue Line (87,392) and Gold Line (43,439).

Annual ridership has been steadily increasing over the past five years, as shown in the figure below.

Day Type	Estimated Ridership	Average Passenger Miles	Day Count	Total Estimated Ridership	Total Passenger Miles
DX	45,395	300,058	212	9,623,656	63,612,366
SA	26,743	161,795	43	1,149,949	6,957,191
SU	18,596	113,066	49	911,220	5,540,216

Note: Data based on incomplete period.



Period	Estimated Weekday Ridership	Estimated Saturday Ridership	Estimated Sunday Ridership
2009	37,805	21,758	17,701
2010	38,443	20,778	17,520
2011	40,047	22,890	17,534
2012	43,402	23,022	17,608
2013	45,395	26,743	18,596

Figure 23. Metro Green Line Average Daily Ridership. (source: Metro *http://isotp.metro.net/MetroRidership/Index.aspx*)

Service Frequency

The Green Line currently operates on the following headway schedule:

Weekday Service Frequency

Time of Day / Direction	Early morning (4-6am)	A.M. Peak (6-9am)	Off-Peak (9am-3pm)	P.M. Peak (3-7pm)	Night (7-9pm)	Late Night (9pm-2am)
Eastbound	7-11 min	7 min	15 min	7-10 min	17-20 min	20 min
Westbound	10-15 min	7 min	15 min	7-10 min	15-20 min	20 min

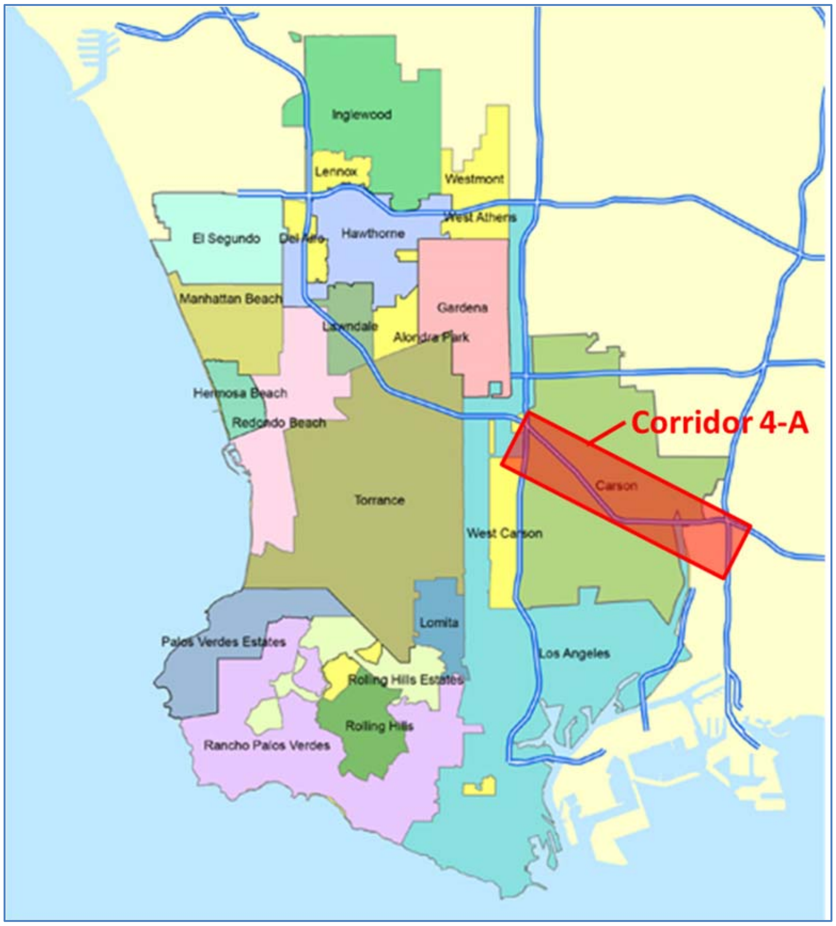
Saturday, Sunday, and Holiday Service Frequency

Time of Day / Direction	Early morning (4-6am)	Day (6am-7pm)	Night (7pm-12am)	Late Night (12am-2am)
Eastbound	15 min	15 min	20 min	20 min
Westbound	15 min	15 min	20 min	20 min

2.6 Corridor 4-A: I-405 (from I-710 to I-110)

2.6.1 Overview

The I-405 corridor, from I-710 at the east to I-110 northwest, is 5.4 miles in length and extends primarily through Carson and terminates to the east in Long Beach.



2.6.2 Highway

2.6.2.1 Highway ITS

Vehicle detection along the corridor is accomplished via embedded pavement loops, with 8 northbound VDS sensors and 9 southbound VDS sensors, providing northbound detection coverage of 1.5 VDS per mile and southbound detection coverage of 1.7 VDS per mile (see Figure 24 below). In addition, seven CCTV cameras are deployed along the corridor, positioned near each of the major intersecting arterials.

Three Caltrans CMS are located along the corridor: two northbound (near the Avalon Blvd ramp and the Del Amo Blvd overpass) and one southbound (near the Wilmington Ave ramp).

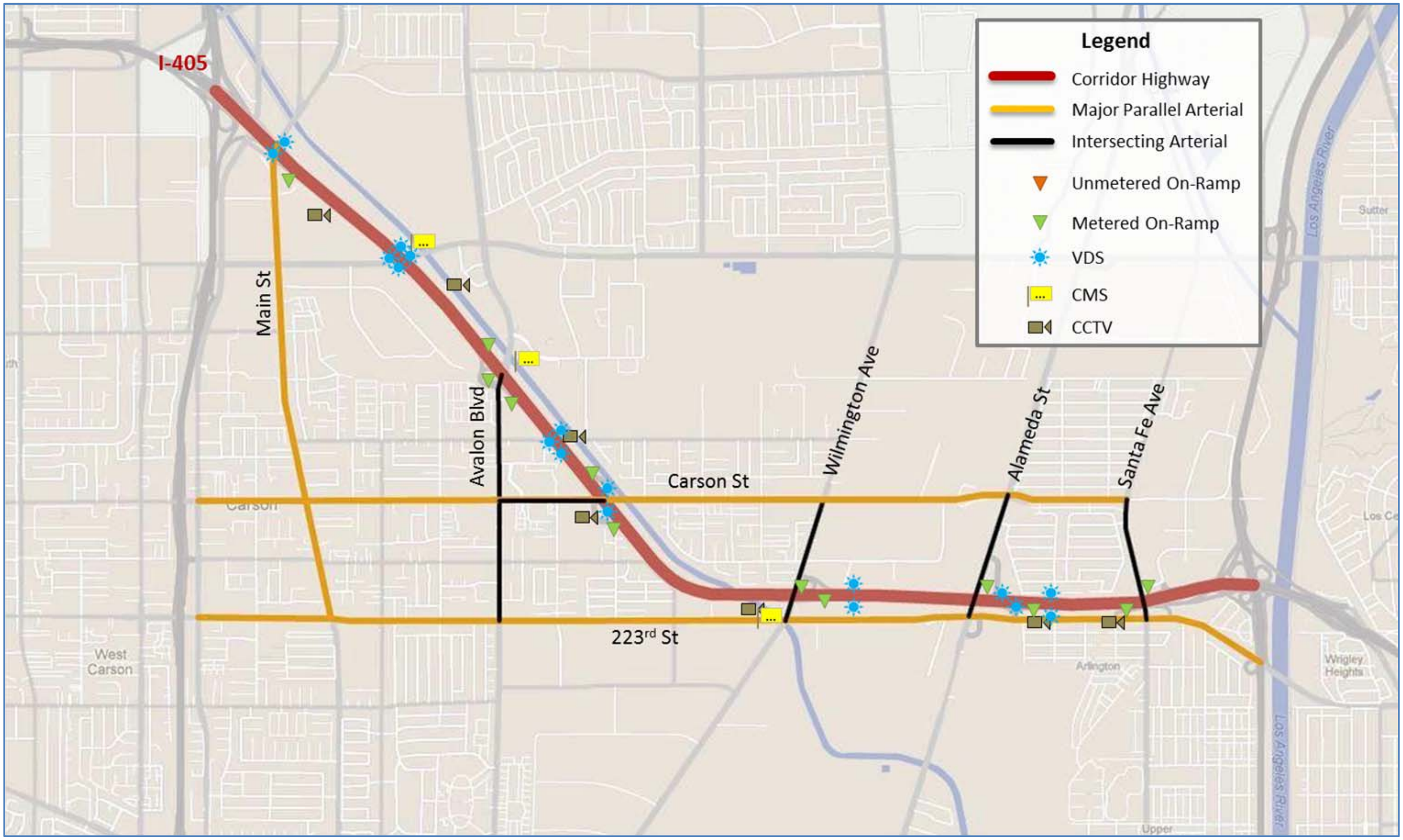


Figure 24. Corridor 4-A (I-405) Overview

2.6.2.2 On-Ramps and On-Ramp Intersections

As depicted in Figure 16 above, all 5 northbound on-ramps and all 7 southbound on-ramps along the 5.4-mile I-405 corridor are metered, providing an average density of 0.9 metered ramps per mile in the northbound direction and 1.3 ramps per mile in the southbound direction.

The northbound on-ramps (from south to north) are:

- Warnock Way (via Santa Fe Ave)
- Alameda St
- Wilmington Ave
- Carson St
- Avalon Blvd

The southbound on-ramps (from south to north) are:

- Wardlow Rd (via Santa Fe Ave)
- 223rd St (east of Alameda St)
- Wilmington Ave
- Carson St
- Avalon Blvd (northbound)
- Avalon Blvd (southbound)
- Main St

Table 10 on the following page provides additional detail about the configurations and storage capacities of the ramps and adjoining intersections.

Table 10. I-405 (A) On-Ramp/Arterial Intersection Configurations and Storage Capacities

I-405 On-Ramp	Fwy Dir	Ramp			Arterial							
		Metered/ Lanes	Unmetered HOV	Ramp Storage (ft)	Turn Pocket Storage		NB/EB Lane Geom.			SB/WB Lane Geom.		
					LT (ft)	RT (ft)	Left	Thru	Right	Left	Thru	Right
Warnock Way (via Santa Fe Ave)	NB	2/2	0	400	1000	400	2	0	1	0	1	1
Wardlow Rd (via Santa Fe Ave)	SB	2/2	0	1040	75*	100	1*	2	0	1*	2	1
223rd St (east of Alameda St)	SB	2/2	0	1060	300	0	2	2	1	0	3	0
Alameda St	NB	2/2	0	1550	300	300	0	2	1	1	2	0
Wilmington Ave	SB	2/2	0	1000	275	150	0	2	1	1	3	0
Wilmington Ave	NB	1/1	0	650	100	250	0	2	1	1	3	0
Carson St	SB	1/2	1	750	50	175	1	2	1	1	3	0
Carson St	NB	1/1	0	850	75	150	1	2	1	1	2	0
Avalon Blvd (northbound)	SB	2/2	0	1150	N/A	0	1	2	0	N/A	N/A	N/A
Avalon Blvd (southbound)	SB	1/1	0	1250	N/A	300†	N/A	N/A	N/A	0	2	1†
Avalon Blvd	NB	2/2	0	700	275	300†	1	2	0	0	2	1†
Main St	SB	1/2	1	550	250	0	0	2	0	1	2	0

*There is no arterial signalization at this on-ramp location.

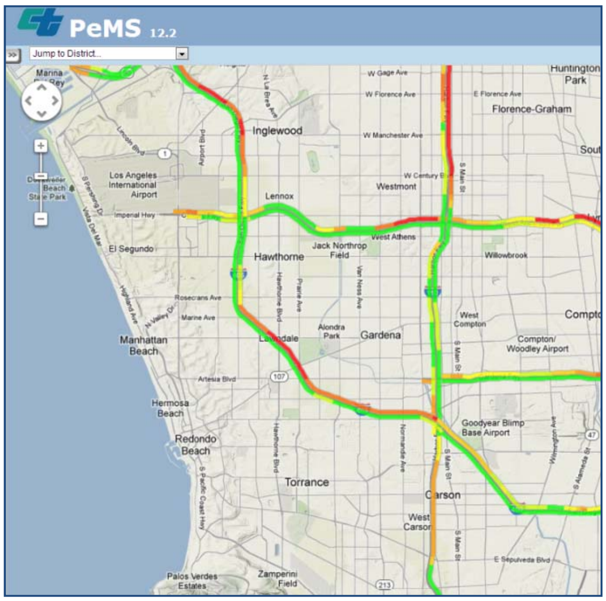
† The right turn pocket is not signalized at these on-ramp locations.

2.6.2.3 Congestion Levels

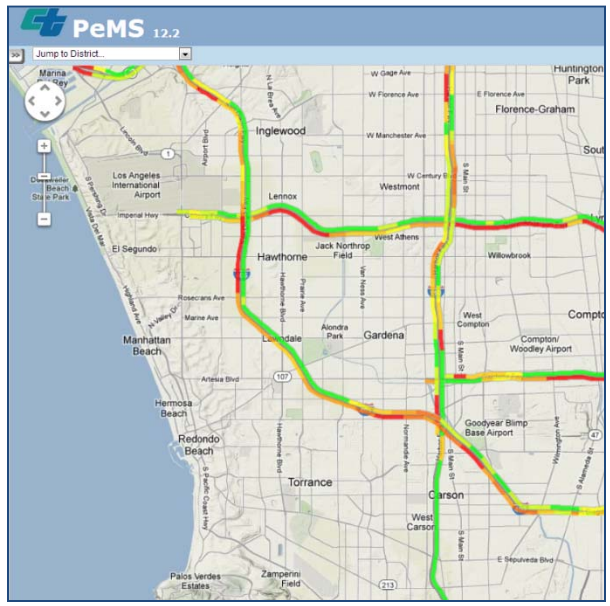
I-405, from I-710 at the south to I-110 the north, experiences moderate levels of congestion in the northbound direction during the A.M. peak and high levels of congestion in the southbound direction during the P.M. peak (see figures below).

Based on the levels and distribution of congestion along this corridor segment, a DCCM system could impact the corridor mobility improvements significantly.

A.M. Peak



P.M. Peak



Lane-by-Lane Speed Profiles

The figures below (Figure 25 and Figure 26) show the lane-by-lane speeds for the I-405 northbound during the typical weekday A.M. peak and for the I-405 southbound during the typical weekday P.M. peak.

As indicated, northbound A.M. peak hour speeds are low throughout the corridor segment, particularly from postmile 31 to 32.5 and from 35 to 36.5. The heavy congestion in this direction stems from heavy commuter traffic demand headed north to employment centers along the I-405 corridor.

Southbound P.M. peak hour speeds are low throughout the corridor segment and in particular from postmile 35 to 33.

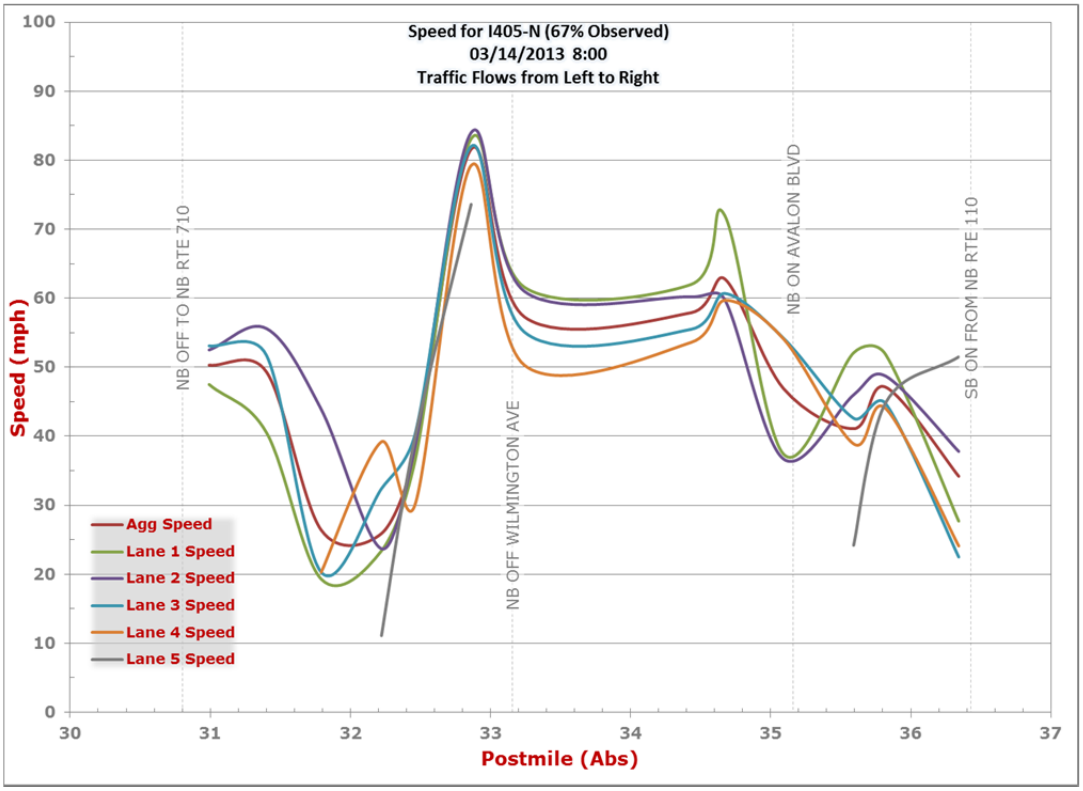


Figure 25. Lane-by-Lane Speed Profile for I-405 (South) NB (A.M. Peak)

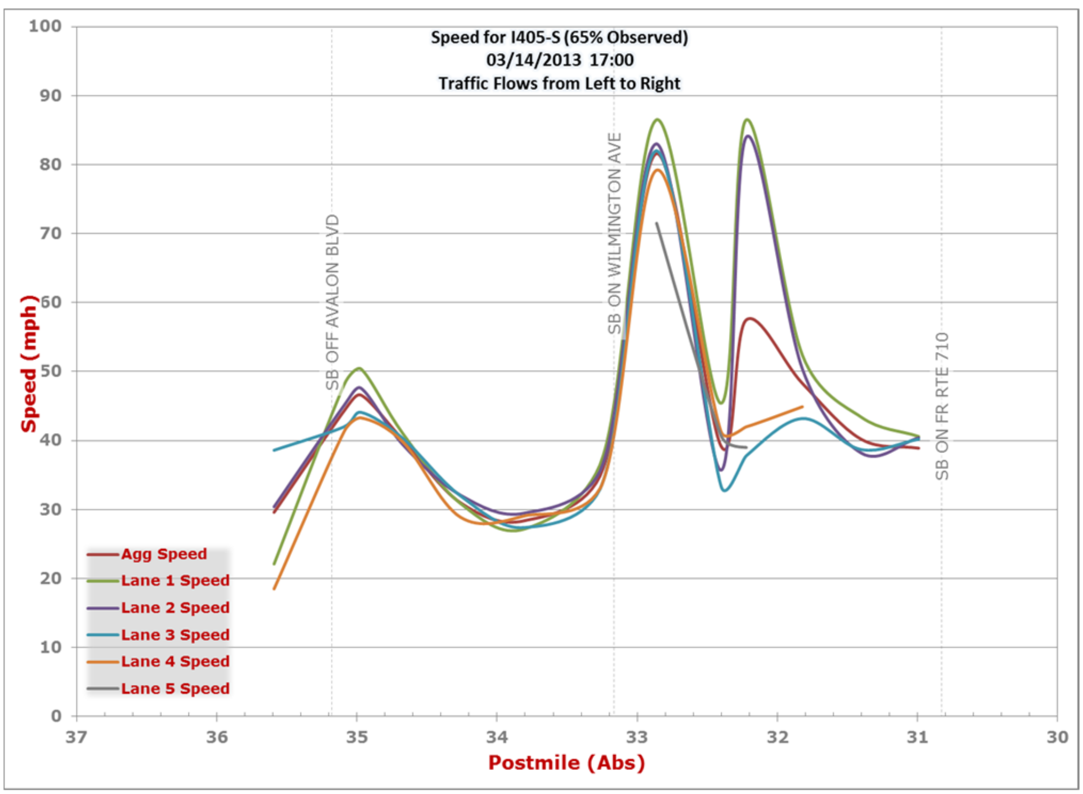


Figure 26. Lane-by-Lane Speed Profile for I-405 (South) SB (P.M. Peak)

Travel Times and Travel Time Delay

The figures below (Figure 27 and Figure 28) illustrate the actual travel times at peak times, as measured during representative sample weeks in January 2013.

I-405 Northbound (5.6 mi) – A.M. Peak

As indicated, the typical A.M. peak hour travel time for the northbound 5.6-mile segment is approximately 9 minutes, with travel time delay of 4 minutes over free flow travel time.

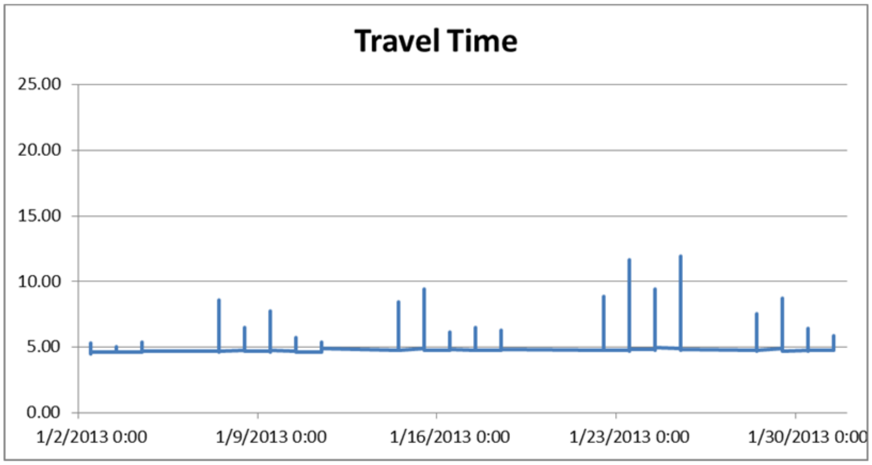


Figure 27. Travel Times and Travel Time Delay for I-405 (South) Northbound (A.M. Peak)

I-405 Southbound (5.6 mi) – P.M. Peak

Typical P.M. peak hour travel time in the southbound 5.6-mile segment is approximately 9 minutes, with travel time delay similar to the A.M. peak of 4 minutes over free flow travel time.

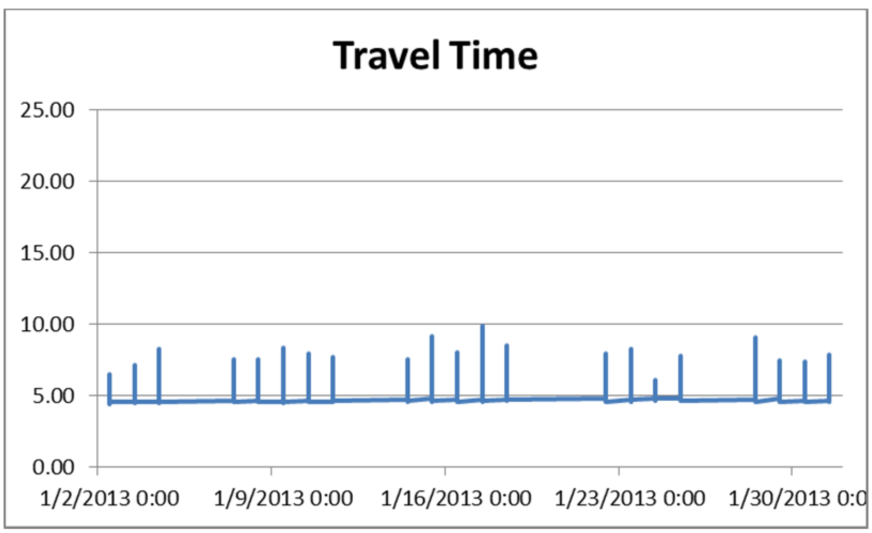


Figure 28. Travel Times and Travel Time Delay for I-405 (South) Southbound (P.M. Peak)

2.6.2.4 Programmed and Planned Improvements

The adopted SBCCOG South Bay Measure R Highway Program STE has identified several planned highway projects identified by various previous planning efforts that were determined to have an operational nexus to the State Highway System for regional mobility. The STE also performed a mobility benefit analysis on each of these projects to estimate the reduction in delay associated with the implementation of the projects.

The two planned highway projects in the I-405 corridor are shown in the table below.

Caltrans Priority*	Type	Dir	Facility	Location Limits	City/ County	Description	Delay Reduc.†
1	Interchange	SB	I-110	at I-405	County	Construct new NB I-405 to SB I-110 connector, flyover ramp	204
13	Interchange	SB	I-110	at I-405	LA	Widen from 3 to 4 lanes through IC	196

* Caltrans-assigned priorities for SBCCOG region projects range from 1 to 25.

† The STE calculated delay reduction as follows: Estimated future 2035 A.M. and P.M. weekday peak hour (2 hours) delay reduction in veh-hrs. As an example, 200 veh-hrs reduction translates to about 200,000 annual veh-hrs savings.

2.6.3 Arterials

East of Wilmington Ave, the I-405 corridor runs east-west. But west of Wilmington, I-405 follows the path of the Dominguez Channel, which runs in a northwesterly direction (see Figure 24 above). Because the local arterial network maintains a standard grid layout along the cardinal directions, there is not a single street that runs parallel to I-405 for the length of the corridor. Along the southern half of the corridor, Carson St (3.8 miles from Via Oro Ave to Main St) and 223rd St are the primary arterials and provide access to the highway via the intersecting streets Santa Fe Ave, Alameda St, and Wilmington Ave (listed in Table 10 above).

The City of Carson conducted a traffic count for Carson Street and 223rd Street in December 2009 (http://carson.ca.us/content/department/dev_service/traffic_engineering.asp) and measured total weekday counts:

Street	Segment		Date	Daily Traffic Counts		
				Directional		Total
	From	To		EB	WB	
Carson St	Main	Avalon	12/1/2009	12,689	12,203	24,892
Carson St	Avalon	I-405	12/1/2009	13,848	12,006	25,854
Carson St	I-405	Wilmington	12/10/2009	7,857	7,782	15,639
Carson St	Wilmington	Alameda	12/10/2009	7,174	6,539	13,713

Carson St	Alameda	Santa Fe	12/14/2009	5,284	5,145	10,429
223rd St	Main	Avalon	12/1/2009	9,129	8,409	17,538
223rd St	Avalon	Wilmington	12/14/2009	10,026	5,807	15,833
223rd St	Wilmington	Alameda	12/14/2009	7,990	8,243	16,233

Along the northern half of the corridor, no major street emerges as a clear parallel arterial to I-405. Main St and Avalon Blvd, however, run north-south and provide on-ramp connectivity to I-405.

Very little up-to-date performance data is available for these arterials due to a lack of arterial data collection and performance measurement systems.

2.6.3.1 Arterial ITS

There are 15 signalized intersections, including 7 major cross streets with direct connections to I-405 on-ramps. One primary controller system—KITS—has been identified and three jurisdictions dividing operations—Long Beach, County of Los Angeles, and Caltrans. Arterial system detection (capable of determining speed and throughput) is currently unavailable at all corridor intersections (see Programmed and Planned Arterial Improvements discussion below).

Table 11. Carson St Arterial ITS

Cross Street	Operating Jurisdiction	System	Controller	Firmware	Arterial Detection?
Via Oro Ave	Long Beach				No
Santa Fe Ave	LA County		ACS	ACS	No
Evonda Ave	LA County		ASC-2-2100	ASC-2-2100	No
Harbor View Ave	LA County		ASC-2-2100	ASC-2-2100	No
Alameda St	LA County	KITS	170 ATC/HC-11	LACO-4E	No
Wilmington Ave	LA County		ASC-25-2100	ASC-25-2100	No
Martin St	LA County				No
Vera St	LA County		ASC-2-2100	ASC-2-2100	No
405 Hwy	Caltrans				No
Bonita St	LA County		170 ATC/HC-11	LACO-4E	No
Avalon Blvd	LA County		ASC-25-2100	ASC-25-2100	No
Grace Ave	LA County		ASC-2-2100	ASC-2-2100	No
Dolores St	LA County		170 ATC/HC-11	LACO-4E	No
Orrick Ave	LA County		ASC-25-2100	ASC-25-2100	No
Main St	LA County		ASC-2-2100	ASC-2-2100	No

* Note: **Bolded** cross streets indicate direct freeway connection.

2.6.3.2 Programmed and Planned Arterial Improvements

The adopted SBCCOG South Bay Measure R Highway Program Strategic Transportation Element (STE) has identified several intersections along Carson Street at which to install new system detection technology. The Los Angeles County ITS Plan has also identified Carson Street candidate intersections for system detection deployment (see Figure 29 below). Note, however, that County of Los Angeles has determined that it will not be installing detection within the boundaries of City of Los Angeles. In addition, there are currently no funded projects to install system detection.

In total, 5 intersections along Carson Street have been identified as top candidates for arterial system detection by SBCCOG and Los Angeles County:

Carson Street Intersection	Identified in SBCCOG STE	Identified in LA County ITS Plan
Alameda St		X
Wilmington Ave		X
405 Fwy	X	
Avalon Blvd		X
Main St	X	

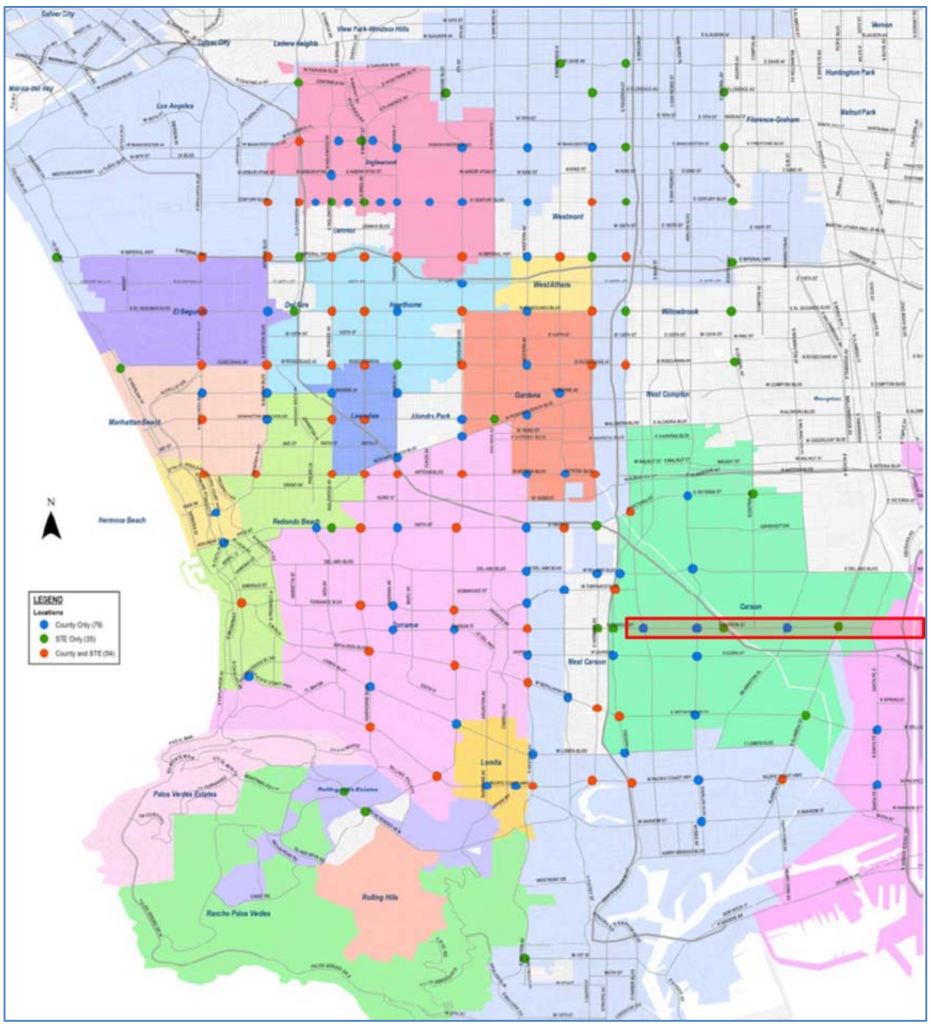


Figure 29. SBCCOG STE and LA County ITS Master Plan Arterial Detection Sites for Carson St

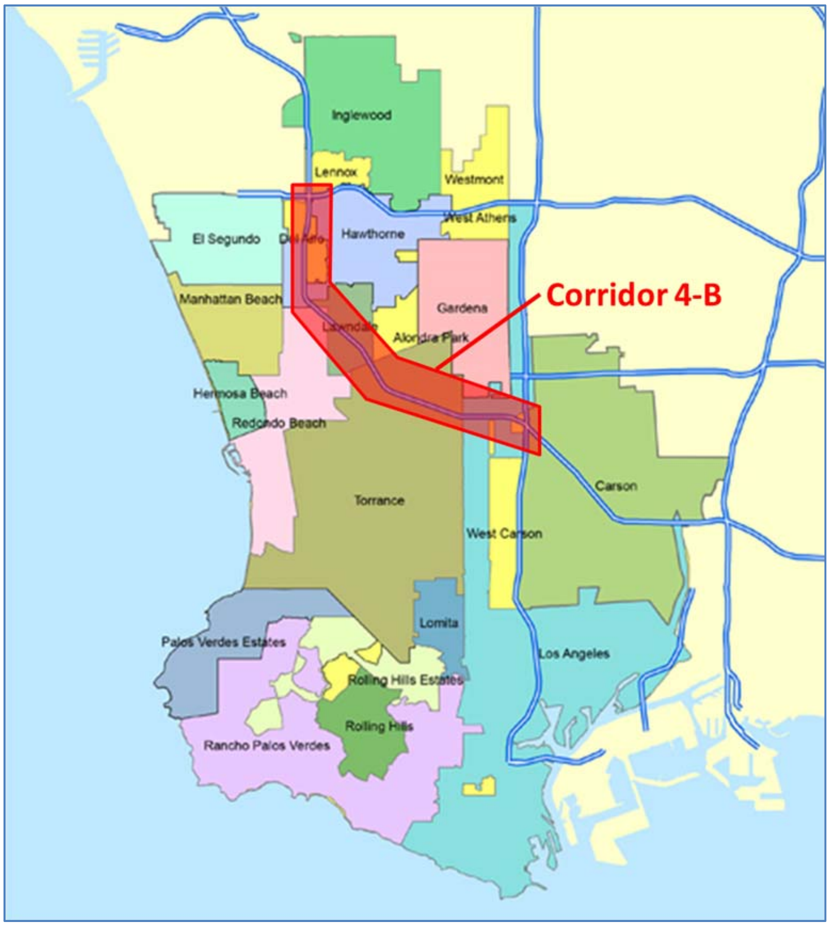
2.6.4 Transit

There is no frequent rapid transit, existing or planned, that runs along this corridor.

2.7 Corridor 4-B: I-405 (from I-110 to I-105)

2.7.1 Overview

The I-405 corridor, from I-110 at the south to I-105 at the north, is 8.2 miles in length and extends primarily through portions of City of Los Angeles, Torrance, Lawndale, Redondo Beach, Hawthorne, El Segundo, and unincorporated Del Aire.



2.7.2 Highway

2.7.2.1 Highway ITS

Vehicle detection along the corridor is accomplished via embedded pavement loops, with 18 northbound VDS sensors and 18 southbound VDS sensors, providing northbound detection coverage of 2.2 VDS per mile and southbound detection coverage of 2.2 VDS per mile (see Figure 30 below). In addition, 9 CCTV cameras are deployed along the corridor, positioned near each of the major intersecting arterials.

Three Caltrans CMS are located along the corridor: two northbound (near Inglewood Ave and Rosecrans Ave ramps) and one southbound (near the Western Ave ramp).

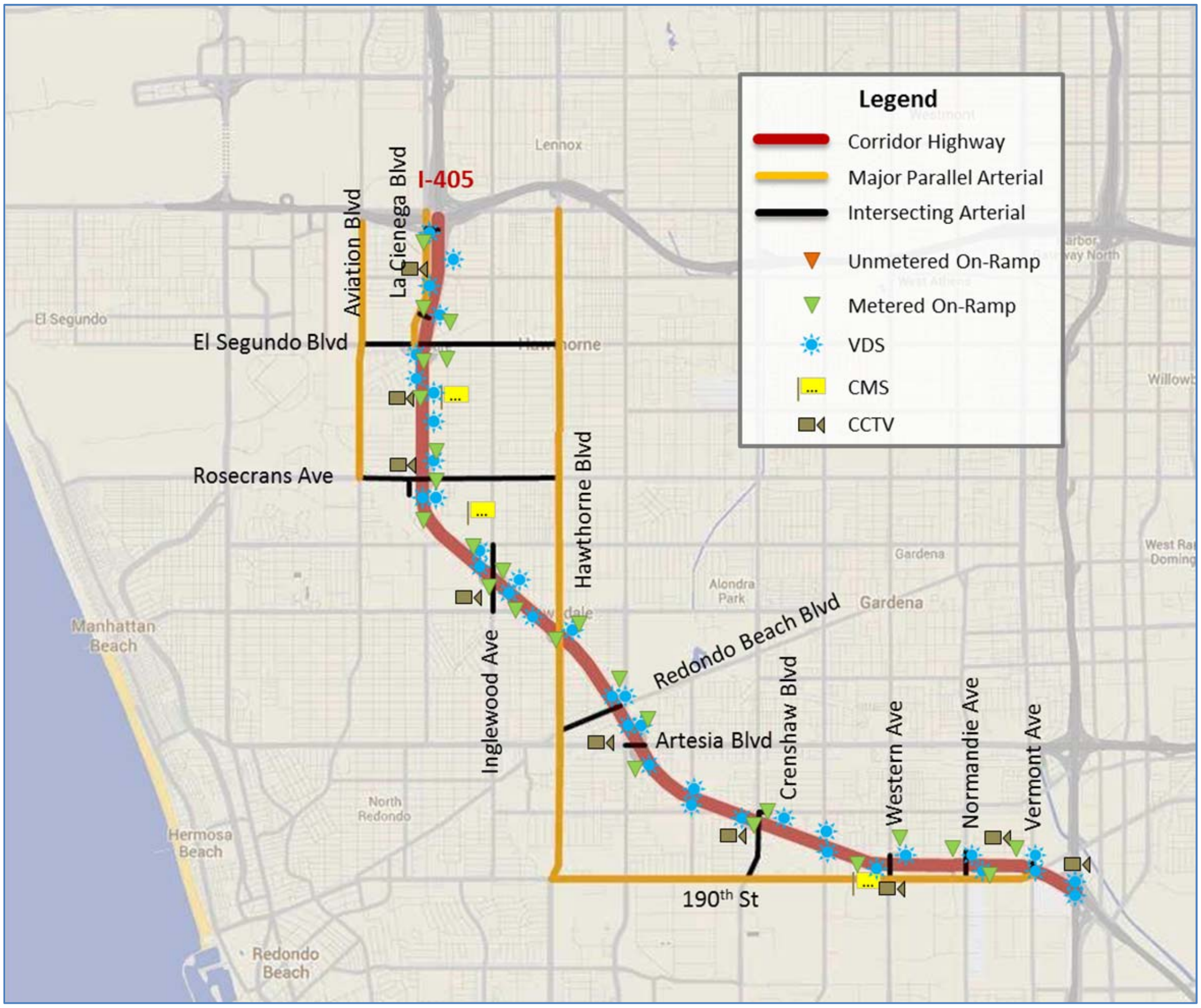


Figure 30. Corridor 4-B (I-405) Overview

2.7.2.2 On-Ramps and On-Ramp Intersections

As depicted in Figure 30 above, all 13 northbound on-ramps and all 11 southbound on-ramps along the 8.2-mile I-405 corridor are metered, providing an average density of 1.6 metered ramps per mile in the northbound direction and 1.5 ramps per mile in the southbound direction.

The northbound on-ramps (from south to north) are:

- Vermont Ave
- Normandie Ave
- Western Ave
- 182nd St (west of Crenshaw Blvd)
- Artesia Blvd (westbound)
- Redondo Beach Blvd
- Hawthorne Blvd (northbound)
- Inglewood Ave (northbound)
- Inglewood Ave (southbound)
- Rosecrans Ave (eastbound)
- Rosecrans Ave (westbound)
- El Segundo Blvd (eastbound)
- El Segundo Blvd (westbound)

The southbound on-ramps (from south to north) are:

- Normandie Ave
- 190th St (west of Western Ave)
- Crenshaw Blvd
- Artesia Blvd (eastbound)
- Hawthorne Blvd
- Inglewood Ave (northbound)
- Inglewood Ave (southbound)
- Hindry Ave (south of Rosecrans Ave)
- El Segundo Blvd (eastbound)
- La Cienega Blvd (near 124th St)
- La Cienega Blvd (near Aviation Blvd)

Table 12 on the following page provides additional detail about the configurations and storage capacities of the ramps and adjoining intersections.

Table 12. I-405 (B) On-Ramp/Arterial Intersection Configurations and Storage Capacities

I-405 On-Ramp	Fwy Dir	Ramp			Arterial							
		Metered/ Lanes	Unmetered HOV	Ramp Storage (ft)	Turn Pocket Storage		NB/EB Lane Geom.			SB/WB Lane Geom.		
					LT (ft)	RT (ft)	Left	Thru	Right	Left	Thru	Right
Vermont Ave	NB	1/2	1	900	200*	0	1*	2	0	0*	2	0
Normandie Ave	SB	1/2	1	600	350*	0	0*	2	0	1*	2	0
Normandie Ave	NB	1/1†	0	700†	50	200	0	2	1	1	2	0
Western Ave	NB	1/1†	0	700†	175	150	0	2	1	1	3	0
190th St (west of Western Ave)	SB	1/1†	0	850†	500	150	2	3	0	0	3	1
182nd St (west of Crenshaw Blvd)	NB	1/1†	0	450†	150	0	0	2	0	1	2	0
Crenshaw Blvd	SB	1/1†	0	725†	375	0	1	3	0	0	3	0
Artesia Blvd (eastbound)	SB	2/2	0	1250	N/A	150*	0*	3	1	N/A	N/A	N/A
Artesia Blvd (westbound)	NB	1/1†	0	875†	N/A	125	N/A	N/A	N/A	0	2	1
Redondo Beach Blvd	NB	1/1†	0	600†	175*	0	1*	2	0	0*	2	0
Hawthorne Blvd (northbound)	NB	2/3	1	600	N/A	225	0	3	1	N/A	N/A	N/A
Hawthorne Blvd	SB	1/2	1	750	175	200	1	4	0	0	3	1
Inglewood Ave (northbound)	SB	1/2	1	900	N/A	0*	0*	3	0	N/A	N/A	N/A
Inglewood Ave (northbound)	NB	1/2	1	1050	N/A	350‡	0	2	1‡	N/A	N/A	N/A
Inglewood Ave (southbound)	SB	1/2	1	1000	N/A	350‡	N/A	N/A	N/A	0	2	1‡
Inglewood Ave (southbound)	NB	1/2	1	750	N/A	100*	N/A	N/A	N/A	0	3	1
Hindry Ave (south of Rosecrans Ave)	SB	1/1†	0	675†	550	0	1	2	0	2	1	0
Rosecrans Ave (eastbound)	NB	1/1	0	350	N/A	0	0	4	0	N/A	N/A	N/A
Rosecrans Ave (westbound)	NB	1/1†	0	850†	N/A	0	N/A	N/A	N/A	0	3	0
El Segundo Blvd	SB	1/2	1	1100	0	275	0	3	1	0	3	0
El Segundo Blvd (eastbound)	NB	1/2	1	800	N/A	200	0	3	1	N/A	N/A	N/A
El Segundo Blvd (westbound)	NB	1/2	1	750	N/A	0	N/A	N/A	N/A	0	3	0
La Cienega Blvd (near 124th St)	SB	1/2	1	850	150	475	0	2	1	1	3	0
La Cienega Blvd (near Aviation Blvd)	SB	1/2†	1	1375†	450	0	0	3	0	2	2	0

*There is no arterial signalization at these on-ramp locations.

† These on-ramps have two lanes that merge into a single lane upon approaching the ramp meter. The ramp storage values reflect the total lane feet of the full ramp, pre- and post-merge.

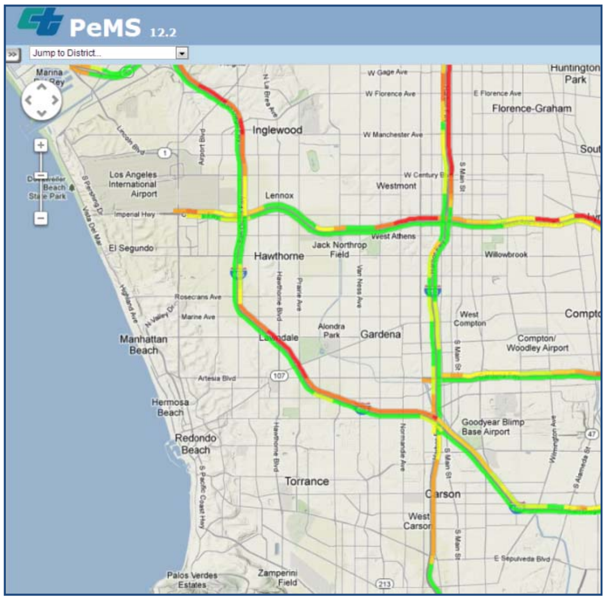
‡ The right turn pocket is not signalized at these on-ramp locations.

2.7.2.3 Congestion Levels

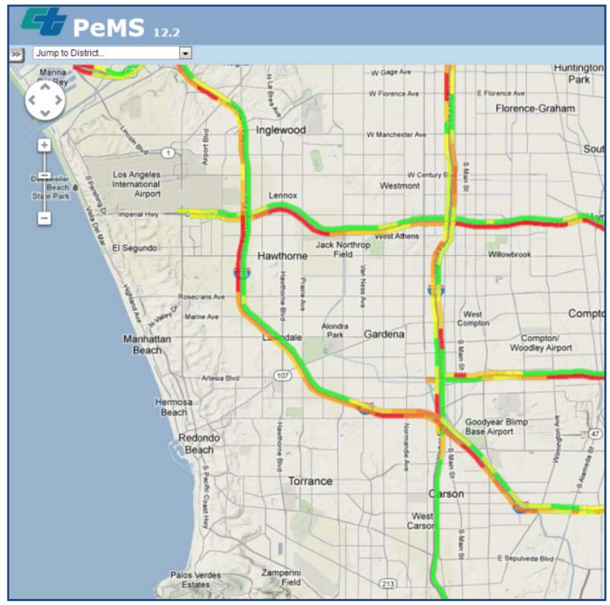
I-405, from I-110 at the south to I-105 at the north, experiences oversaturated levels of congestion in the northbound direction during the A.M. peak (in particular up to Rosecrans Ave) and in the southbound direction during the P.M. peak for the length of the corridor(see figures below).

Based on these very high congestion levels, a DCCM system may not be able to provide significant mobility improvements.

A.M. Peak



P.M. Peak



Lane-by-Lane Speed Profiles

The figures below (Figure 31 and Figure 32) show the lane-by-lane speeds for the I-405 northbound during the typical weekday A.M. peak and for the I-405 southbound during the typical weekday P.M. peak.

As indicated, northbound A.M. peak hour speeds are very low throughout the corridor segment, with moderate inter-lane speed variations. The heavy congestion in this direction stems from heavy commuter traffic demand headed north to employment centers along the I-405 corridor.

Southbound P.M. peak hour speeds are low throughout the corridor segment and in particular from postmile 37 to 41 and from 43.5 to 45. As indicated by the slow speeds, the corridor segment is fully saturated and severely congested.

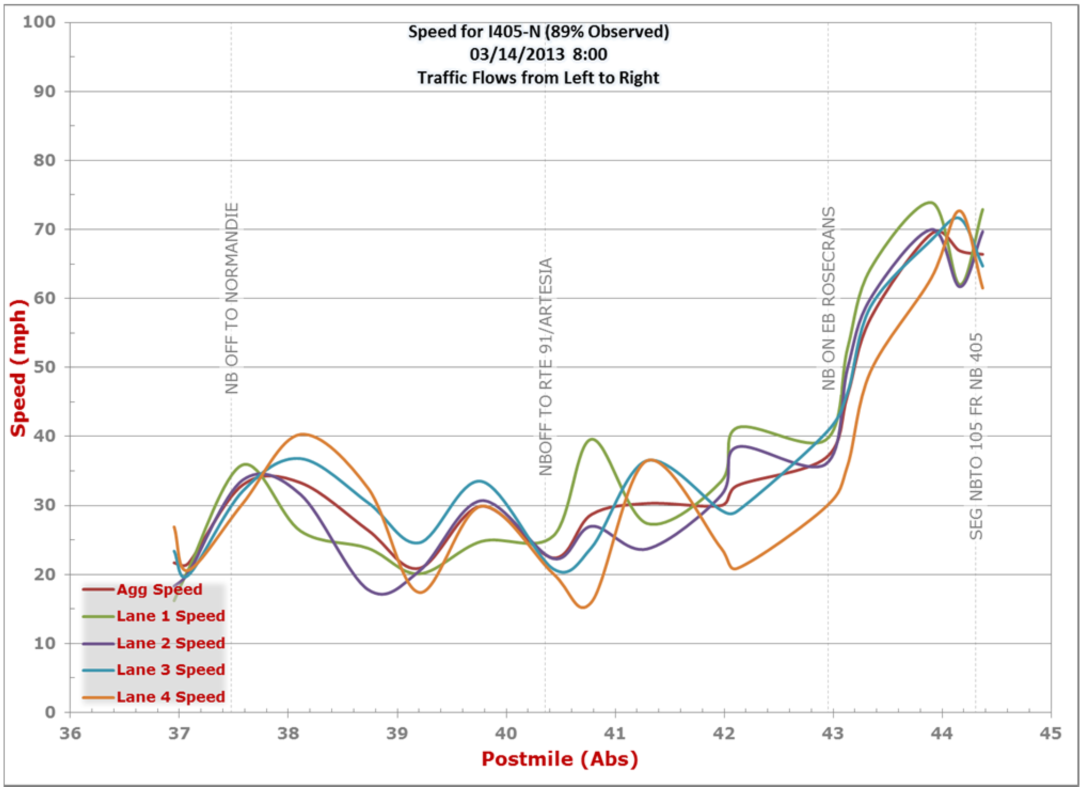


Figure 31. Lane-by-Lane Speed Profile for I-405 (Mid) NB (A.M. Peak)

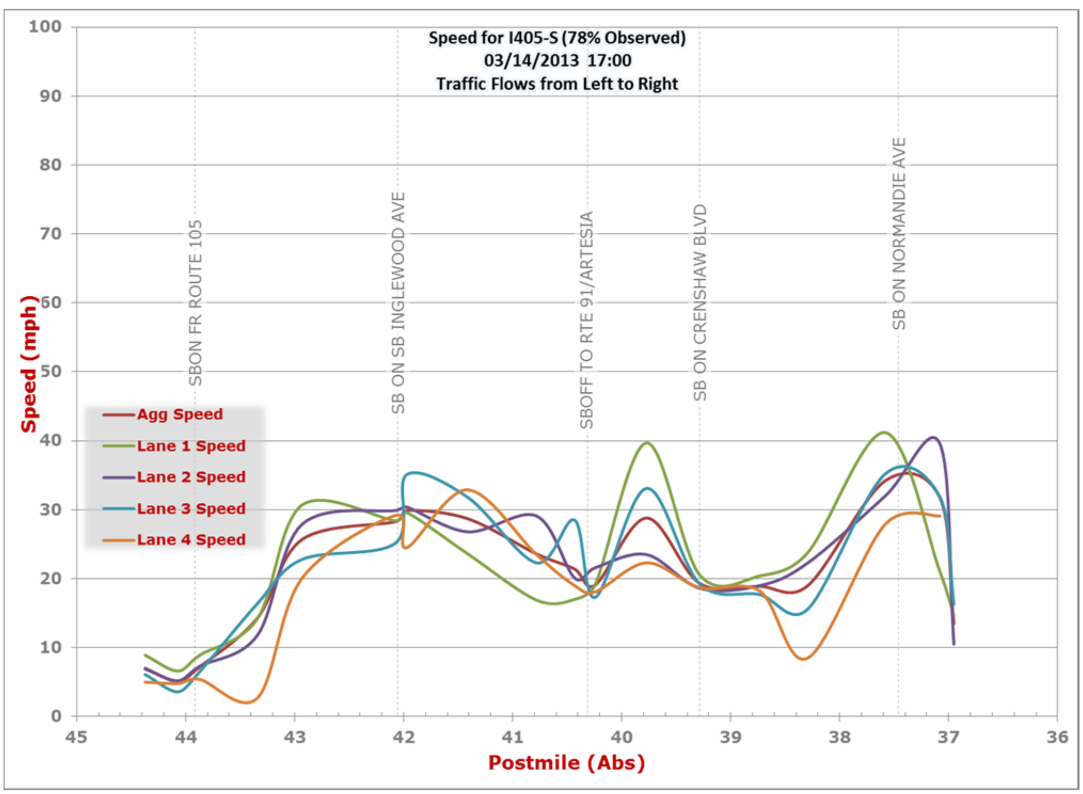


Figure 32. Lane-by-Lane Speed Profile for I-405 (Mid) SB (P.M. Peak)

Travel Times and Travel Time Delay

The figures below (Figure 33 and Figure 34) illustrate the actual travel times at peak times, as measured during representative sample weeks in January 2013.

I-405 Northbound (8.3 mi) – A.M. Peak

As indicated, the typical A.M. peak hour travel time for the northbound 8.3-mile segment is approximately 20 minutes, with travel time delay of 13 minutes over free flow travel time.

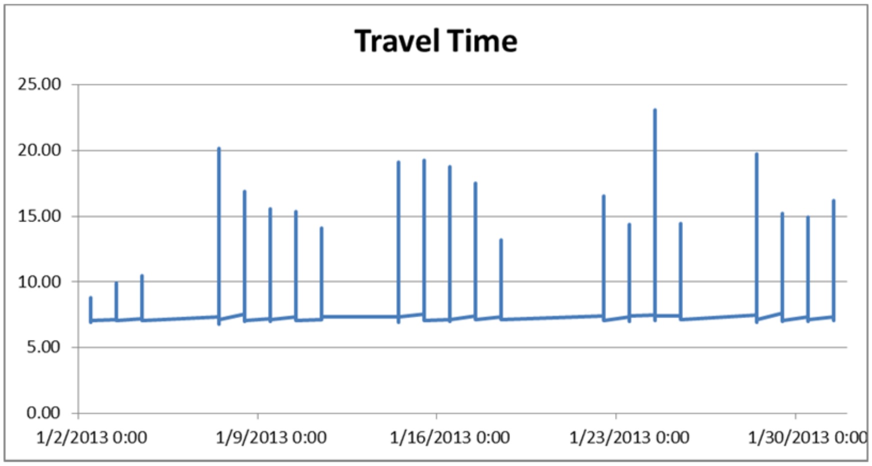


Figure 33. Travel Times and Travel Time Delay for I-405 (Mid) Northbound (A.M. Peak)

I-405 Southbound (8.3 mi) – P.M. Peak

Similar to the A.M. Peak, typical P.M. peak hour travel time in the southbound 8.3-mile segment is approximately 20 minutes, with travel time delay of 13 minutes over free flow travel time.

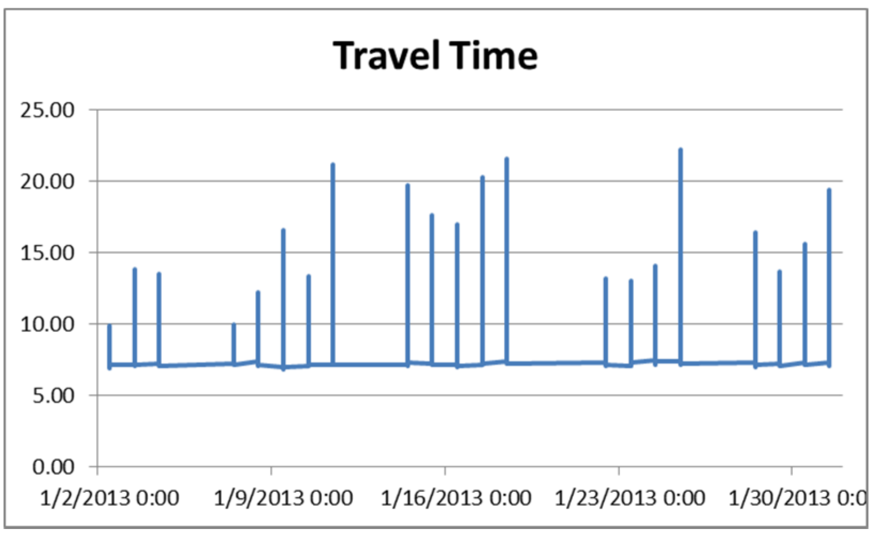


Figure 34. Travel Times and Travel Time Delay for I-405 (Mid) Southbound (P.M. Peak)

2.7.2.4 Programmed and Planned Improvements

The adopted SBCCOG South Bay Measure R Highway Program Strategic Transportation Element (STE) has identified several planned highway project identified by various previous planning efforts that were determined to have operational nexus to the State Highway System for regional mobility. The STE also performed mobility benefit analysis on each of these projects to estimate the reduction in delay associated with the implementation of the projects. The 13 planned highway projects in the I-405 corridor are shown in the table below.

Caltrans Priority*	Type	Dir	Facility	Location Limits	City/ County	Description	Delay Reduc.†
12	Auxiliary lane	NB	I-405	Inglewood Av to Rosecrans Av	HAW/ RB/ LAW	Add NB auxiliary lane	97
23	Ramp	NB	I-405	at Rosecrans Av	HAW	Widen NB off-ramp	5
9	Ramp	SB	I-405	at Rosecrans Av	HAW	Widen SB off-ramp to Rosecrans Av, add signal at end of ramp	17
22	Ramp	NB /SB	I-405	at Inglewood Av	RB/LAW	Widen NB loop on-ramp, widen SB on-ramp and create right-turn only lane in existing Caltrans ROW. Install a new SB right-turn only lane on Inglewood Av to the SB 405 on-ramp and off-ramp	5
8	Ramp	SB	I-405	at Inglewood Av	RB	Widen SB on-ramp from SB Inglewood Av including a designated right-turn lane within existing ROW	74
24	Auxiliary lane	NB	I-405	Hawthorne Bl to Inglewood Av	LAW	Add NB auxiliary lane	1
18	Ramp	NB	I-405	at Hawthorne Bl	LAW	New SB Hawthorne Bl to NB I-405 ramp & upgrade sig. at NB and SB ramps	30
14	Auxiliary lane	NB	I-405	Artesia Bl to Hawthorne Bl	LAW	Add NB auxiliary lane	98
25	Ramp	NB	I-405	at Artesia Bl	TOR	Add third lane to NB on-ramp from WB Artesia Bl	0
2	Arterial/Ramp	NB /SB	I-405	at 182nd St / Crenshaw Bl	TOR	I-405 at 182nd St/Crenshaw Bl improvements	141
6	Auxiliary lane	NB	I-405	Normandie Av to Western Av	LA	Add NB auxiliary lane to the Western Av off-ramp	148

Caltrans Priority*	Type	Dir	Facility	Location Limits	City/ County	Description	Delay Reduc.†
11	Auxiliary lane	SB	I-405	Rosecrans Av to Inglewood Av	HAW/ RB	Add SB auxiliary lane	58
21	Ramp	SB	I-405	at 190th St	TOR	Widen SB on-ramp at 190th St	9

* Caltrans-assigned priorities for SBCCOG region projects range from 1 to 25.

† The STE calculated delay reduction as follows: Estimated future 2035 A.M. and P.M. weekday peak hour (2 hours) delay reduction in veh-hrs. As an example, 200 veh-hrs reduction translates to about 200,000 annual veh-hrs savings.

2.7.3 Arterials

Because this segment of I-405 runs diagonally to the primary street grid, there are multiple arterials in close proximity to the freeway that both run parallel to and intersect it.

The primary north-south running arterials of this corridor (from west to east) are:

- Aviation Blvd (40,000 average daily trips within the corridor),
- La Cienega Blvd (60,000 average daily trips), and
- Hawthorne Blvd (60,000 average daily trips).

The primary east-west running arterial of this corridor is 190th St (50,000 average daily trips).

Very little performance data is available for these arterials due to a lack of arterial data collection and performance measurement systems. However, in 2008 the City of Torrance commissioned a citywide traffic analysis, which calculated intersection level of service (LOS) for key intersections along 190th Street (http://www.torranceca.gov/pdf/traffic/4211_Trf_06-03-2008.pdf):

Intersection	Weekday A.M. Peak Hour		Weekday P.M. Peak Hour	
	Delay LOS (HCM)	V/C LOS (ICU)	Delay LOS (HCM)	V/C LOS (ICU)
190th St/Crenshaw Blvd	39.7 - D	0.98 - E	49.4 - D	1.07 - F
190th St/Hawthorne Blvd	34.4 - C	0.88 - D	36.5 - D	0.91 - E
190th St/I-405 SB Ramps	36.6 - D	0.89 - D	33.5 - C	0.93 - E

2.7.3.1 Arterial ITS

Along the 3.6-mile segment of 190th Street between Vermont Avenue and Hawthorne Boulevard, there are 15 signalized intersections, including 6 major cross streets with direct connections to I-405 on-ramps (see Table 13 below). There are 3 primary controller systems—ATCS, Centracs and LADOT (Harbor Gateway 2)—with operation divided between the City of Los Angeles, Torrance, and Caltrans. Arterial system detection (capable of determining speed and throughput) is currently unavailable any corridor intersection (see Programmed and Planned Arterial Improvements for 190th Street discussion below).

Table 13. 190th St Arterial ITS

Cross Street	Operating Jurisdiction	System	Controller	Firmware	Detection Type	Arterial Detection?
Hawthorne Bl.	Caltrans	ATCS				No
Prairie Av.	Torrance	Centracs	ASC/2S-2100	ASC/2S-2100	video	No
Exxon/Mobil Entrance	Torrance	Centracs	ASC/2S-2100	ASC/2S-2100	Loops	No
Crenshaw Bl.	Torrance	Centracs	ASC/2S-2100	ASC/2S-2100	Loops	No
Honeywell Entrance	Torrance	Centracs	ASC/3	ASC/3	Loops	No
Van Ness Av.	Torrance	Centracs	ASC/2S-2100	ASC/2S-2100	Loops	No
Gramercy Pl.	Torrance	Centracs	ASC/2S-2100	ASC/2S-2100	Loops	No
405 Fwy SB Western Av. Ramps	Caltrans					No

Cross Street	Operating Jurisdiction	System	Controller	Firmware	Detection Type	Arterial Detection?
Western Av.	Los Angeles	Harbor Gateway 2	2070	TSCP	Fully-Actuated	No
Harbor Gate Wy.	Los Angeles	Harbor Gateway 2	2070	TSCP	Semi-Actuated	No
Industrial Dwy/405 Fwy.	Caltrans	Harbor Gateway 2	2070	TSCP	Semi-Actuated	No
Normandie Av.	Los Angeles	Harbor Gateway 2	2070	TSCP	Semi-Actuated	No
Pacific Gateway Dr.	Los Angeles	Harbor Gateway 2	2070	TSCP	Semi-Actuated	No
405 Fwy SB Western Av. Off	Caltrans	Harbor Gateway 2	2070	TSCP	Semi-Actuated	No
Vermont Av.	Los Angeles	Harbor Gateway 2	2070	TSCP	Fully-Actuated	No

* Note: **Bolded** cross streets indicate direct freeway connection.

Table 14. La Cienega Blvd Arterial ITS

Cross Street	Operating Jurisdiction	System	Controller	Firmware	Detection Type	Arterial Detection?
Imperial Hwy.	Los Angeles	LADOT	170	TSCP	Semi-Actuated	No
I-405 Fwy.	Caltrans	LADOT	2070	TSCP	Semi-Actuated	No
Pacific Concourse Dr.	County	KITS	170E	LACO-4E	loops	No
120th St.	County	KITS	170E	LACO-4E	video/reg. loops	No
I-405 Fwy/124th Pl.	Caltrans					No
El Segundo Bl.	County	KITS	170E	LACO-4E	loops	No

* Note: **Bolded** cross streets indicate direct freeway connection.

2.7.3.2 Programmed and Planned Arterial Improvements for 190th Street

The adopted SBCCOG South Bay Measure R Highway Program Strategic Transportation Element (STE) has identified several intersections along 190th Street at which to install new system detection technology. The Los Angeles County ITS Plan has also identified 190th Street candidate intersections for system detection deployment (see Figure 35 below). Note, however, that County of Los Angeles has determined that it will not be installing detection within the boundaries of City of Los Angeles. In addition, there are currently no funded projects to install system detection.

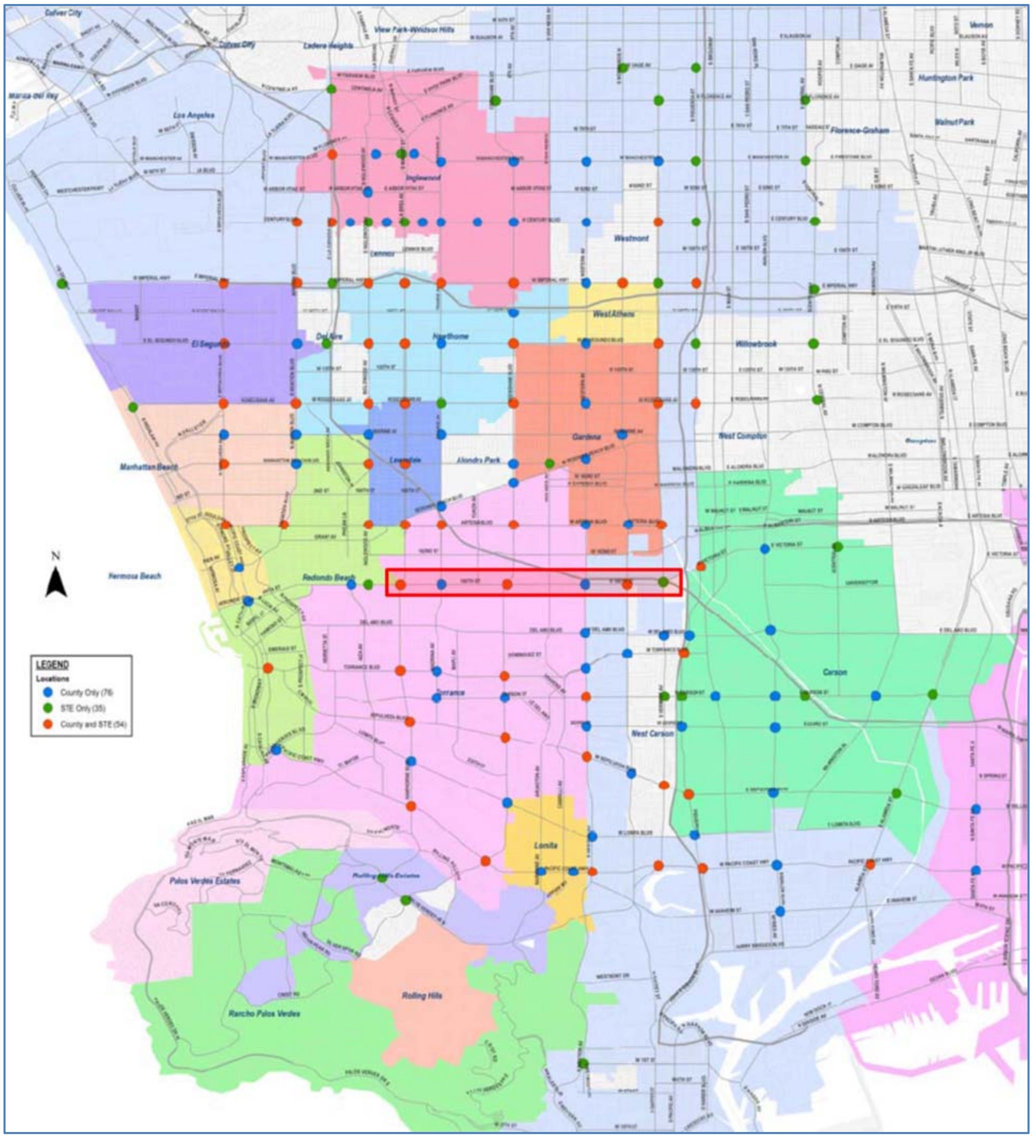


Figure 35. SBCCOG STE and LA County ITS Master Plan Arterial Detection Sites for 190th St

In total, 5 intersections along 190th Street have been identified as top candidates for arterial system detection by SBCCOG and Los Angeles County:

190th Street Intersection	Identified in SBCCOG STE	Identified in LA County ITS Plan
Vermont Ave	X	
Normandie Ave	X	
Crenshaw Blvd	X	X
Prairie Ave		X
Hawthorne Blvd	X	

2.7.4 Transit

The primary high-frequency (every 15 minutes or less) transit line that operates with stops within the I-405 corridor is the Metro Green Line Light Rail Transit (LRT), which provides corridor service between Aviation/LAX and Redondo Beach Station via grade-separated track west of I-405. Note, however, that because the Green Line currently extends south only as far as Marine Ave, it only covers the northern half of this corridor. There is no high-frequency transit that covers the southern half of the corridor.

Under Measure R, Metro has developed a plan to expand the Green Line south into Torrance, continuing to follow the I-405 corridor. The project is currently in the planning stages however and construction is not scheduled to be completed until 2028.

Free Metro-operated parking facilities for the Metro Green Line that serve the SBCCOG region are located at the following stations (also see map above):

- Redondo Beach Station (120 spaces)
- El Segundo Station (91 spaces)
- Aviation/LAX Station (390 spaces)
- Hawthorne/Lennox Station (623 spaces)

Ridership

Average weekday ridership for the Metro Green Line for the most recent month end (April 2013) was 42,416 boardings, making the Green Line the third most traveled light rail line in the county after the Blue Line (87,392) and Gold Line (43,439).

Annual ridership has been steadily increasing over the past five years, as shown in the figure below.

Day Type	Estimated Ridership	Average Passenger Miles	Day Count	Total Estimated Ridership	Total Passenger Miles
DX	45,395	300,058	212	9,623,656	63,612,366
SA	26,743	161,795	43	1,149,949	6,957,191
SU	18,596	113,066	49	911,220	5,540,216

Note: Data based on incomplete period.

Period	Estimated Weekday Ridership	Estimated Saturday Ridership	Estimated Sunday Ridership
2009	37,805	21,758	17,701
2010	38,443	20,778	17,520
2011	40,047	22,890	17,534
2012	43,402	23,022	17,608
2013	45,395	26,743	18,596

Figure 36. Metro Green Line Average Daily Ridership

Service Frequency

The Green Line currently operates on the following headway schedule:

Weekday Service Frequency

Time of Day / Direction	Early morning (4-6am)	A.M. Peak (6-9am)	Off-Peak (9am-3pm)	P.M. Peak (3-7pm)	Night (7-9pm)	Late Night (9pm-2am)
Eastbound	7-11 min	7 min	15 min	7-10 min	17-20 min	20 min
Westbound	10-15 min	7 min	15 min	7-10 min	15-20 min	20 min

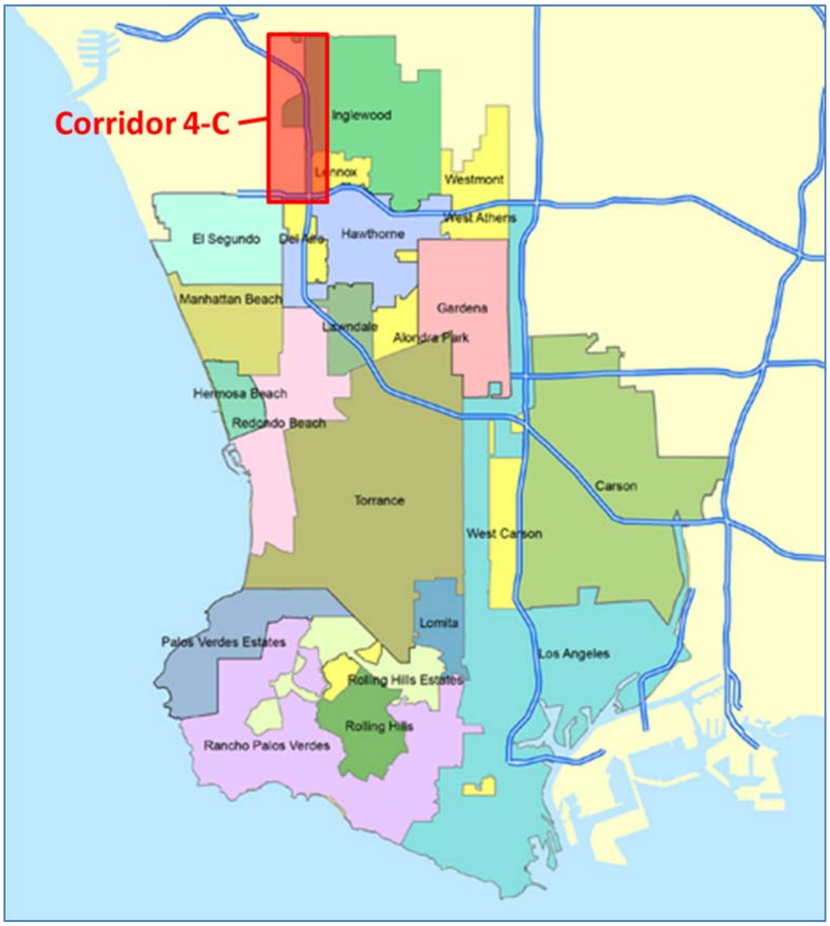
Saturday, Sunday, and Holiday Service Frequency

Time of Day / Direction	Early morning (4-6am)	Day (6am-7pm)	Night (7pm-12am)	Late Night (12am-2am)
Eastbound	15 min	15 min	20 min	20 min
Westbound	15 min	15 min	20 min	20 min

2.8 Corridor 4-C: I-405 (from I-105 to La Tijera Blvd)

2.8.1 Overview

The I-405 corridor, from I-105 at the south to La Tijera Blvd at the north, is 3.1 miles in length and extends primarily through portions of City of Los Angeles, Inglewood, and unincorporated Del Aire and Lennox.



2.8.2 Highway

2.8.2.1 Highway ITS

Vehicle detection along the corridor is accomplished via embedded pavement loops, with 7 northbound VDS sensors and 6 southbound VDS sensors, providing northbound detection coverage of 2.3 VDS per mile and southbound detection coverage of 1.9 VDS per mile (see Figure 37 below). In addition, 7 CCTV cameras are deployed along the corridor, positioned near each of the major intersecting arterials.

One Caltrans CMS is located along the southbound of the corridor, positioned north of the Century Blvd ramp.

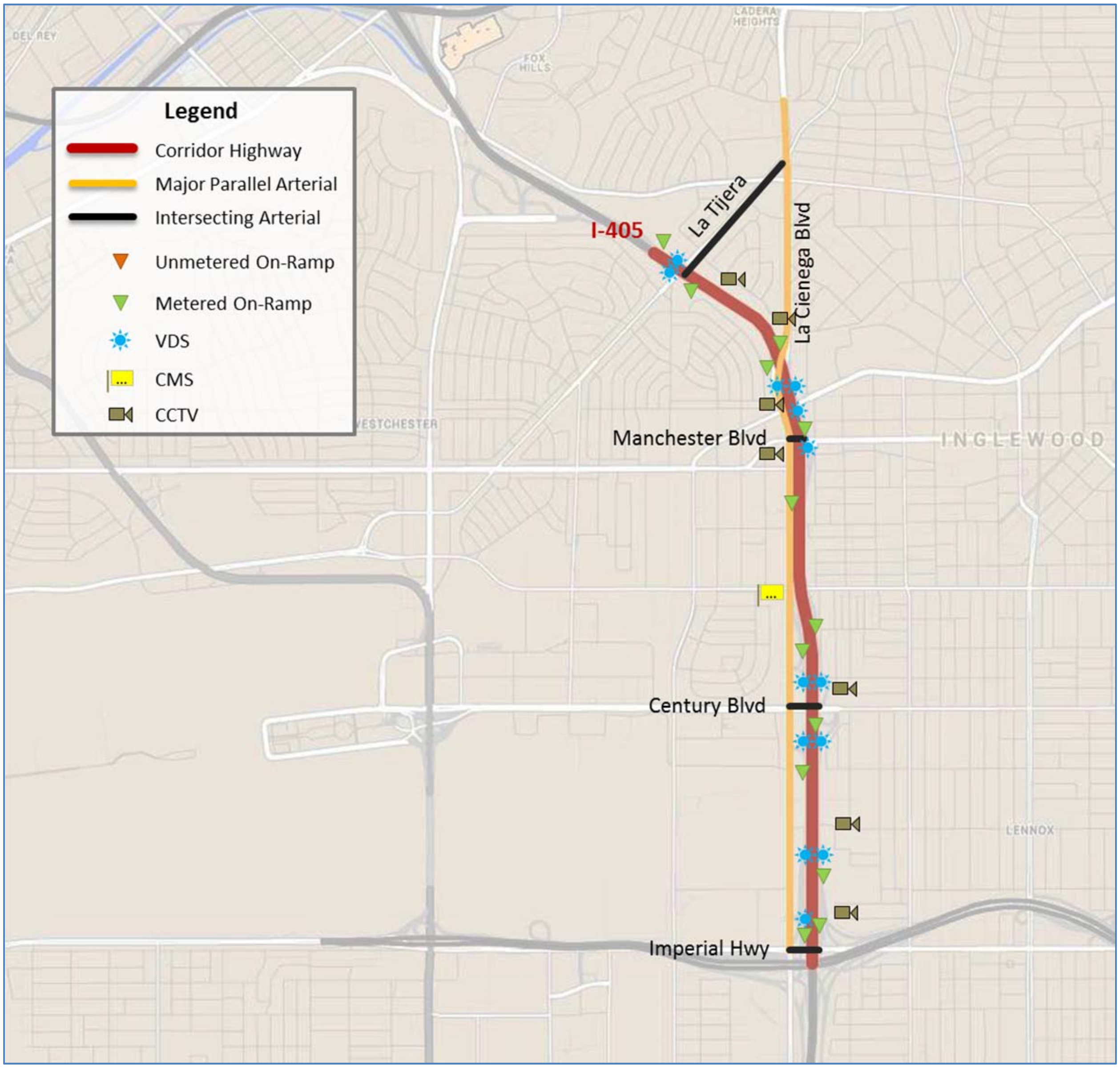


Figure 37. Corridor 4-C (I-405) Overview

2.8.2.2 On-Ramps and On-Ramp Intersections

As depicted in Figure 37 above, all 7 northbound on-ramps and all 6 southbound on-ramps along the 3.1-mile I-405 corridor are metered, providing an average density of 2.3 metered ramps per mile in the northbound direction and 1.9 ramps per mile in the southbound direction.

The northbound on-ramps (from south to north) are:

- Imperial Hwy (eastbound)
- Imperial Hwy (westbound)
- Century Blvd (eastbound)
- Century Blvd (westbound)
- Manchester Blvd (eastbound)
- Manchester Blvd (westbound)
- La Tijera Blvd

The southbound on-ramps (from south to north) are:

- Imperial Hwy (westbound)
- 102nd St/Century Blvd (eastbound)
- 98th St/Century Blvd (westbound)
- Olive St/Manchester Blvd
- La Cienega Blvd
- La Tijera Blvd

Table 15 on the following page provides additional detail about the configurations and storage capacities of the ramps and adjoining intersections.

Table 15. I-405 (C) On-Ramp/Arterial Intersection Configurations and Storage Capacities

I-405 On-Ramp	Fwy Dir	Ramp			Arterial							
		Metered/ Lanes	Unmetered HOV	Ramp Storage (ft)	Turn Pocket Storage		NB/EB Lane Geom.			SB/WB Lane Geom.		
					LT (ft)	RT (ft)	Left	Thru	Right	Left	Thru	Right
Imperial Hwy (eastbound)	NB	1/2	1	1400	N/A	250	0	3	1	N/A	N/A	N/A
Imperial Hwy (westbound)	NB	1/2	1	900	N/A	300	N/A	N/A	N/A	0	3	1
La Cienega (north of Imperial Hwy)	SB	1/2	1	1350	200	150	1	2	1	1	3	0
La Cienega (south of Century Blvd)	SB	2/2	0	450	950	0	0	2	0	2	2	0
Century Blvd (eastbound)	NB	1/2	1	825	N/A	300	1	3	1	N/A	N/A	N/A
Century Blvd (westbound)	NB	2/2	0	700	N/A	0*	N/A	N/A	N/A	0	3	0*
La Cienega (north of Century Blvd)	SB	1/1	0	275	225	175	0	2	1	1	2	0
Olive St (south of Manchester Blvd)	SB	2/2	0	1350	650	0	1	2	0	2	2	0
Manchester Blvd (eastbound)	NB	1/2	1	1200	N/A	175	0	2	1	N/A	N/A	N/A
Manchester Blvd (westbound)	NB	2/2	0	600	N/A	200*	N/A	N/A	N/A	0	2	1*
La Cienega Blvd (SB) (south of Hill St)	SB	1/1	0	700	400*	N/A	N/A	N/A	N/A	1*	2	0
La Tijera Blvd	SB	1/2	1	650	175	0	0	4	0	1	3	0
La Tijera Blvd	NB	1/2	1	2150	300	0	1	3	0	0	4	0

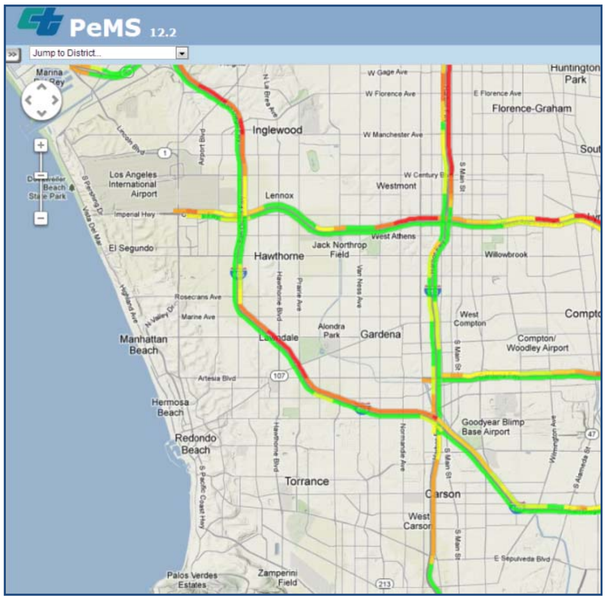
*There is no arterial signalization at these on-ramp locations.

2.8.2.3 Congestion Levels

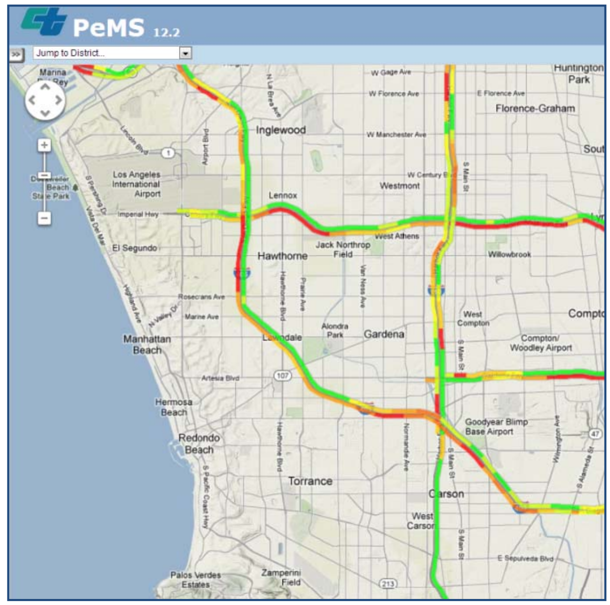
I-405, from I-105 at the south to La Tijera Blvd at the north, experiences very high levels of congestion in the northbound direction during the A.M. peak and moderate-to-high levels of congestion in the southbound direction during the P.M. peak (see figures below).

Based on these very high northbound congestion levels, a DCCM system may not be able to provide significant mobility improvements for the A.M. peak period.

A.M. Peak



P.M. Peak



Lane-by-Lane Speed Profiles

The figures below (Figure 38 and Figure 39) show the lane-by-lane speeds for the I-405 northbound during the typical weekday A.M. peak and for the I-405 southbound during the typical weekday P.M. peak.

As indicated, northbound A.M. peak hour speeds are very low between postmile 46 and 49, with moderate inter-lane speed variations in particular between postmile 46 and 47. The significant congestion in this direction stems from heavy commuter traffic demand headed north to employment centers along the I-10 and SR-90 corridors.

Southbound P.M. peak hour speeds are generally moderate, with significant slowdowns from postmile 47 to 45 as traffic approaches the I-105 interchange.

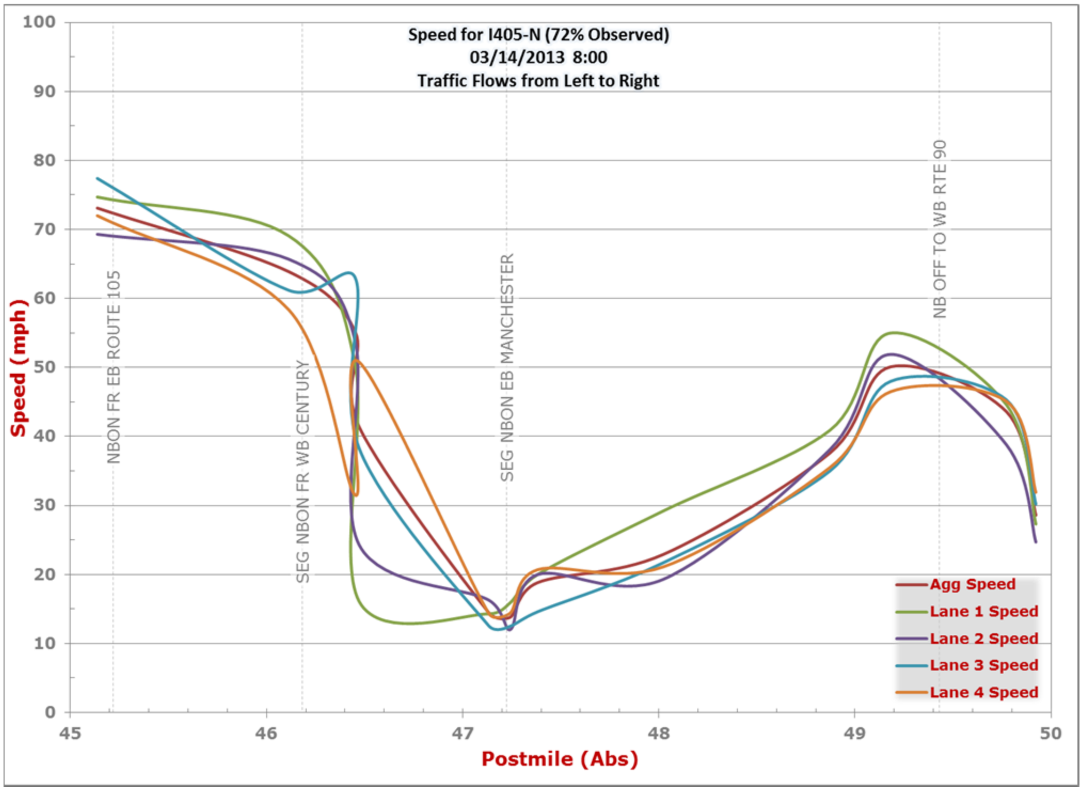


Figure 38. Lane-by-Lane Speed Profile for I-405 (North) NB (A.M. Peak)

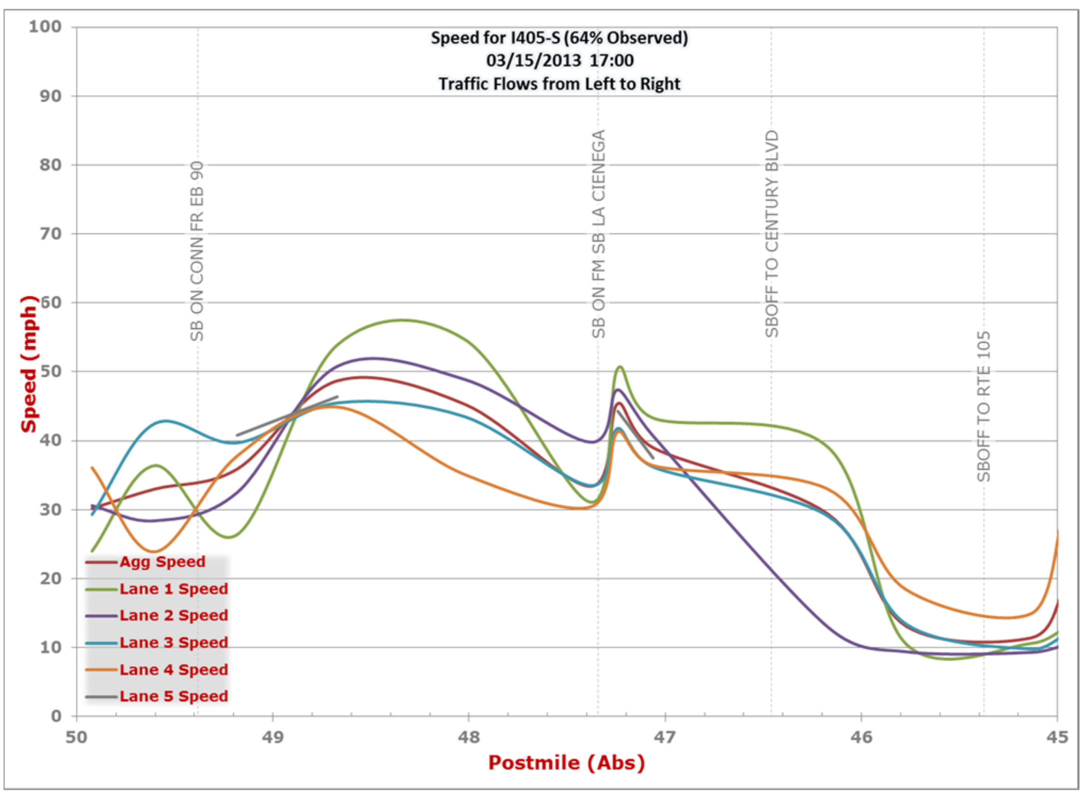


Figure 39. Lane-by-Lane Speed Profile for I-405 (North) SB (P.M. Peak)

Travel Times and Travel Time Delay

The figures below (Figure 40 and Figure 41) illustrate the actual travel times at peak times, as measured during representative sample weeks in January 2013.

I-405 Northbound (5.3 mi) – A.M. Peak

As indicated, the typical A.M. peak hour travel time for the northbound 5.3-mile segment is approximately 13 minutes, with travel time delay of 8 minutes over free flow travel time.

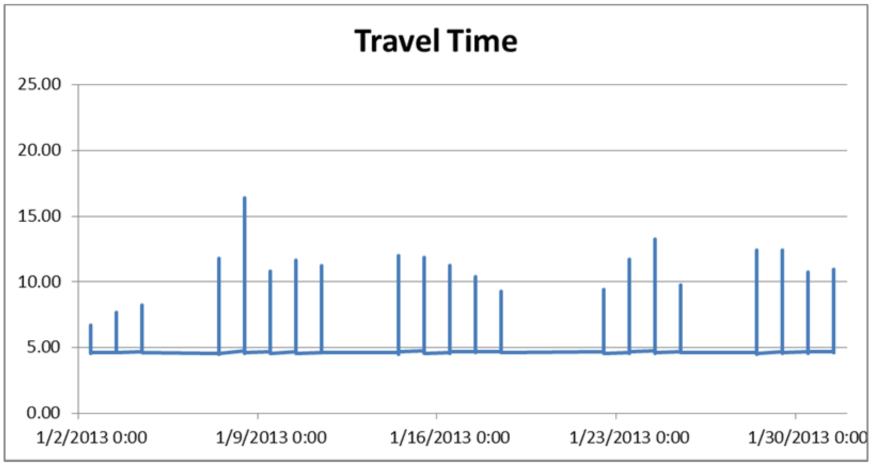


Figure 40. Travel Times and Travel Time Delay for I-405 (North) Northbound (A.M. Peak)

I-405 Southbound (5.3 mi) – P.M. Peak

Typical P.M. peak hour travel time in the southbound 5.3-mile segment is approximately 10 minutes, with travel time delay of 5 minutes over free flow travel time.

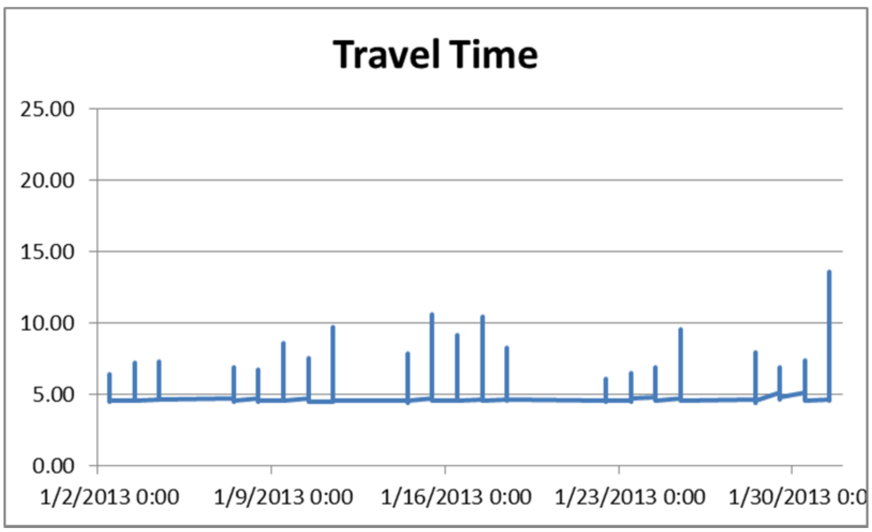


Figure 41. Travel Times and Travel Time Delay for I-405 (North) Southbound (P.M. Peak)

2.8.2.4 Programmed and Planned Improvements

The adopted SBCCOG South Bay Measure R Highway Program Strategic Transportation Element (STE) has identified several planned highway project identified by various previous planning efforts that were determined to have operational nexus to the State Highway System for regional mobility. The STE also performed mobility benefit analysis on each of these projects to estimate the reduction in delay associated with the implementation of the projects.

The 6 planned highway projects in the I-405 corridor are shown in the table below.

Caltrans Priority*	Type	Dir	Facility	Location Limits	City/ County	Description	Delay Reduc.†
4	Auxiliary Lane	NB	I-405	South of El Segundo Bl to I-105	HAW	Add NB lane	250
10	Auxiliary Lane	SB	I-405	Howard Hughes Pkwy to Century Bl	ING	Add SB auxiliary lane	316
28	Ramp	SB	I-405	at La Cienega Bl	ING	Widen SB I-405 on-ramp from SB La Cienega Bl	14
16	Auxiliary Lane	SB	I-405	Manchester Bl. to Century Bl	ING/LA	Add SB auxiliary lane	79
19	Ramp	NB	I-405	at Manchester Bl	ING	Improve turn radii at NB I-405 off-ramp at Manchester Bl, and close Ash Av and include bus improvement	28
20	Interchange	SB	I-405	at I-405	HAW	Add HOV connector from westbound I-105 to southbound I-405	23
		NB	I-405	at I-405	HAW	Add HOV connector from westbound I-105 to northbound I-405	
		NB / SB	I-105	I-105 / I-405 HOV Connectors	HAW	Add HOV connectors from WB I-105 to NB and SB I-405	

* Caltrans-assigned priorities for SBCCOG region projects range from 1 to 25.

† The STE calculated delay reduction as follows: Estimated future 2035 A.M. and P.M. weekday peak hour (2 hours) delay reduction in veh-hrs. As an example, 200 veh-hrs reduction translates to about 200,000 annual veh-hrs savings.

2.8.3 Arterials

La Cienega Boulevard is the primary parallel arterial in the I-405 corridor, running 3.3 miles from Imperial Highway in the south to La Tijera Blvd in the north (see Table 16 below). La Cienega Boulevard is a significant regional arterial, accommodating 60,000 average daily trips north of Industrial Ave and 20,000 trips south of Industrial Ave.

South of Florence Avenue, La Cienega Boulevard parallels I-405 to the west (see Figure 37 above) at a distance of no more than 350 feet from the highway. North of Florence Avenue, however, I-405 changes to a northwesterly direction while La Cienega Boulevard continues to run north-south. At its most northern point (at La Cienega and La Tijera), La Cienega Boulevard is 0.6 miles east of the highway.

Very little up-to-date performance data is available for these arterials due to a lack of arterial data collection and performance measurement systems. However, the SBCCOG STE noted that the intersection of La Cienega Blvd and Centinela Ave received an LOS of E for the A.M. peak and an E for the P.M. peak in 2009. In 2001, the intersection of La Cienega Blvd and Manchester Blvd received an LOS of E for the A.M. peak and a D for the P.M. peak.

2.8.3.1 Arterial ITS

There are 15 signalized intersections, including 6 major cross streets with direct connections to I-405 on-ramps, and 3 primary controller systems—LADOT (Westchester and Airport), QuicNet Pro, and ATCS—with operation divided between the City of Los Angeles, Inglewood, County of Los Angeles, and Caltrans. Arterial system detection (capable of determining speed and throughput) is currently unavailable at all corridor intersections (see Programmed and Planned Arterial Improvements discussion below).

Table 16. La Cienega Blvd Arterial ITS

Cross Street	Operating Jurisdiction	System	Controller	Firmware	Detection Type	Arterial Detection?
La Tijera Bl.	Los Angeles	Westchester ATCS	2070	TSCP	Semi-Actuated	No
Centinela Av.	Los Angeles	Airport	170	TSCP	Semi-Actuated	No
Hill St.	Inglewood	QuicNet Pro	170E	Bitran 233		No
Florence Av.	Inglewood	QuicNet Pro	170E	Bitran 233		No
Manchester Bl.	Inglewood	QuicNet Pro	170E	Bitran 233		No
Olive St.	Inglewood	QuicNet Pro	170E	Bitran 233		No
Hillcrest Bl.	Inglewood	QuicNet Pro	170E	Bitran 233		No
Arbor Vitae St.	Inglewood	QuicNet Pro	170E	Bitran 233		No
I-405 Fwy.	Caltrans	Westchester ATCS	170	TSCP	Semi-Actuated	No
Century Bl.	Los Angeles	Airport	2070	TSCP	Fully-Act'd	No
I-405 Fwy.	Caltrans	ATCS	170	TSCP	Semi-Actuated	No
W 104th St	Los Angeles	Airport	170	TSCP	Semi-Actuated	No

Cross Street	Operating Jurisdiction	System	Controller	Firmware	Detection Type	Arterial Detection?
Lennox Bl.	Los Angeles		170	TSCP	Semi-Actuated	No
111th St.	Los Angeles		170	TSCP	Semi-Actuated	No
I-405 Fwy.	Caltrans	ATCS	170	TSCP	Fully-Actuated	No
Imperial Hwy.	Los Angeles		170	TSCP	Semi- Act'd	No

* Note: **Bolded** cross streets indicate direct freeway connection.

2.8.3.2 Programmed and Planned Arterial Improvements for La Cienega Boulevard

The adopted SBCCOG South Bay Measure R Highway Program Strategic Transportation Element (STE) has identified several intersections along La Cienega Boulevard at which to install new system detection technology. The Los Angeles County ITS Plan has also identified La Cienega Boulevard candidate intersections for system detection deployment (see Figure 42 below).

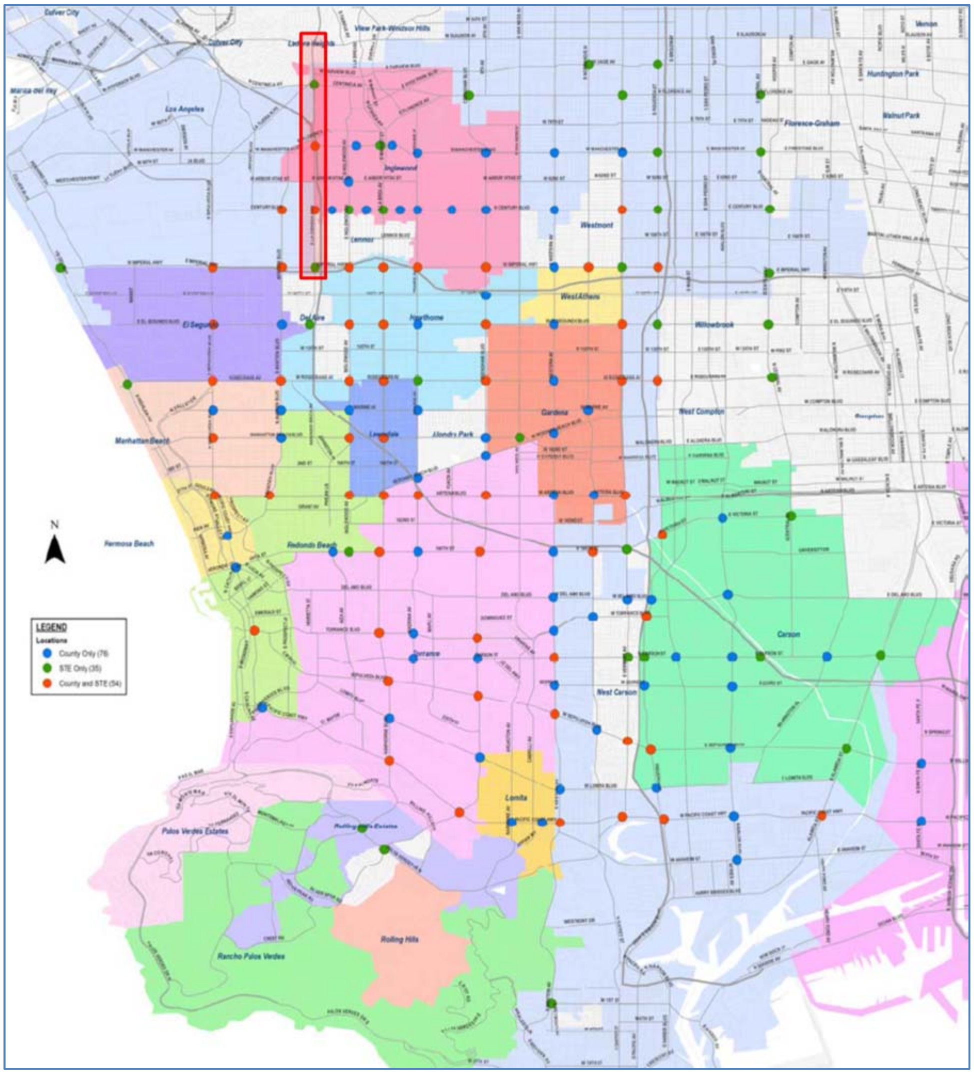


Figure 42. SBCCOG STE and LA County ITS Master Plan Arterial Detection Sites for La Cienega Blvd

In total, 4 intersections along La Cienega Boulevard have been identified as top candidates for arterial system detection by SBCCOG and Los Angeles County. Note, however, that County of Los Angeles has determined that it will not be installing detection within the boundaries of City of Los Angeles. In addition, there are currently no funded projects to install system detection.

La Cienega Blvd Intersection	Identified in SBCCOG STE	Identified in LA County ITS Plan
Imperial Hwy	X	
Century Blvd	X	
Manchester Blvd	X	X
Centinela Ave	X	

2.8.4 Transit

There is no frequent rapid transit, existing or planned, that runs along this corridor.

3. Corridor Evaluation Strategies and Prioritization

3.1 Introduction

Development of the corridor evaluation strategies for this project was guided by the following overarching questions:

- *What are the opportunities for DCCM deployment? Can significant mobility gains be achieved?*
- *What are the challenges for DCCM deployment? What are the significant risks that can or cannot be managed?*
- *Who are the affected agencies and key stakeholders? What is the level of coordination and level of effort required by various affected agencies to make DCCM work in the short and long term?*
- *What is the quickest and easiest approach to implement and deploy DCCM that can make an immediate impact and provide for additional future gains?*

In order to answer these questions and to assess the relative strengths of the corridors and prioritize DCCM implementation among them, corridor evaluation criteria have been developed and are discussed here. The evaluation criteria can be divided into five major categories:

1. **System demand**
2. **Potential of physical infrastructure to support demand coordination**
3. **Potential of ITS infrastructure to support demand coordination**
4. **Institutional coordination challenges**
5. **Potential to support future Integrated Corridor Management (ICM)**

The following subsections provide detailed discussion of the evaluation criteria introduced above, including the reasons for their inclusion and how they contribute to ensuring an effective DCCM system.

3.2 System Demand

This evaluation criteria category is concerned with the level and distribution of demand throughout the corridor and the ability of the infrastructure to support it. Key attributes are:

1. Existing congestion levels
2. Distribution of congestion (both within a facility and between facilities)
3. Anticipated future demand

3.2.1 Congestion Levels

The level of congestion plays a key role in determining how much of an impact a DCCM solution can have on corridor throughput and congestion reduction. At one end, a corridor in complete free flow will see no impact of DCCM, since there is no congestion in need of reduction. At the other end, a corridor that is comprehensively oversaturated will similarly see no benefit from DCCM, since there is no spare capacity available to balance demand.

DCCM promises the greatest benefit to corridors that have moderate to high levels of congestion, which can support re-balancing of demand in order to delay or eliminate flow breakdown situations. Corridors that do not suffer from congestion or are oversaturated are not likely to benefit from DCCM.

3.2.2 Congestion Distribution

In addition to overall levels of congestion, the distribution of congestion within a corridor is an important factor in determining the potential benefit of DCCM. A corridor in which demand is unevenly balanced throughout the network, both throughout the highway and between the highway and parallel arterials, can realize more benefit from the demand-balancing capabilities of DCCM than a corridor in which demand is more evenly distributed.

3.2.3 Anticipated Future Demand

Demand growth within a corridor must be considered when evaluating the viability of a DCCM solution. A corridor with anticipated future demand growth that pushes it into oversaturated levels is not a good candidate for DCCM, as there will not be enough spare capacity available to balance demand.

3.3 Potential of Physical Infrastructure to Support Demand Coordination

The Physical Infrastructure criteria category is concerned with the suitability of the road network for supporting coordinated dynamic congestion response strategies. Key attributes are:

1. Sufficient corridor length
2. Highway-arterial accessibility
3. Designed highway and arterial capacities
4. Availability of on-ramp and turn pocket storage
5. Planned physical infrastructure improvements

3.3.1 Corridor Length

Corridor length is another important consideration when evaluating the potential of a corridor to take advantage of DCCM. A longer corridor will be better able to mitigate congestion throughout its network because it has more roadway, intersections, and ramps with which to balance demand.

A corridor length of 10 miles is considered a good rule-of-thumb minimum distance for effective demand coordination.

3.3.2 Highway-Arterial Accessibility

A corridor road network that provides good accessibility between the highway and major arterials is well suited to implementing an effective DCCM solution since DCCM depends upon efficiently coordinating the flow of demand between different portions of the network. Corridors with low levels of accessibility between highways and major arterials will encounter friction when attempting to shift traffic from one to the other.

High accessibility indicators include:

- minimal distance between highway and parallel arterial(s) and
- high availability of connecting access points (i.e., intersecting arterials).

3.3.3 Designed Capacities

The amount of capacity available on the highways and major arterials within a corridor dictate how well changes in demand and congestion can be accommodated. A system that, for example, is capable of diverting excess demand from one facility to another will be ineffective if there is not capacity available in which to divert.

A DCCM solution will be most promising for a corridor whose highway and major arterial capacities are substantial enough to accommodate shifts in demand in peak- and non-peak hour situations.

3.3.4 Corridor Ramp/Arterial Storage

In order to accommodate and manage fluctuations in demand on portions of the network, the corridor must provide sufficient storage capability on on-ramps and along arterials in order to balance demand among them. Highways without sufficient ramp storage will be unable to reduce meter rates as needed since the limited ramp storage may lead to frequent queue flushings or spillback into the arterial intersection.

3.3.5 Planned Infrastructure Improvements

Any planned infrastructure improvements that increase the available roadway capacity should be considered when evaluating how much of an impact a DCCM solution can have on corridor throughput and congestion reduction.

3.4 Potential of ITS Infrastructure to Support Demand Coordination

The ITS Infrastructure criteria category is concerned with the condition or availability of systems that may be relied upon to implement coordinated dynamic congestion response strategies. Key attributes are:

1. Highway detection capabilities and coverage
2. Arterial detection capabilities and coverage
3. Ramp metering capabilities and coverage
4. Traveler information capabilities and coverage
5. Planned ITS infrastructure improvements

3.4.1 Highway Detection

In order to balance demand among corridor facilities, there must be ITS deployed throughout the corridor that can detect changes in throughput and flow, make determinations about how to respond to congestion, and enact the proper responses and coordination. Robust freeway detection via VDS and

CCTV cameras is necessary for providing traffic information in real-time to support transportation demand management system as well as for performance evaluation and monitoring.

Caltrans-operated VDS coverage is high in the region; however, there is some concern about the reliability of the in-pavement loop detectors, which comprise the majority of VDS stations throughout the corridors. According to the SBCCOG Strategic Transportation Element (STE) (pg. 19), the current health rate of VDS in the region is 65% (i.e., at any one moment, as many as 35% of the VDS stations are not working), well short of the 90% maintenance goal set forth by Caltrans. As the STE notes, it is critical that the VDS network is maintained in order to support the real-time operational needs of a DCCM system.

3.4.2 Arterial Detection

As with highway detection, real-time arterial throughput and flow detection is necessary to support transportation demand management system as well as for performance evaluation and monitoring.

However, there is currently little arterial system detection currently in place, meaning that information today on travel times, speeds, congestion patterns, and level of service (LOS) are generated mostly through infrequent manual counts. The SBCCOG STE and Los Angeles County ITS Plan have targeted South Bay intersections for system detection installation; following through on these plans will be critical to realize the demand coordination goals of DCCM.

3.4.3 Ramp Meters

Ramp meters are a critical part of arterial-freeway coordination. Without them, there cannot be coordinated demand management between arterials and freeways. Additionally, having a high saturation of metered on-ramps throughout the corridor means a greater degree of precision and control of demand balancing.

3.4.4 Traveler Information

Traveler information dissemination is another important part of enacting demand management solutions. By communicating with the traveling public and alerting them to incidents or other upstream conditions and providing them information on alternate routes or travel recommendations, the public can be actively engaged in supporting the demand balancing goals of DCCM.

Changeable Message Signs are the main dissemination tool to provide real-time traveler information to the driving public.

3.4.5 Planned ITS Infrastructure Improvements

Any planned ITS infrastructure improvements should be considered when evaluating how much of an impact a DCCM solution can have on detecting and acting upon changes in corridor throughput and congestion.

3.5 Institutional Coordination Challenges

This evaluation criteria category is concerned with inter-agency or other institutional issues that may impact the ability to implement DCCM strategies for a specific corridor. Key coordination challenges are:

1. Level of agency coordination required
2. Other institutional or physical barriers

3.5.1 Agency Coordination Required

Owing to the high number of cities and jurisdictions within the SBCCOG corridors, inter-agency coordination will be required no matter which corridor gets selected for DCCM implementation. However, because each city and jurisdiction has its own traffic circulation priorities (for example, on signal phasing, ramp meter rates, and potential diversion route scenarios), the fewer cities that must be coordinated with the more comprehensive and effective can the DCCM solution be.

3.5.2 Other Institutional Barriers

Finally, any other institutional challenges specific to a particular jurisdiction or agency that might impact the ability to implement fully a DCCM solution must also be noted.

3.6 Potential to Support Future Integrated Corridor Management (ICM)

The ICM Readiness evaluation criteria category is concerned with the prevalence of infrastructure and systems that can be readily adopted by an ICM system to manage and balance multi-modal corridor-wide throughput. Key ICM features that are prominent in successful national and international ICM deployments that will be assessed for the South Bay region are:

1. Lane management
2. Parallel rapid transit
3. Planned improvements

3.6.1 Lane Management

The utilization of managed lanes, via demand-based tolling, reversible lanes, or other dynamic lane approaches, is an important tool in managing demand in a multi-modal, person-miles-of-travel prioritized context.

3.6.2 Rapid Transit

Transit is a key component of an integrated multimodal corridor. However, in order for travelers to be able to shift to transit along the corridor, it must:

- serve locations within that corridor,
- be frequent,
- be time-competitive, and
- be easy to access from other modes (which often means available parking facilities).

Additionally, in order to facilitate the vehicle-to-transit transfer and ensure sufficient parking capacity, advanced parking systems must be implemented that provide parking status information to the ICM system and to drivers.

3.7 Prioritization Framework

This section presents the procedure developed to rank and prioritize corridor alternatives based upon the evaluation criteria described in the previous sections. The process includes consideration of both quantitative data analysis and qualitative assessment and provides an assessment rating on a 1-to-5 scale, with 1 being poor and 5 being excellent.

Evaluation criteria reflect the expected conditions of the corridors in the year 2014—the target timeframe for the deployment of the DCCM pilot.

Table 17. Corridor Evaluation Framework

Evaluation Criterion	Assessment Rating		
	1 (poor)	3 (fair)	5 (excellent)
System Demand (20%)			
Highway congestion levels	Oversaturated or Low	Moderate	High
Highway congestion variability	Even		Unbalanced
Physical Infrastructure (20%)			
Corridor length	2 mi	6 mi	10+ mi
Highway-arterial accessibility Avg distance between hwy and arterial Number of intersecting arterials	 1 mi 1 per 4 mi	 0.5 mi 1 per 2 mi	 0.25 mi 1 per mile
Highway capacity	8,000 veh/hr	12,000 veh/hr	16,000 veh/hr
Arterial capacity	1,000 veh/hr	2,000 veh/hr	3,000 veh/hr
Ramp/artreial storage Avg ramp storage Avg turn pocket storage	 500 ft 100 ft	 750 ft 250 ft	 1,000 ft 500 ft
ITS Infrastructure (20%)			
Highway detection capability VDS stations per mile CCTV cameras per mile	 1 per mi 1 per 2 mi		 2 per mi 1 per mi
Arterial detection capability % intersections w/ detection	 0%	 50%	 100%
Ramp metering capability Meters per mile (each direction)	 0	 1 per 2 mi	 1 per mi
Traveler info dissemination capability CMS per mile (each direction)	 0	 1 per 4 mi	 1 per 2 mi
Institutional Coordination Challenges (20%)			

Evaluation Criterion	Assessment Rating		
	1 (poor)	3 (fair)	5 (excellent)
Agency coordination required Num. of impacted jurisdictions	5 or more	3	1
Arterial controller integration effort Number of controller systems Number of controller operators	5 or more 5 or more	3 3	1 1
Other identified institutional barriers	*TBD*	*TBD*	*TBD*
ICM Readiness (20%)			
Lane management	N/A	HOV-only	HOT/managed lns
Frequent rapid transit Service area; Vehicle capacities; Arterial and freeway access; Parking availability	No frequent rapid transit within corridor	Some overlap with corridor; medium-capacity vehicles; somewhat accessable; limited parking	Route fully within corridor; high-capacity vehicles; easy to access; available parking

4. Performance Measures and Evaluation Plan

4.1 Evaluation Performance Measures

This section presents the key performance measures that are recommended to be used to assess the performance of the pilot system in terms of its ability to reduce congestion and maximize available system capacity. The DCCM evaluation performance measures are selected based on the SBCCOG South Bay Highway Program – Strategic Transportation Element (STE), Caltrans Transportation Management System (TMS) Master Plan, and the federal MAP-21 guidelines.

The SBCCOG South Bay Highway Program STE describes the required performance measures for its highways and selected major arterials for annual program performance monitoring and periodic evaluations. It is to assess how the program is meeting the various goals and objectives that have been set for mobility improvements in the South Bay and to assess before and after studies to measure the impacts of specific projects. The STE describes the relationship between the program goals and objectives, the system monitoring initiatives and the performance measures to be used to track the region's progress in achieving the mobility goals. For the highways, the performance measures include delay, travel time, vehicle miles traveled, vehicle hours traveled, congestion period, travel time variation, and collisions. For the arterials, the performance measures include travel time, throughput flow, congestion period, travel time variation, level of service, and collisions.

The Caltrans TMS Master Plan describes objectives and performance measures to quantify progress towards specified goals for each TMS process including, detection, traffic control, traveler information, and incident management. The objectives for traffic control (such as DCCM) include improvements to mobility, productivity, and safety. The stated performance measures include flow rates (vehicles per hour per lane), hours of delay experienced (excluding incident delays and including ramp wait times), and collisions.

The Moving Ahead for Progress in the 21st Century Act (MAP-21) is to guide the nation's transportation system's growth and development. This legislation integrates performance into many federal transportation programs and contains several performance elements. The cornerstone of MAP-21's highway program is a performance and outcome-based program. States will invest resources in projects to achieve individual targets that collectively will make progress toward national goals. The national performance goals for the Federal highway programs as established in MAP-21 include safety, infrastructure condition, congestion reduction, system reliability, freight movement and economic vitality, environmental sustainability, and reduced project delivery delays. For the safety goals, the USDOT will establish performance measures to assess serious injuries per vehicle mile travelled, fatalities per vehicle mile travelled, number of serious injuries, and number of fatalities. For congestion reduction goals, the USDOT will establish performance measures to assess traffic congestion.

The DCCM highway measures will provide a gage of the roadway traffic mobility, productivity, reliability, and safety. The DCCM arterial measures will provide a gage of the roadway traffic mobility and productivity. Arterial reliability and safety measures may not be feasible as data collection could be limited for these measures. Reliability measures require a large sample size of data, typically provided by vehicle detector stations at regular intervals along a corridor. Safety measures require incident data collection, which are also limited for arterial corridors.

The following are the key performance measures that are recommended to be used to assess the performance of the DCCM pilot system in terms of its ability to reduce congestion and maximize the use of the available infrastructure capacity:

Highway

- Delay per mile
- Volume (ADT)
- Volume (peak period and peak hour)
- Throughput (vehicles/lane/hour)
- Average speed
- Travel time
- Travel time reliability (travel time variability or buffer index)
- Number of incidents or collisions
- Hours of delay experienced (congestion period)

Arterial

- Intersection LOS
- Volume (ADT)
- Volume (peak period and peak hour)
- Average speed
- Travel time

The delay per mile and congestion period measures will provide a summary of the condition of the traffic congestion. Since the selected corridor length will be specific to this pilot project, this measure can also be used to compare against any other corridor condition. The volume and throughput flow measures will provide a summary of the traffic productivity. To be more productive, the corridor should carry more vehicles and people. The average speed and travel time measures will provide a summary of the traffic mobility in terms of motorist experience. The travel time reliability measure will provide a summary of the reliability of the system. With better controlled environment, improvement to reliability is expected. Number of incidents or collisions measure will provide a summary of the condition of traffic safety. The arterial intersection level of service measure will provide a summary of the qualitative performance level of the arterial control environment.

With the development of the DCCM system, additional performance measures could be introduced for consideration, depending on the level of detection deployment and capabilities. This will be a part of the evaluation plan.

5. Corridor Recommendation

This section presents the final corridor selection ratings and recommendations for implementing a pilot DCCM system in the South Bay.

Although this report recommends only a single corridor for the DCCM pilot, it must be emphasized that all six corridors would benefit from DCCM. The selected pilot corridor is intended to serve as a test case and as a model for the implementation of DCCM concepts on the other regional corridors.

Because ramp meter-arterial signal system coordination is a relatively untested concept, achievability was a key concern in the evaluation of the corridors. For example, a corridor suffering from severe freeway and arterial congestion could argue a greater need for congestion management solutions, but this very oversaturation may overwhelm the ability of DCCM to balance demand effectively. Likewise, a corridor with poor arterial-freeway connectivity or that lacks a robust parallel arterial network will impose friction on a DCCM system as it attempts to redistribute demand between facilities. While these challenges can certainly be overcome, it was considered important for the initial pilot DCCM corridor to be tested with a minimum of barriers, so that success could be demonstrated early and lessons learned could be established and more easily applied to other more complex corridors.

5.1 Corridor Rankings

Based on its scoring on the evaluation criteria established in Section 3 (*Corridor Evaluation Strategies and Prioritization*), I-110 North emerged as the top ranked corridor for initial DCCM readiness and is recommended by this report for DCCM pilot deployment. The rank order of the seven corridors is as follows:

Rank	Corridor	Score (1 poor - 5 excellent)
1	I-110 (from I-405 to Imperial Hwy)	4.1
2	I-105 (from Sepulveda Blvd to Central Ave)	3.6
3	I-405 (from I-710 to I-110)	3.2
4	I-405 (from I-105 to La Tijera Bvd)	3.0
5	SR-91 (from I-110 to Central Ave)	3.0
6	I-405 (from I-110 to I-105)	2.9
7	I-110 (from SR-47 to I-405)	2.4

A high-level summary of how each corridor scored on the evaluation criteria is shown in Table 18.

Note that each corridor currently lacks any arterial system detection capability and no near-term projects are planned to install system detection. This capability is a major requirement of the DCCM system and so funding will have to be identified to install at minimum arterial system detection along the primary parallel arterial of the corridor in order for the pilot DCCM system to be effective.

Table 18. All corridors evaluation summary overview

Evaluation Criterion	Assessment Rating (1 poor - 5 excellent)						
	Corridor 1 SR-91	Corridor 2-A I-110 (south)	Corridor 2-B I-110 (north)	Corridor 3 I-105	Corridor 4-A I-405 (south)	Corridor 4-B I-405 (mid)	Corridor 4-C I-405 (north)
System Demand	**2.0**	**2.0**	**4.5**	**3.5**	**4.5**	**3.0**	**3.5**
Peak Hour congestion levels	2	2	5	2	5	1	3
Congestion variability	2	2	4	5	4	5	4
Physical Infrastructure	**2.9**	**3.9**	**4.3**	**4.5**	**2.5**	**3.0**	**3.3**
Corridor length	1	4	3	5	3	5	3
Highway-arterial accessibility	3	5	5	5	1	1	2
Highway capacity	4	3	5	2	2	3	5
Arterial capacity	3	4	5	5	2	3	3
Ramp/arterial storage	4	3	4	5	4	3	4
ITS Infrastructure	**3.2**	**1.7**	**3.3**	**3.2**	**3.2**	**3.5**	**3.2**
Hwy detection/surveillance capability	4	2	4	5	4	5	4
Arterial detection/surveillance capability	1	1	1	1	1	1	1
Ramp metering capability	5	2	5	4	5	5	5
Traveler info dissemination capability	2	2	3	2	2	2	2
Institutional Coordination	**5.0**	**3.0**	**3.5**	**2.5**	**4.0**	**2.0**	**3.0**
Agency coordination required	5	3	3	2	5	1	3
Arterial controller integration effort	5	3	4	3	3	3	3
ICM Readiness	**2.0**	**1.5**	**5.0**	**4.0**	**2.0**	**3.0**	**2.0**
Lane management	3	1	5	3	3	3	3
Transit capabilities	1	2	5	5	1	3	1
Overall Potential Improvement Opportunity	**3.0**	**2.4**	**4.1**	**3.6**	**3.2**	**2.9**	**3.0**

5.2 Corridor 1 (SR-91) Evaluation

As discussed in Section 3.7 (Prioritization Framework), each of the five evaluation categories—System Demand, Physical Infrastructure, ITS Infrastructure, Institutional Coordination Challenges, and ICM—receive equal 20% weightings toward the corridor's overall score. Table 19 below breaks down the corridor's scores for each category.

Table 19. Corridor 1 (SR-91) Evaluation Summary

Evaluation Criterion	Rating	Discussion
System Demand	**2.0**	
Peak Hour congestion levels	2	Oversaturated A.M. congestion in the EB P.M. limit how much of an impact DCCM can have
Congestion variability	2	Low-to-moderate speed variations mean less opportunity for demand smoothing
Physical Infrastructure	**2.9**	
Corridor length	1	2.1 miles is too short a corridor to deploy DCCM effectively
Highway-arterial accessibility	3	Victoria St runs parallel for length of corridor and is accessible via intersecting arterials, but is nearly 0.5 mi away from SR-91
Highway capacity	4	4+1 lanes in each direction for length of corridor
Arterial capacity	3	Victoria St has 4 through lanes; carries 50,000 ADT
Ramp/arterial storage	4	Each ramp averages 1050 ft of total storage; arterial turn average 450 ft of storage
ITS Infrastructure	**3.2**	
Highway detection/surveillance capability	4	Average of 2.4 VDS stations per mile per direction; 0.7 CCTV per mile along corridor
Arterial detection/surveillance capability	1	No arterial system detection capability
Ramp metering capability	5	Average of 1.4 metered ramps per mile in the EB and 1.0 metered ramps/mi in the WB
Traveler information dissemination capability	2	Average of 0 CMS per mile in the EB and 0.5 CMS/mi in the WB
Institutional Coordination	**5.0**	
Agency coordination required	5	Corridor falls completely within the City of Carson
Arterial controller integration effort	5	1 arterial controller system used in the region (KITS)
ICM Readiness	**2.0**	
Lane management	3	Single-lane HOV throughout the corridor; no direct access ramps or dynamic management
Transit capabilities	1	No frequent rapid transit, existing or planned, runs along this corridor
Overall Rating	**3.0**	**This segment of SR-91 is an ok candidate for the DCCM pilot, but suffers from oversaturated peak hour congestion and a very short corridor length.**

5.3 Corridor 2-A (I-110 South) Evaluation

Table 20. Corridor 2-A (I-110 South) Evaluation Summary

Evaluation Criterion	Rating	Discussion
System Demand	**2.0**	
Peak Hour congestion levels	2	Moderate northbound congestion in A.M. and low congestion in P.M.; little potential impact for DCCM
Congestion variability	2	Low to moderate speed variations, limited potential for DCCM to improve flow via demand smoothing
Physical Infrastructure	**3.9**	
Corridor length	4	7.7 mi is a good corridor length to deploy DCCM
Highway-arterial accessibility	5	Figueroa St runs parallel for length of corridor at a very short distance (<0.2 mi) and is accessible via intersecting arterials; Vermont Ave is also a potential parallel arterial
Highway capacity	3	4 through lanes but no HOV in each direction for length of corridor
Arterial capacity	4	Both Figueroa St and Vermont Ave have 4 through lanes
Ramp/arterial storage	3	Each ramp averages 1275 ft of total storage; arterial turn pockets at ramp intersections average 250 ft of storage
ITS Infrastructure	**1.7**	
Highway detection/surveillance capability	2	Average of 1.2 VDS stations/mi in NB, but no SB detection; no CCTV
Arterial detection/surveillance capability	1	No arterial system detection capability
Ramp metering capability	2	Average of 0.8 metered ramps per mile in the NB; however only 0.1 metered ramps/mi in SB
Traveler information dissemination capability	2	Only 1 CMS in the NB and 0 in the SB
Institutional Coordination	**3.0**	
Agency coordination required	3	Corridor falls within the City of Los Angeles, Carson, and unincorporated Los Angeles County
Arterial controller integration effort	3	*TBD*
ICM Readiness	**1.5**	
Lane management	1	No HOV or managed lanes
Transit capabilities	2	Low frequency express bus service
Overall Rating	**2.4**	**This segment of I-110 is considered a marginal candidate for DCCM. It is a good length and has good arterial accessibility, but suffers from low congestion levels and poor detection, especially in the southbound. The corridor would benefit greatly from investment in ITS infrastructure.**

5.4 Corridor 2-B (I-110 North) Evaluation

Table 21. Corridor 2-B (I-110 North) Evaluation Summary

Evaluation Criterion	Rating	Discussion
System Demand	**4.5**	
Peak Hour congestion levels	5	Moderate bi-directional congestion in A.M. and moderate-to-high congestion in P.M. are good congestion levels for DCCM to work with
Congestion variability	4	Significant speed variations, in particular in the SB P.M., provide opportunity for DCCM to improve flow via demand smoothing
Physical Infrastructure	**4.3**	
Corridor length	3	5.2 mi is a moderate corridor length to deploy DCCM
Highway-arterial accessibility	5	Figueroa St runs parallel for length of corridor at a very short distance (<0.2 mi) and is accessible via intersecting arterials; Vermont Ave is also a potential parallel arterial
Highway capacity	5	4 through lanes plus 2 BRT/HOT lanes in each direction for length of corridor
Arterial capacity	5	Both Figueroa St and Vermont Ave have 4-6 through lanes , carrying 50k ADT each
Ramp/arterial storage	4	Each ramp averages 1400 ft of total storage; arterial turn pockets at ramp intersections average 300 ft of storage
ITS Infrastructure	**3.3**	
Highway detection/surveillance capability	4	Average of 2.0 VDS stations per mile per direction; 0.6 CCTV per mile along corridor
Arterial detection/surveillance capability	1	No arterial system detection capability
Ramp metering capability	5	Average of 1.0 metered ramps per mile in the NB and 0.8 metered ramps/mi in the SB
Traveler information dissemination capability	3	Average of 0.6 CMS per mile in the NB and 0.0 CMS/mi in the SB
Institutional Coordination	**3.5**	
Agency coordination required	3	Corridor falls within the City of Los Angeles, Gardena, Carson, and unincorporated Los Angeles County
Arterial controller integration effort	4	2 arterial controller systems used in the region: LADOT and KITS
ICM Readiness	**5.0**	
Lane management	5	Dual-lane congestion-priced HOT lanes throughout the corridor
Transit capabilities	5	Busway-running BRT for length of corridor
Overall Rating	**4.1**	**This segment of I-110 is considered an excellent candidate for DCCM, offering good congestion distribution and excellent parallel arterial connectivity and capacity.**

5.5 Corridor 3 (I-105) Evaluation

Table 22. Corridor 3 (I-105) Evaluation Summary

Evaluation Criterion	Rating	Discussion
System Demand	**3.5**	
Peak Hour congestion levels	2	Very high P.M. demand levels in the EB limit how much of an impact DCCM can have
Congestion variability	5	Significant speed variations, in particular in the WB A.M., provide opportunity for DCCM to improve flow via demand smoothing
Physical Infrastructure	**4.6**	
Corridor length	5	8.5 mi is a very good corridor length to deploy DCCM
Highway-arterial accessibility	5	Imperial Hwy runs parallel for length of corridor at a very short distance (<0.35 mi) and is accessible via intersecting arterials
Highway capacity	2	Bottlenecks sometimes occur (especially in the WB) due to reduction from 4 to 3 mixed flow lanes; single HOV lane in each direction
Arterial capacity	5	Imperial Hwy has 4-6 through lanes, carrying 30k ADT each; El Segundo Blvd as a secondary
Ramp/arterial storage	5	Each ramp averages 1690 ft of total storage; arterial turn pockets at ramp intersections average 400 ft of storage
ITS Infrastructure	**3.2**	
Highway detection/surveillance capability	5	Average of 1.9 VDS stations per mile per direction; 1.1 CCTV per mile along corridor
Arterial detection/surveillance capability	1	No arterial system detection capability
Ramp metering capability	4	Average of 1.2 metered ramps per mile in the EB and 0.6 metered ramps/mi in the WB
Traveler information dissemination capability	2	Average of 0.2 CMS per mile in the EB and 0.2 CMS/mi in the WB
Institutional Coordination	**2.5**	
Agency coordination required	2	Corridor falls within 5 jurisdictions: City of Los Angeles, unincorporated Los Angeles County, Hawthorne, Inglewood, and El Segundo
Arterial controller integration effort	3	3 arterial controller systems used in the region: LADOT, KITS, QuickNet Pro
ICM Readiness	**4.0**	
Lane management	3	Single-lane HOV throughout the corridor; no direct access ramps or dynamic management
Transit capabilities	5	Grade-separated high frequency LRT (Metro Green Line) for length of corridor
Overall Rating	**3.6**	**This segment of I-110 is considered a good candidate for DCCM, offering excellent parallel arterial connectivity/capacity. But suffers from very high P.M. peak demand.**

5.6 Corridor 4-A (I-405 South) Evaluation

Table 23. Corridor 4-A (I-405 South) Evaluation Summary

Evaluation Criterion	Rating	Discussion
System Demand	**4.5**	
Peak Hour congestion levels	5	Moderate A.M. congestion and high P.M. demand levels in the SB are good congestion levels for DCCM to work with
Congestion variability	4	Significant speed variations, in particular in the NB A.M., provide opportunity for DCCM to improve flow via demand smoothing
Physical Infrastructure	**2.5**	
Corridor length	3	5.4 mi is a moderate corridor length to deploy DCCM
Highway-arterial accessibility	1	Carson St runs parallel to the freeway for the southern half of the corridor; however due to the freeway bend at Wilmington Ave, no single arterial offers good access at the northern half
Highway capacity	2	3+1/4+1/5+1 lanes in each direction for the length of the corridor (reduction to 3+1 lanes around the I-110 interchange presents bottleneck opportunity)
Arterial capacity	2	Carson St has 4 through lanes
Ramp/arterial storage	4	Each ramp averages 900 ft of total storage; arterial turn pockets at ramp intersections average 400 ft of storage
ITS Infrastructure	**3.2**	
Highway detection/surveillance capability	4	Average of 1.6 VDS stations per mile per direction; 1.3 CCTV per mile along corridor
Arterial detection/surveillance capability	1	No arterial system detection capability
Ramp metering capability	5	Average of 0.9 metered ramps per mile in the NB and 1.3 metered ramps/mi in the SB
Traveler information dissemination capability	2	Average of 0.4 CMS per mile in the NB and 0.2 CMS/mi in the SB
Institutional Coordination	**4.0**	
Agency coordination required	5	Corridor falls completely within the City of Carson
Arterial controller integration effort	3	3 controller operators in the region (Long Beach, LA County, and Caltrans)
ICM Readiness	**2.0**	
Lane management	3	Single-lane HOV throughout the corridor; no direct access ramps or dynamic management
Transit capabilities	1	No frequent rapid transit, existing or planned, runs along this corridor
Overall Rating	**3.2**	**This segment of I-405 is a fair candidate for DCCM, offering good congestion levels. But suffers from short corridor length and a lack of good parallel arterials.**

5.7 Corridor 4-B (I-405 Mid) Evaluation

Table 24. Corridor 4-B (I-405 Mid) Evaluation Summary

Evaluation Criterion	Rating	Discussion
System Demand	**3.0**	
Peak Hour congestion levels	1	Oversaturated A.M. congestion in the NB and P.M. congestion in the SB limit DCCM impact
Congestion variability	5	Significant speed variations, in particular in the SB P.M., provide opportunity for DCCM to improve flow via demand smoothing
Physical Infrastructure	**3.0**	
Corridor length	5	8.2 mi is a good corridor length for which to deploy DCCM
Highway-arterial accessibility	1	190th St runs parallel to the freeway for the southern half of the corridor; however due to the diagonal running of the freeway between Crenshaw and Rosecrans, no single arterial offers good access along the entire corridor
Highway capacity	3	4+1 lanes in each direction for most of the corridor; reduction to 3+1 lanes on the SB approaching the I-110 interchange presents bottleneck opportunity)
Arterial capacity	3	190th St has 4-6 through lanes
Ramp/arterial storage	3	Each ramp averages 810 ft of total storage; arterial turn pockets average 260 ft of storage
ITS Infrastructure	**3.5**	
Highway detection/surveillance capability	5	Average of 2.2 VDS stations per mile per direction; 1.1 CCTV per mile along corridor
Arterial detection/surveillance capability	1	No arterial system detection capability
Ramp metering capability	5	Average of 1.6 metered ramps per mile in the NB and 1.5 metered ramps/mi in the SB
Traveler information dissemination capability	2	Average of 0.2 CMS per mile in the NB and 0.1 CMS/mi in the SB
Institutional Coordination	**2.0**	
Agency coordination required	1	Corridor falls within 7 jurisdictions: City of Los Angeles, unincorporated Los Angeles County, Torrance, Lawndale, Redondo Beach, Hawthorne, and El Segundo
Arterial controller integration effort	3	3+ arterial controller systems used in the region: ATCS, Centracs, and LADOT
ICM Readiness	**3.0**	
Lane management	3	Single-lane HOV throughout the corridor; no direct access ramps or dynamic management
Transit capabilities	3	Metro Green Line (elevated, frequent service) runs along the north half of this corridor
Overall Rating	**2.9**	**This segment of I-405 is a fair candidate for DCCM, offering good corridor length. But suffers from oversaturated congestion levels, a lack of good parallel arterials, and requires coordination among many agencies.**

5.8 Corridor 4-C (I-405 North) Evaluation

Table 25. Corridor 4-C (I-405 North) Evaluation Summary

Evaluation Criterion	Rating	Discussion
System Demand	**3.5**	
Peak Hour congestion levels	3	Very high A.M. congestion in the NB and high P.M. congestion in the SB are fair congestion levels for DCCM to work with
Congestion variability	4	Significant speed variations, in particular in the SB P.M., provide opportunity for DCCM to improve flow via demand smoothing
Physical Infrastructure	**3.0**	
Corridor length	2	3.1 mi is a short corridor length for which to deploy DCCM
Highway-arterial accessibility	3	La Cienega Blvd parallels the freeway for the majority of the corridor; however due to the freeway bend at Manchester, the corridor loses good arterial access north of this point
Highway capacity	5	4+1 lanes in each direction for length of corridor
Arterial capacity	3	La Cienega Blvd has 4-6 through lanes; 60k ADT north of Industrial Ave, 20k ADT south
Ramp/arterial storage	3	Each ramp averages 950 ft of total storage; arterial turn pockets average 350 ft of storage
ITS Infrastructure	**3.4**	
Highway detection/surveillance capability	5	Average of 2.1 VDS stations per mile per direction; 1.1 CCTV per mile along corridor
Arterial detection/surveillance capability	1	No arterial system detection capability
Ramp metering capability	5	Average of 2.3 metered ramps per mile in the NB and 1.9 metered ramps/mi in the SB
Traveler information dissemination capability	2	Average of 0.3 CMS per mile in the NB and 0.0 CMS per mile in the SB
Institutional Coordination	**3.0**	
Agency coordination required	3	Corridor falls within 3 jurisdictions: Los Angeles, unincorporated L.A. County, & Inglewood
Arterial controller integration effort	3	3 arterial controller systems used in the region: LADOT, QuickNet Pro, and ATCS
ICM Readiness	**2.0**	
Lane management	3	Single-lane HOV throughout the corridor; no direct access ramps or dynamic management
Transit capabilities	1	No frequent rapid transit runs along this corridor. Future Crenshaw/LAX Line will overlap the southern half of the corridor
Overall Rating	**3.0**	**This segment of I-405 is a fair candidate for DCCM. ITS infrastructure is good, but very high system demand, short corridor length, and lack of arterial accessibility for the length of the corridor are limiting factors.**