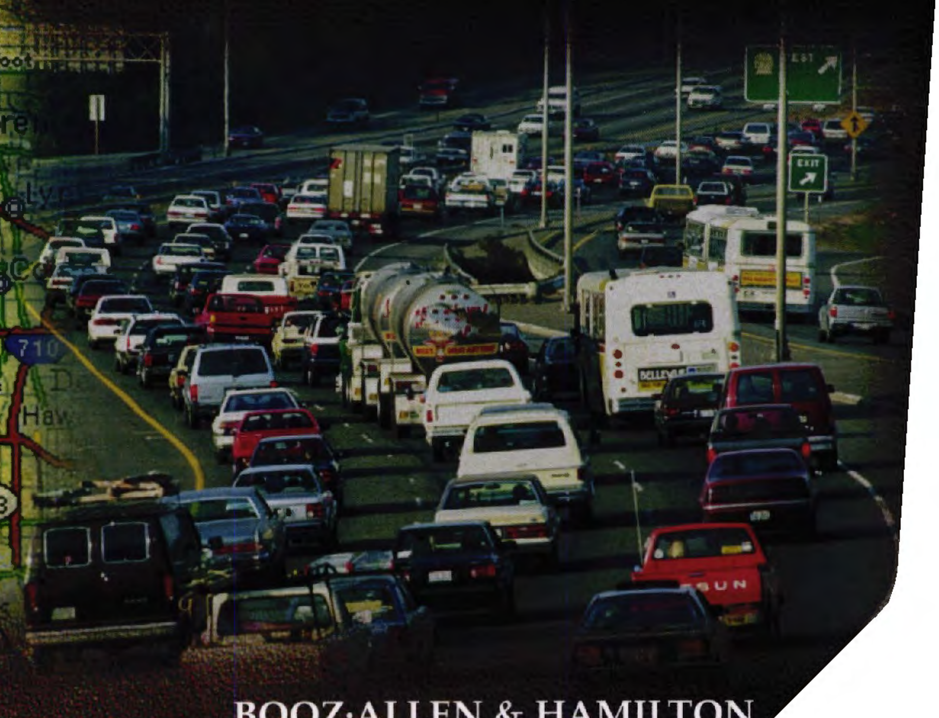
# Santa Monica Freeway Smart Corridor System Final Evaluation Report

LACMTA Contract No. PS-4340-0565

PVEA Project No. DE-FG51-96R020762

*April 30, 2001*

BOOZ·ALLEN & HAMILTON

In Association with

The Robert Group

Minagar & Associates

# SANTA MONICA FREEWAY SMART CORRIDOR SYSTEM

# FINAL EVALUATION REPORT

APRIL 30, 2001

LACMTA CONTRACT
NO. PS-4340-0565
PVEA PROJECT NO.-DE-FG51-96RO 20762

PREPARED FOR
LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY
ONE GATEWAY PLAZA
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## ACKNOWLEDGEMENTS

Booz·Allen & Hamilton acknowledges participation of the members of the Smart Corridor Steering Committee, without whose inputs this report would not have been possible.

In addition, Booz·Allen thanks all individuals who have participated in interviews, and/or focus groups. Their contributions have provided valuable insights to this innovative project.

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## EXHIBITS

# LIST OF ABBREVIATIONS

| | |
|---|---|
| **ACAD** | Automated Computer Aided Design |
| **ADT** | Average Daily Traffic |
| **AID** | Arterial Incident Detection System |
| **ATMS** | Advanced Transportation Management System |
| **ATIS** | Advanced Traveler Information System |
| **ATSAC** | Automated Traffic Surveillance and Control |
| **CALTRANS** | State of California Department of Transportation |
| **CCTV** | Closed-Circuit Television |
| **CHP** | California Highway Patrol |
| **CMS** | Changeable Message Sign |
| **CO** | Carbon Monoxide |
| **HAR** | Highway Advisory Radio |
| **IM** | Incident Manager |
| **IMAJINE** | Inter-Modal And Jurisdictional Integrated Network Environment (a Southern California ITS Priority Corridor Showcase Program 'Early Start' project) |
| **IN** | Intersection Code No. (LADOT) |
| **ITS** | Intelligent Transportation System |
| **Kg** | Kilogram |
| **LACMTA** | Los Angeles County Metropolitan Transportation Authority |
| **LADOT** | City of Los Angeles Department of Transportation |
| **MOEs:** | Measures of Effectiveness |
| **MP file** | Relates Detector Number to Intersection Number & Direction |
| **MPG** | Miles per Gallon |
| **MPH** | Miles per Hour |
| **MTA** | Metropolitan Transportation Authority (also referred as LACMTA) |
| **NA** | Not Available / Not Applicable |
| $NO_X$ | Nitrogen Oxides Emissions |
| **SATMS** | Semi Automated Traffic Management System |
| **TMT** | Traffic Management Team |
| **TOD** | Time-of-Day Plan (LADOT) |
| **TP** | Timing Plan |
| **VOC** | Volatile Oxygen Compounds Emission |

Executive Summary

# EXECUTIVE SUMMARY

## BACKGROUND

This evaluation report provides a description of the findings of an evaluation of the Santa Monica Freeway Smart Corridor system. A previous evaluation summarized the lessons learned during the development, deployment, and operation of Smart Corridor. This evaluation investigates the operational impact of Smart Corridor in more detail, and updates the evaluation of its institutional and system related impacts.

The key project stakeholders are the California Department of Transportation (Caltrans), California Highway Patrol (CHP), Los Angeles County Metropolitan Transportation Authority (LACMTA), and the Los Angeles Department of Transportation (LADOT).

The origins of Smart Corridor can be traced back to the mid-1960s and 1970s, when Caltrans began to develop freeway surveillance and control systems in the Los Angeles region. During the 1980s, LADOT began to develop automated traffic control systems for arterial streets. In 1987, in response to concerns about increasing traffic congestion and energy consumption, and compliance with air quality standards, Assembly Bill #457 specified the elements of a Smart Corridor Telecommunications Demonstration Project. The demonstration was to be conducted on a portion of the Santa Monica Freeway, taking advantage of the computerized traffic control equipment already in place. The project was to be coordinated by the Los Angeles County Transportation Commission (later to become LACMTA), which in turn was required to consult with local and state traffic and law enforcement agencies to coordinate the project with existing plans and programs.

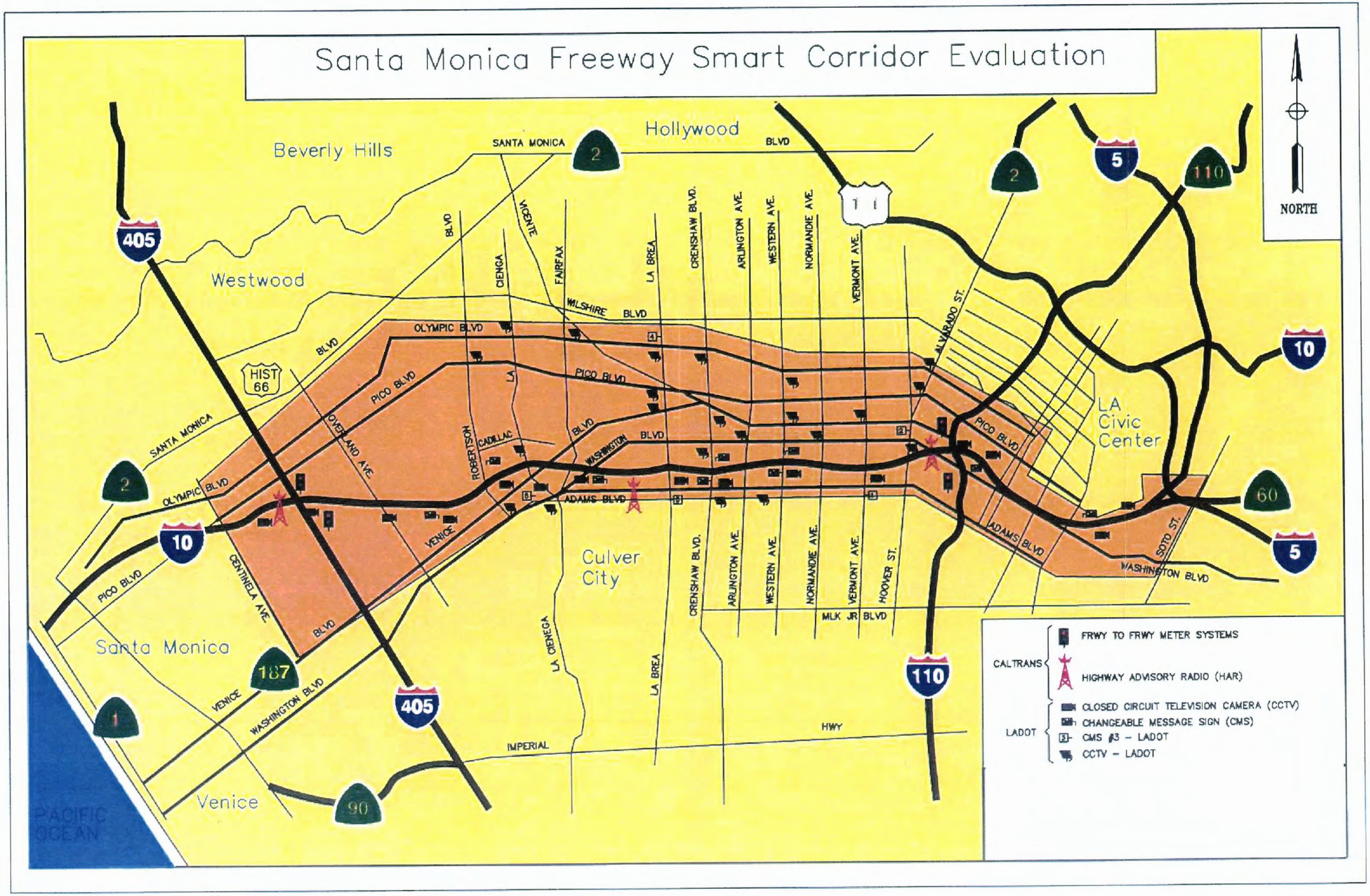
When it became operational in 1993, the Smart Corridor project was unique in a number of ways. Most significantly, it was the one of the first corridor management projects of its kind launched in the country. One of the most notable uses of Smart Corridor occurred during the aftermath of the January 17, 1994, Northridge Earthquake.

## SYSTEM DESCRIPTION

The Santa Monica Freeway Smart Corridor system study area comprises an approximately 11-mile section of Santa Monica Freeway (I-10), between the Harbor Freeway (I-110) and San Diego (I-405) Freeway (see Exhibit 1). Within this area are five major parallel arterials: Adams, Venice, Washington, Pico, and Olympic Boulevards.

The overall goal of Smart Corridor was to improve traffic operations within the corridor. Providing congestion relief during incidents, minimizing the propensity for secondary accidents, reducing fuel consumption, and improving air quality were perceived as candidate benefits for deploying Smart Corridor system. These benefits were to be attained through the application of advanced technologies that would enable system operators to more effectively detect traffic incidents, direct travelers to alternate bypass routes, and respond to associated shifts in traffic patterns within the corridor.

**Exhibit ES-1: Santa Monica Freeway Smart Corridor Area Of Operations And ITS Infrastructure**



Smart Corridor used three components to achieve this goal:

- To coordinate and maximize the efficiency of existing real time monitoring and control systems of the participating agencies.
- To provide dynamic, real time traffic information to motorists in the corridor.
- To provide timely and effective accident/incident management within the corridor.

The Smart Corridor project comprised a mix of Intelligent Transportation Systems (ITS) technologies that support real time traffic monitoring, control strategies, and information dissemination. Of particular importance was the wide range of agencies that participated in Smart Corridor, and the extent to which inter-agency coordination impacted the performance of Smart Corridor.

## EVALUATION APPROACH

After a decade of development, deployment, operations, and maintenance of the current system, this evaluation provides an independent and objective assessment of Smart Corridor's performance, impacts, successes, and lessons. This evaluation assesses the system's overall performance in response to study area freeway and arterial incidents (defined as any unusual occurrence causing significant delay within the corridor), focusing on the following six evaluation areas:

- Operational performance,
- Institutional coordination,
- System benefits assessment,
- System user assessment,
- Emissions and energy impacts,
- Costs.

Evaluation goals and objectives were developed for each of the six evaluation areas. The evaluation goals are summarized below.

*Goal 1 – Assess the operational performance of the Smart Corridor system in the study area.*

*Goal 2 – Assess the extent of institutional coordination associated with the Smart Corridor system.*

*Goal 3 – Assess the system benefits arising from operational coordination arrangements associated with Smart Corridor.*

*Goal 4 – Assess the transportation system impacts arising from Smart Corridor.*

*Goal 5 – Assess the emissions and energy impacts associated with the operational performance of the Smart Corridor system in the study area.*

*Goal 6 – Document costs associated with the Smart Corridor system.*

Evaluation goals 1 and 5 investigated the impacts of the Smart Corridor system on the transportation network (freeway and arterial) in the study area, including emissions and energy. This part of the evaluation was based on an analysis of data provided by Caltrans and LADOT related to 3 freeway and 4 arterial incidents that occurred in November and December 1999.

Evaluation goals 2, 3, and 4 investigated the working relationships established as a result of the Smart Corridor system, and their operational impact on the subject incidents, operational arrangements for using the Smart Corridor system, and perceived impacts of the Smart Corridor system on travelers. This part of the evaluation was based on structured interviews with operational, technical, and managerial staff, individually and in one or more groups, and with representative groups that provided the perceptions of travelers.

Evaluation goal 6 estimated the costs associated with developing, installing, operating and maintaining the Smart Corridor system.

## CONCLUSIONS

Overall, the Smart Corridor system positively impacted traffic conditions during the 7 sample incidents. While the improvements for individual incidents were small, the potential impacts across the Los Angeles area are enormous, given the third of a million freeway incidents that occur across the region each year. As the Smart Corridor concept is expanded across the region, it will be an appropriate tool to mitigate the impacts of such incidents, and provide overall congestion relief.

It is important to keep in mind that any incident, freeway or arterial, in a corridor such as this study area is highly likely to lead to deterioration in transportation system performance. This is especially true with major incidents, when freeway traffic will likely spill over onto the arterial network. Smart Corridor provided the means to proactively manage such conditions. For the evaluation of the operational performance of Smart Corridor, 11 measures of effectiveness (MOEs) were identified, e.g., change in average speed, change in total travel time, and change in fuel consumed. The impact of Smart Corridor on each of these 11 MOEs was simulated using the computer based Synchro Plus traffic model. It is particularly interesting to note that, of the 11 MOEs considered in each of the 7 incidents evaluated, 68 percent improved, 14 percent remained unchanged, and 18 percent worsened. Put simply, there are very strong indications that for the subject incidents, Smart Corridor control improved conditions compared to no Smart Corridor control.

For Smart Corridor to succeed, new institutional relationships were needed. Not only were these relationships developed during development of Smart Corridor, the strengthened institutional relationships ultimately outlived the Smart Corridor system. Subsequent deployments of ITS type projects in the region have undoubtedly benefited from this.

From an operational standpoint, Smart Corridor showed that a centralized database was appropriate to this pilot effort covering an 11-mile section of the Santa Monica freeway.

However, it became apparent that this was not a viable avenue to explore for future expansion across the more than 400 miles of freeway in the Los Angeles region. Distributed systems where local jurisdictions retain responsibility for their respective systems are considered more practical. One local example of this concept is the ongoing Southern California Priority Corridor ITS Network, which conforms to the National ITS Architecture (see http://www.odetics.com/itsarch), and is expected to become partially operational during 2001. Further, integrated solutions, and not standalone systems such as Smart Corridor, are preferred to maximize resource efficiency; e.g., operators should work using the minimum number of workstations

## LEGACY

The Smart Corridor system was intended to be a demonstration of the integration of multi-jurisdictional transportation management and information systems, using real time advanced technologies. By the end of the 1990s, technology advances had overtaken Smart Corridor, and other ITS initiatives in the region had moved ahead. While the centralized database of the Smart Corridor system closed in 1999, most of the infrastructure installed as part of Smart Corridor remains in use today.

In addition to the infrastructure legacy of Smart Corridor, there is also a strong institutional legacy. The main project stakeholders, Caltrans, CHP, LADOT, and LACMTA, have indicated a strong willingness to move forward together on similar initiatives. All four are key stakeholders working together to expand the Smart Corridor concept, and deploy other ITS infrastructure and technologies throughout the region.

LACMTA continues to encourage deployment of Smart Corridor concepts using a funding mechanism referred to as Proposition C. Proposition C was approved in 1990 to increase the Los Angeles County sales tax by a ½ cent, of which 25 percent has been designated for transit related highway improvements. Since Proposition C became effective in 1992, approximately $375 million has been programmed by LACMTA for the implementation of signal synchronization, bus priority, Smart Corridor and ITS projects along the regionally significant arterials identified by sub-regional Traffic Forums. With the lessons learned from Santa Monica Freeway Smart Corridor Demonstration Project, LACMTA is leading the county to further advance system integration among all modes of transportation.

Introduction

# 1.0 INTRODUCTION

## BACKGROUND

This evaluation report provides a description of the findings of an evaluation of the Santa Monica Freeway Smart Corridor. A previous evaluation of Smart Corridor summarized the lessons learned during the development, deployment, and operation of Smart Corridor. This evaluation investigates the operational impact of Smart Corridor in more detail, and updates the evaluation of its institutional and system related impacts.

Traffic congestion in the Los Angeles metropolitan area has been consistently rated among the highest in the nation. Over the past three decades, the region has responded in many ways to this congestion and associated air quality concerns. Caltrans developed its Semi Automated Traffic Management System (SATMS) during the 1970s. The city of Los Angeles introduced its Automated Traffic Surveillance and Control (ATSAC) center to coincide with the 1984 Olympic Games. Such were the successes of SATMS and ATSAC, their principles of coordinated control and integrated databases, together with their established infrastructure, formed the basis of Smart Corridor.

When it became operational in 1993, the Smart Corridor project was unique in a number of ways. Most significantly, it was one of the first corridor management projects of its kind launched in the country. In fact, the early conceptual design and funding for the Smart Corridor project pre-dated even the Federal Highway Administration's (FHWA) early intelligent vehicle and highway systems (IVHS) projects. (Subsequently the acronym IVHS was replaced by ITS.) One of the most notable uses of Smart Corridor occurred during the aftermath of the January 17, 1994, Northridge Earthquake, which caused significant damage to the freeway.

The final product was an integrated application of a variety of ITS technologies and traffic management techniques, including traffic monitoring, control strategies, and information dissemination technology. Moreover, it was an example of a design that incorporated the newest technologies with existing traffic management and information systems into a single, coordinated management and response system. Since implementation, its main objective has been to provide congestion relief, reduce accidents, reduce fuel consumption, and improve air quality. To achieve this, the Smart Corridor system placed a strong emphasis on using technology to provide real time information to travelers.

The Smart Corridor system was intended to be a demonstration of the integration of multi-jurisdictional transportation management and information systems, using real time advanced technologies. By the end of the 1990s, technology advances had overtaken Smart Corridor, and other ITS initiatives in the region had moved ahead. While the centralized database of the Smart Corridor system closed in 1999, most of the infrastructure installed as part of Smart Corridor remains in use today.

## SMART CORRIDOR IN HISTORICAL PERSPECTIVE

Understanding the historical perspective of Smart Corridor offers an interesting insight to the development of the project. Exhibit 1-1 provides a timeline of relevant national transportation milestones, ITS milestones, local milestones, and other environmental events and trends that contributed to the impetus for the Santa Monica Freeway Smart Corridor. (The numbers in bold parentheses in the following text correspond to that numbered item on the timeline.) By the time Smart Corridor was completed in 1993, it had been just 216 years since Felipe de Neve and the first Mexican-Spanish missionary settlers selected a possible site on the banks of the Porciuncula River for a civilian settlement. The site was named El Pueblo de la Reina de los Angeles, and it was to become the location of the city we now know as Los Angeles.[1]

**(1)** On September 4th of 1781 the Pueblo of Los Angeles was officially established and populated with settlers recruited in the Sinaloa and Sonora villages of Mexico. Over time, California became a very attractive piece of land to Washington policy makers, partially because of reports from Lewis & Clark in 1805. On December 8th, 1812 a severe earthquake struck Southern California. There would be at least four more significant earthquakes (magnitude 6.0 or higher) in this area by the time Santa Monica Freeway Smart Corridor was implemented.

**(2)** On May 13th of 1846, the United States declared war on Mexico. California was claimed as an American possession. On February 2, 1848, Mexican resistance to American forces ended with the Treaty of Guadulupe-Hildalgo and, as a result, Mexico ceded all land north of the Rio Grande River to the United States. In 1850, California was divided into 27 counties. Los Angeles County was established, consisting initially of 4,340 square miles.[2]

**(3)** The advent of public transportation in Los Angeles began on July 3rd, 1873, when the City Council passed the first franchise ordinance for a street railway on Main and Alameda Streets. In 1875 with the construction of the Los Angeles and Independent Railroad, connecting the harbor of Santa Monica to the city of Los Angeles, R.S. Baker and Senator John P. Jones of Nevada created the city of Santa Monica.[3]

1 *(http://www.socalhistory.org/lachron.htm)*

2 *(http://www.socalhistory.org/lachron.htm)*

3 *(http://www.socalhistory.org/lachron.htm)*

**Exhibit 1-1: Timeline For The Santa Monica Freeway Smart Corridor System**

| | 1781- 1970 | 1970-1990 | 1990-2000 |
|---|---|---|---|
| **National Transportation Milestones** | Henry Ford produces 19,051 "Model Ts" (5)<br>Federal-Aid Highway Act (11) | Auto smog inspection bill passes Congress (19) | Intermodal SurfaceTransportation Efficiency Act - ISTEA (24)<br>TEA-21 (30) |
| **Intelligent Transportation System Milestones** | | Los Angeles Area Freeway Surveillance and Control Project (15)<br>Los Angeles DOT ATSAC (20)<br>SMART Corridor concept outlined in Asembly Bill # 457 (27) | ITS Priority Corridors (25) |
| **Southern California & Los Angeles Milestones** | Pueblo of Los Angeles officially established (1)<br>Deep water port at San Pedro, Los Angeles Aqueduct (4)<br>Real estate and oil boom (7)<br>Defense & Aircraft Industries (8)<br>Santa Monica Freeway Completed (13)<br>Great suburban boom (12)<br>Mexican-American War, Los Angeles County established (2)<br>First franchise for a street railway approved in Los Angeles (3) | Los Angeles Olympic Games (21)<br>The South Coast Air Quality Management District (AQMD) is formed (18) | Northridge Earthquake (29)<br>Los Angeles County Metropolitan Transportation Authority Created (26) |
| **Relevant Environmental Events/Trends** | First Los Angeles gas station. Gas costs between 10-12 cents a gallon (6)<br>County of Los Angeles sets up an air pollution control district. (9)<br>City of Los Angeles Highways and Freeways Element first adopted (14)<br>Higest smog level recorded (10) | OPEC Oil/U.S. Energy Crisis (17)<br>The United States EPA imposes strict pollution standards on Los Angeles County (22)<br>1st International Earth Day (16) | Clean Air Act (23)<br>Petroleum Violation Escrow Account - PVEA (28) |

The street railways adequately served their purpose until real growth in the Los Angeles basin began at the end of the 19th century and in the early part of the 20th century. **(4)** The 1890s and the first decade of the twentieth century were highlighted by the construction of key city-building projects: the deep water port at San Pedro, the Los Angeles Aqueduct carrying water from the Owens Valley, and an intercity electric railway system.[4] Always at the forefront of transportation and technological innovation, Los Angeles became one of the first American cities to illuminate streets with electricity when it installed a 150-foot tall electric streetlight in 1882. In 1887, the first electric streetcars appeared in Los Angeles. **(5)(6)** In 1905, Henry Ford built 19,051 Model Ts, and in 1912 the first gas station opened in Los Angeles.[5] With the introduction of the automobile, Los Angeles would from this point on be known for its transportation excesses and its personal transportation convenience.

**(7)** In the early 1920s the Los Angeles area's transportation environment began to change even more rapidly with a real estate and oil boom that caused significant suburban growth. Over 100,000 automobiles were registered in Los Angeles. By 1925 there were more automobiles per capita in Los Angeles than in any other city in the nation. By the late 1920s numerous companies had opened manufacturing facilities in Los Angeles County, creating thousands of jobs. The Hollywood film business grew into a regional economic power. By 1930, 94 percent of all dwellings in Los Angeles were single-family homes. The city's population was over 1 million, while the county population was over 2 million. Los Angeles was the fifth largest city in America.[6] **(8)** Even more jobs and homes were built between 1940 and 1950 as World War II caused the development of the defense and aircraft industries in Los Angeles. In 1943 "smog," or smoke-laden fog, was officially recognized in Los Angeles. In fact, the smog was neither smoke nor fog, but a photochemical substance with its origin in the nitrogen oxides and hydrocarbon vapors emitted by automobiles and other sources. These vapors undergo photochemical reactions in the lower atmosphere. The highly toxic gas ozone arises from the reaction of nitrogen oxides with hydrocarbon vapors in the presence of sunlight, and some nitrogen dioxide is produced from the reaction of nitrogen oxide with sunlight. The resulting smog causes a light brownish coloration of the atmosphere, reduced visibility, plant damage, irritation of the eyes, and respiratory distress.[7]

**(9)** In 1947, the State legislature passed a bill allowing the County of Los Angeles to set up an air pollution control district. In 1948, 650,000 automobiles were assembled in Los Angeles auto plants. **(10)** On September 13th, 1954 the smog level in Los Angeles was the highest recorded to date. Beginning in 1955, Southern Californians learned to pause and listen whenever they heard a "SigAlert" traffic bulletin being broadcast over local radio stations. Loyd Sigmon, a local broadcaster, gave his name to a device that allowed automated transmittal of public safety information by the Los Angeles Police Department (LAPD) to local radio stations, perhaps becoming one of the earliest examples of ATIS. Today, responsibility for transmitting SigAlerts is the responsibility of the California Highway Patrol (CHP).

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4 (*http://www.tierraproperties.com/short_history_of_los_angeles_real_estate.htm*)

5 (*http://www.socalhistory.org/lachron.htm*)

6 (*http://www.tierraproperties.com/short_history_of_los_angeles_real_estate.htm*)

7 (*http://www.britannica.com/bcom/eb/article/1/0,5716,70091+1+68319,00.html*)

**(11)** On June 29, 1956 President Eisenhower signed the Federal-Aid Highway Act, which began the single greatest public works program in the nation's history: the Interstate Highway System.[8] With the combination of the private automobile and highways, subdivision housing became a mass-production industry. **(12)** In the 1950s Los Angeles experienced a great suburban boom which continued rapidly into the early 1960s.[9] **(13)** To accommodate suburban growth in the Los Angeles area, the Santa Monica Freeway, part of Interstate 10, was built in the mid-60s.

**(14)** The existing City of Los Angeles Highways and Freeways Element was first adopted in 1959. The focus of the Highways and Freeways Element was the expansion of the City's transportation network through large infrastructure investments. Since 1959, a number of factors have emerged which would indicate that significant construction of new highway infrastructure is impractical. Due to the air quality problems of the South Coast Air Basin, the Federal government had imposed severe air quality guidelines, taking into account that almost 50 percent of the pollutants came from mobile sources. There was increasing community opposition to freeway construction projects in already urbanized areas. In addition, with more competing demands on the State's and City's financial resources and the escalating construction cost of new streets and freeways, less public investment was being committed to infrastructure development. For environmental and fiscal reasons, it was clear that the primary emphasis on "building out of congestion" was no longer viable.[10] Other traffic solutions were necessary, including traffic congestion management.

In 1965, the then California Division of Highways started the first 'Freeway Operations Group' in Los Angeles. **(15)** A portion of that group developed the Los Angeles Area Freeway Surveillance and Control Project. Assembly Concurrent Resolution #111, adopted in 1970, officially authorized the 42-mile experimental project on the Santa Monica, San Diego, and Harbor freeways. Governor Ronald Reagan officially inaugurated the first traffic operations center (TOC), at the time referred to as Freeway Operations Headquarters, on November 23, 1971. In 1976, the TOC was relocated into the current Caltrans District Office location, and subsequently upgraded in 1982 with an improved central traffic management system, referred to as the Semi-Automatic Traffic Management System (SATMS). In January 2000, SATMS was replaced by Caltrans' new Advanced Traffic Management System (ATMS).

**(16)** On April 23rd, 1970 the first international Earth Day was celebrated. From this day forward there would be a new environmental consciousness in the United States, and environmental legislation and environmentally oriented public agencies became more and more prominent. **(17)** The United States also experienced its first energy crisis in the 1970s with the rising prices of crude oil, partly as a result of strained relations with the Organization of Petroleum Exporting Countries (OPEC). **(18)** In 1975, the South Coast Air Quality Management District (SCAQMD) was formed to monitor air quality in Southern California. **(19)** In 1980, the U.S. Congress passed a lasting and important auto smog inspection bill, which had a profound impact on automobile regulation in Los Angeles.

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8 *(http://www.tfhrc.gov/pubrds/summer96/p96su10c.htm)*

9 *(http://www.tierraproperties.com/short_history_of_los_angeles_real_estate.htm)*

10 *(http://www.ci.la.ca.us/PLN/Trans-Element/TE/ch2.htm)*

**(20)** The Los Angeles Automated Traffic Surveillance and Control (ATSAC) system, one of the first automated traffic management systems in the nation, was first put into operation within the Coliseum Area in June of 1984, just one month before the Summer Olympic Games. **(21)** The Olympics Traffic Coordination Center was located adjacent to the Caltrans TOC, which provided valuable information to transportation decision-makers during the 16-day event. Because of its unique capabilities, ATSAC served as one of the key elements in the city's Olympics Transportation Plan. This installation encompassed 118 signalized intersections and 396 detectors covering an area of four square miles.[11] Despite the localized success of ATSAC, Los Angeles still had traffic congestion and air quality problems in the mid-1980s. **(22)** In 1988, the United States Environmental Protection Agency (EPA) imposed strict pollution standards on Los Angeles County because of its high smog levels. **(23)** Under the 1990 Clean Air Act, EPA set official limits on how much a single pollutant can be in the air in any city in the United States. This law meant that Los Angeles had to take drastic measures to ensure that its citizens had the same basic health and environmental protections as all Americans.[12] **(24)** In 1991, the Intermodal Surface Transportation Efficiency Act (ISTEA) was passed in Congress. The Law's emphasis on "efficiency" was intended to result in increased planning for those modes of transportation that are more efficient than the single-occupancy automobile.

**(25)** The ITS Priority Corridors Program was established under ISTEA, which included the Intelligent Vehicle Highway Systems (IVHS) Act (now called ITS). The IVHS Act called for the establishment of Priority Corridors according to a number of specific criteria set out in the act, with the controlling ISTEA criterion indicated as severe or extreme ozone non-attainment. Subsequent to the passage of ISTEA, the United States Department of Transportation (USDOT) selected the only four areas in the country meeting all of the criteria as Priority Corridor Sites: I-95 (Maryland to Connecticut), Houston, Gary-Chicago-Milwaukee, and Southern California. Beginning in 1993, these four Priority Corridors have developed a range of ITS plans, approaches, and activities.[13] The Southern California ITS Priority Corridor developed a Showcase Program that featured three 'Early Start' projects in Los Angeles County, namely IMAJINE, a regional ATIS, and Integrated Mode Shift Management System. In addition, LACMTA funded a bus priority pilot project.

**(26)** The Los Angeles County Metropolitan Transportation Authority (LACMTA) was created in the state legislature in May 1992. This bill merged the Los Angeles County Transportation Commission (LACTC) and the Southern California Rapid Transit District (RTD). The merger became effective on April 1, 1993.

**(27)** In 1987, in response to concerns about increasing traffic congestion and energy consumption, and compliance with air quality standards, Assembly Bill #457 specified the elements of a Smart Corridor Telecommunications Demonstration Project. The demonstration was to be conducted on a portion of the Santa Monica Freeway, taking advantage of the computerized traffic control equipment already in place. The project was to be coordinated by the Los Angeles County Transportation Commission (later to become LACMTA), which in turn

11 City of Los Angeles Department of Transportation, , June 1994. ATSAC Evaluation Study.

12 ( http://www.epa.gov/oar/oaqps/peg_caa/pegcaa02.html#topic2)

13 ( http://www.itsdocs.fhwa.dot.gov/jpodocs/repts_pr/2jx01!.pdf)

was required to consult with local and state traffic and law enforcement agencies to coordinate the project with existing plans and programs. On July 16th, 1993 Smart Corridor System commenced operations.[14]

**(28)** A major portion of the funding (approximately %6.5 million) for the Smart Corridor project came from the Petroleum Violation Escrow Account (PVEA), money paid to the Federal Government by oil companies as restitution for overcharging U.S. consumers from 1973 to 1981. The PVEA supplements the California Energy Commission's state budget. The state has spent $624 million in PVEA funds to finance various school and hospital energy efficiency, alternative fuel vehicle and conservation programs.[15] Not only did the environmental consciousness of the 1970s and 1980s provide a catalyst for the Project; it also funded it. PVEA money has funded other similar projects in California and around the country.

**(29)** One of the first real tests of the Smart Corridor was the Northridge Earthquake. On January 17th of 1994 a magnitude 6.8 earthquake epicentered in Northridge rocked the Los Angeles basin, causing significant damage to the Santa Monica Freeway and closing both directions of traffic for more than 3 months. Traffic engineers were fortunate to have a variety of advanced traffic management tools available, which had been implemented as part of the Smart Corridor project. Such tools included centralized traffic signal control and surveillance, changeable message signs, closed-circuit television, and highway advisory radio (HAR). A strong spirit of cooperation among jurisdictions and agencies was observed. An example of multi-jurisdictional coordination was the integration of Culver City's traffic signals into the Los Angeles ATSAC system to provide seamless traffic signal coordination customized to the traffic situation resulting from the earthquake.

According to the Texas Transportation Institute's ten-year study on congestion published in 1998, Los Angeles remained at the top of the study's rankings in 1997. The research also determined the economic impact of traffic congestion by considering the value of time delay as perceived by motorists and the cost of fuel wasted in traffic. Los Angeles topped the list with an annual congestion cost of $8.6 billion.[16]

**(30)** The Transportation Equity Act for the 21st Century (TEA-21) was enacted June 9, 1998 as Public Law 105-178. TEA-21 authorized the Federal surface transportation programs for highways, highway safety, and transit for the 6-year period 1998-2003. In 1990, the state's Transportation System Management Program funded $1 billion statewide, over a 10-year period. Money from these funding sources will continue to be used on projects that will build off the experience of the Santa Monica Freeway Smart Corridor.

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14 U.S. Department of Transportation ITS Joint Program Office, March 1994. "User Services: Travel and Traffic Management" in IVHS Deployment.

15 *(http://www.lao.ca.gov/analysis_2001/general_govt/gen_04_CC_PVEA_an101.htm)*

16 *(http://tti.tamu.edu/researcher/v34n1/congestion.stm)*

## ORGANIZATION OF THIS REPORT

The remainder of this report is divided into six sections:

- Description of the Smart Corridor system,
- Evaluation approach,
- Operational performance, and emissions and energy impacts,
- Institutional coordination and systems benefits, and system users,
- Costs,
- Conclusions.

Description

# 2.0 DESCRIPTION OF THE SMART CORRIDOR SYSTEM

## INTRODUCTION

The Santa Monica Freeway Smart Corridor system study area comprises an approximately 11-mile section of Santa Monica Freeway (I-10), between the Harbor Freeway (I-110) and San Diego (I-405) Freeway. Within this area are five major parallel arterials: Adams, Venice, Washington, Pico, and Olympic Boulevards (see Exhibit 2-1.)

The overall goal of Smart Corridor was to improve traffic operations within the corridor. Providing congestion relief during incidents, minimizing the propensity for secondary accidents, reducing fuel consumption, and improving air quality were perceived as candidate benefits for deploying Smart Corridor system. These benefits were to be attained through the application of advanced technologies that would enable system operators to more effectively detect traffic incidents, direct travelers to alternate bypass routes, and respond to associated shifts in traffic patters within the corridor. Smart Corridor used three components to achieve this goal:

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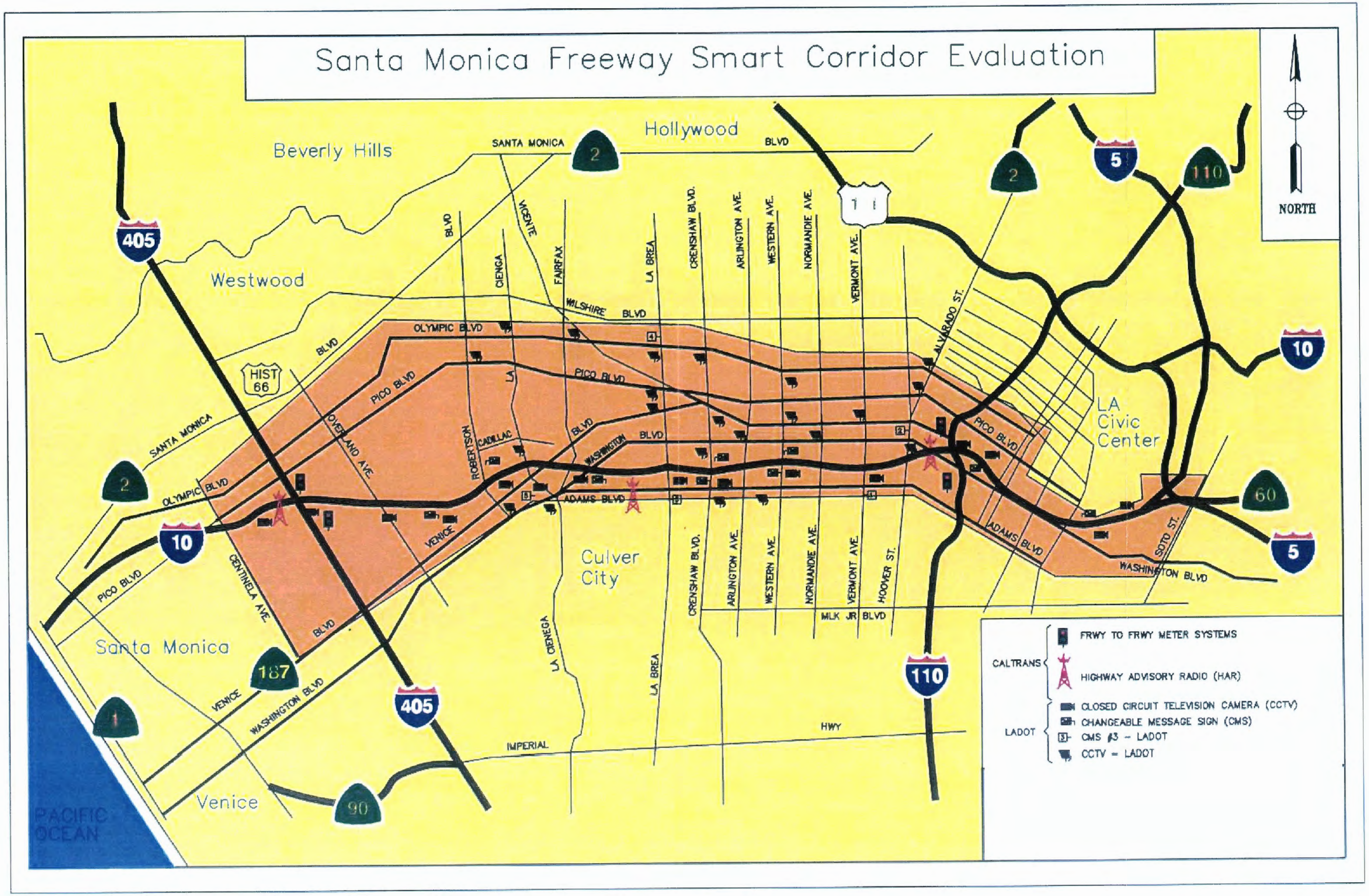
- To provide dynamic, real time traffic information to motorists in the corridor.
- To provide timely and effective accident/incident management within the corridor.

The Smart Corridor project comprised a mix of intelligent transportation systems (ITS) technologies that support real time traffic monitoring, control strategies, and information dissemination. Of particular importance is the wide range of agencies that participated in Smart Corridor, and the extent to which inter-agency coordination impacted the performance of Smart Corridor.

The complement of ITS infrastructure in the operational area consists of centrally monitored and controlled:

- Ramp and freeway-to-freeway meter systems,
- Highway advisory radio (HAR),
- Closed Circuit Television (CCTV),
- Changeable Message Signs (CMS),
- Alternate Route Guidance Signs ("Trailblazer"),
- Real time traffic monitoring systems,
- Centrally controlled traffic management systems.

**Exhibit 2-1: Santa Monica Freeway Smart Corridor Area Of Operations And ITS Infrastructure**



## INCIDENT AND RESPONSE MANAGEMENT STRATEGIES

Understanding how the Smart Corridor system functions is essential to the conduct of the evaluation. The system deployed incident management strategies, a traffic responsive signal system and supporting transportation management system devices that were strategically located within the corridor. The system aimed to detect and verify incident conditions using loop detectors and freeway and arterial surveillance devices and divert local and regional traffic through use of traveler information devices. The system strived to accommodate diverted traffic using a traffic responsive signal system.

Operationally, the Smart Corridor system classified all incidents within the corridor based on confidence levels. Once an appropriate confidence level was reached within a predetermined amount of time, the system notified the operator. The operator subsequently verified the incident using closed-circuit television cameras, volumes and occupancy data. The operator then reviewed the expert system's recommended incident response plan, and launched its implementation via actions such as CMS activation, signal timing modifications, and highway advisory radio broadcast.

The Smart Corridor's incident management system, a network of three expert subsystems, provided automated incident detection, correlation and confirmation. The subsystem also generated response plans and provided subsequent dynamic incident management. An Incident Manager (IM) was responsible to oversee incident resolution. The system automatically monitored and detected incidents within the project boundary without any operator intervention. The IM would notify the appropriate agency's operator regarding any potential incident, with a corresponding incident report within that agency's jurisdiction. Contingent upon confirmation and approval of the notified operator, the system would automatically generate a response plan and launch its implementation in phases, with operator approval. The IM would continue to monitor the impacted incident area and recommend additional response action contingent upon management requirements. This process would continue until the traffic conditions returned to normal.

The incident response plan was generated by the system, which estimated the duration of the probable incident and performed an analysis of the existing arterial or freeway capacity over the duration of the incident. There were a host of response plans, which were implemented by the system including posting a message on the CMS for redirecting traffic flow and or special traffic signal timing/flush plans. Upon normalization of the traffic conditions within the impacted/detected area, the system operator would terminate the activated response plans and revert to the non-incident operations.

## PROJECT STAKEHOLDERS

For a project of this nature to be successful, it required a new inter-agency and inter-jurisdictional organizational structure, unprecedented at the time, to manage the development, deployment, operations and maintenance of advanced technologies. The system was developed and deployed through a partnership involving Caltrans, CHP, LACMTA, LADOT, and, eventually, the local municipalities of Beverly Hills, Culver City and Santa Monica as well. Seldom, if at all, had these jurisdictions worked together at this level.

Caltrans manages freeway and ramp metering operations, while CHP provides associated enforcement. LACMTA manages transit operations, while each city maintains responsibility for managing and operating its respective surface streets.

As a groundbreaking project, the Smart Corridor required considerable commitment from all participating agencies from the initial development stage through deployment, day-to-day operations and maintenance of the system.

Evaluation Approach

# 3.0 EVALUATION APPROACH

## INTRODUCTION

After a decade of development, deployment, operations, and maintenance of the current system, this evaluation provides an independent and objective assessment of Smart Corridor's performance, impacts, successes, and lessons. This evaluation assesses the system's overall performance in response to study area freeway and arterial incidents (defined as any unusual occurrence causing significant delay within the corridor), focusing on the following six evaluation areas:

- Operational performance,
- Institutional coordination,
- System benefits assessment,
- System user assessment,
- Emissions and energy impacts,
- Costs.

## EVALUATION GOALS AND OBJECTIVES

Evaluation goals and objectives were developed for each of the six evaluation areas. These are summarized below.

Operational Performance

*Goal 1 – Assess the operational performance of the Smart Corridor system in the study area.*

This evaluation area investigated the impacts of the Smart Corridor system on the transportation network (freeway and arterial) in the study area, based on an analysis of data provided by Caltrans and LADOT related to 4 freeway and 5 arterial incidents that occurred in November and December 1999.

*Objective 1.1 –Assess the overall operational impact of the Smart Corridor system in responding to the subject incidents, on freeways and arterials in the study area.*

Institutional Coordination

*Goal 2 – Assess the extent of institutional coordination associated with the Smart Corridor system.*

This evaluation area investigated the working relationships established as a result of the Smart Corridor system, and their operational impact on the subject incidents, based on structured interviews with operational, technical, and managerial staff, individually and in one or more groups.

*Objective 2.1 – Document the extent and type of institutional coordination.*

System Benefits Assessment

*Goal 3 – Assess the system benefits arising from operational coordination arrangements associated with Smart Corridor.*

This evaluation area focused on the operational arrangements for using the Smart Corridor system. It was conducted in conjunction with Goal 2.

*Objective 3.1 – Identify the impact of the Smart Corridor system on the operational and maintenance procedures and policies of the participating transportation agencies.*

*Objective 3.2 – Identify the impact of the Smart Corridor system on staffing/skill levels and training.*

System User Assessment

*Goal 4 – Assess the transportation system impacts arising from Smart Corridor.*

This evaluation area focused on the perceived impacts of the Smart Corridor system on travelers. For the purposes of this evaluation, representative groups provided the perceptions of travelers.

*Objective 4.1 – Document the perceptions of Smart Corridor system users.*

Emissions and Energy Impacts

*Goal 5 – Assess the emissions and energy impacts associated with the operational performance of the Smart Corridor system in the study area.*

This evaluation area investigated the emissions and energy impacts of the Smart Corridor system on the transportation network (freeway and arterial) in the study area. This evaluation area was based on an analysis of the 4 freeway and 5 arterial incidents assessed under Goal 1:

*Objective 5.1 – Estimate the emissions and energy impacts of the Smart Corridor system*

Costs

*Goal 6 – Document costs associated with the Smart Corridor system.*

This evaluation area estimated the costs associated with developing, installing, operating and maintaining the Smart Corridor system:

*Objective 6.1 – Estimate the deployment costs of the Smart Corridor system.*

*Objective 6.2 – Estimate the operation and maintenance costs of the Smart Corridor system.*

A full description of the evaluation is provided in the formal deliverable for Task B of this project—the Evaluation Implementation Plan, dated September 19, 2000. That document represents the guiding document for conducting the evaluation.

Specific evaluation approaches related to each evaluation goal are described in the following sections, as appropriate to each goal and objective. For the purposes of facilitating the presentation of the results from this evaluation, the findings for evaluation goals 1 and 5 have been combined into the Operational Performance & Emissions and Energy Impacts section in this report. Similarly, the findings for evaluation goals 2, 3, and 4 have been combined into the Institutional Coordination and Systems Benefits & System Users section in this report.

Operational Performance

# 4.0 OPERATIONAL PERFORMANCE, EMISSIONS AND ENERGY IMPACTS

## INTRODUCTION

This section summarizes the impact of the Smart Corridor system on the transportation network (freeway and arterial) in the study area, based on an analysis of data provided by Caltrans and LADOT related to 4 freeway and 5 arterial incidents that occurred in November and December 1999. This section specifically addresses evaluation goals 1 and 5 of the overall Evaluation Implementation Plan, and provides a description of the evaluation approach for assessing the Smart Corridor system, data sources, incident descriptions, measures of effectiveness, constraints and assumptions, and findings.

## EVALUATION APPROACH

To evaluate the performance of the Smart Corridor system, an analytical approach was used to compare how the system performed during each incident condition (defined as the 'after' condition) with how it would have performed without the system (defined as the 'before' condition). System performance was assessed using simulation modeling, by a comparison of after and before conditions for each incident. After conditions are represented by the actual capacity, signal timings, and traffic volumes in effect during incident conditions. Before conditions are represented by the capacity and signal timings in effect during incident-free conditions in a comparable time period, superimposed with traffic volumes in effect during the subject incident. Before conditions are hypothetical, as no corresponding data exists prior to the deployment of Smart Corridor. The evaluation approach is more fully described in Figure 4-1.

The Synchro Plus Version 4 traffic model was used for simulation of after and before conditions, since it has the capability to simultaneously model freeway interchanges, ramps, and signalized intersections along arterial streets. The input data included traffic volumes, roadway and intersection geometry, and traffic signal timing plans. The evaluation compared performance data pertaining to eleven operational measures of effectiveness (MOEs) for each before-after comparison.

An impact area was defined for each incident. This was based on changes in traffic volumes and/or signal timing plans. The process encompassed first defining the time domain associated with each incident based on CHP incident reports. Subsequently, the network domain or influence sphere was defined based on documented changes in operational parameters occurring during the incident. The operational parameters considered for this comparison included traffic signal timing plan, cycle length, progression direction priority, signal splits, and traffic volumes. This process involved searching more than 18,000 pages of computer printouts as well as other electronic data files.

**Exhibit 4-1: Approach For Evaluating Smart Corridor System Impacts**

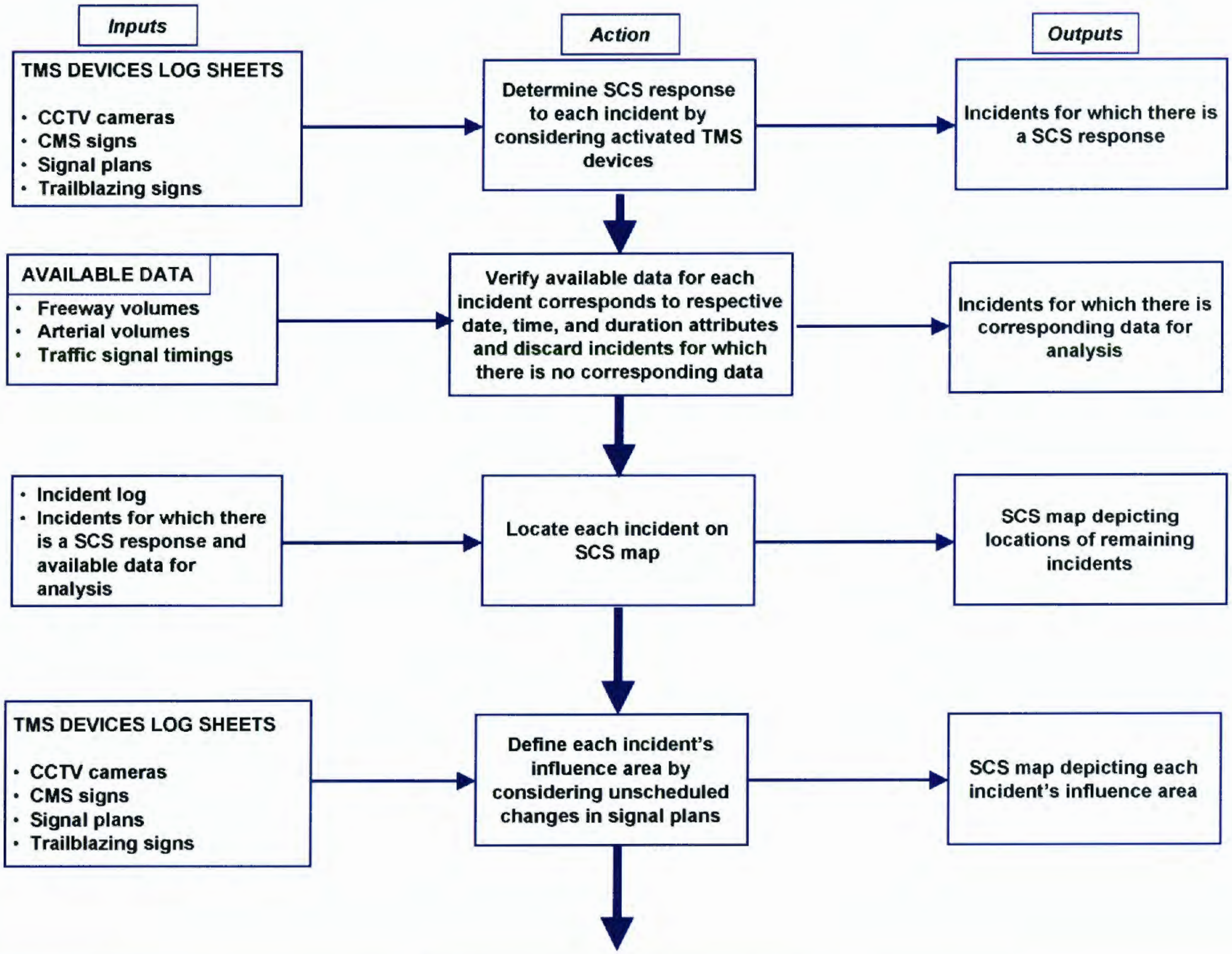


**Exhibit 4-1 (continued): Approach for Evaluating Smart Corridor System Impacts**

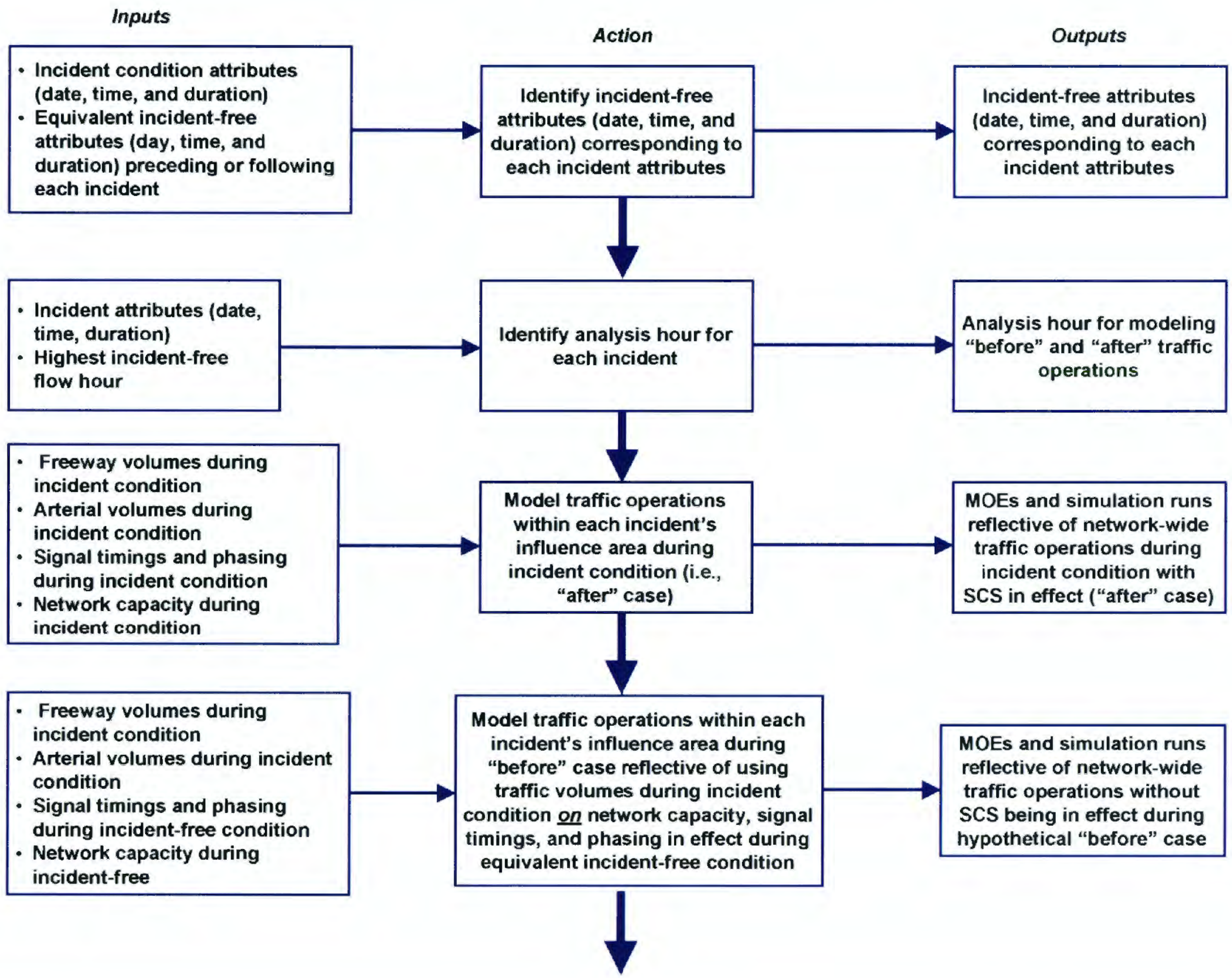
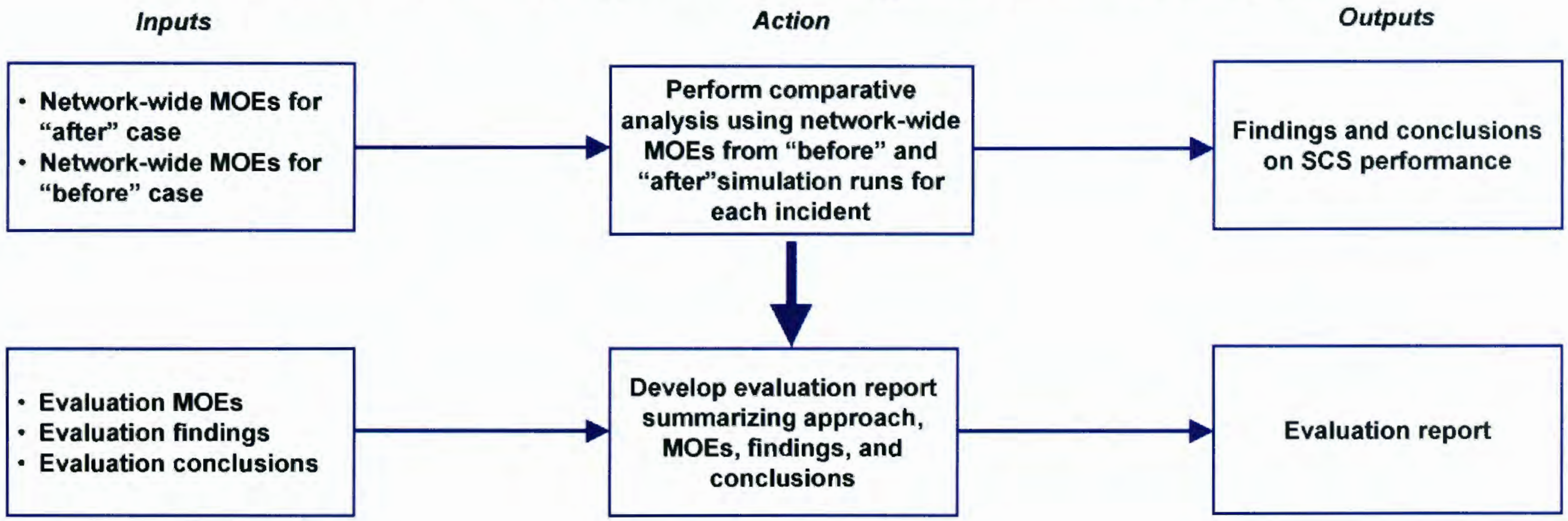


**Exhibit 4-1 (continued): Approach for Evaluating Smart Corridor System Impacts**




***<u>TERMS:</u>***

- **TMS refers to Transportation Management System.**
- **The term network-wide traffic operations refers to operational conditions within the influence area associated with each incident.**
- **"After" case is representative of network-wide traffic operations under incident condition benefiting from the SmartCorridor system. It is modeled by using traffic volumes, network capacity, and signals timings and phasing during each incident condition.**
- **"Before" case is a hypothetical condition representative of network-wide traffic operations that *<u>would have existed</u>* under incident condition in absence of the SmartCorridor system. This scenario requires using "after" case traffic volumes *<u>on</u>* network capacity, signal timings, and phasing in effect during equivalent incident-free condition.**

## DATA SOURCES

Sources of quantitative data included traffic data from variety of databases. These databases automatically recorded and archived the outputs of traffic signal timings and detectors strategically located within the Smart Corridor. LADOT provided ATSAC data that were summarized in 15-minute intervals. The data pertained to traffic signal timings and traffic volumes along arterial streets during freeway/arterial incident and associated non-incident conditions. Caltrans provided freeway main-lane occupancy and volume data that was summarized in 5-minute intervals. Table 4-1 summarizes data sources used in this evaluation.

**Table 4-1: Evaluation Data Sources**

| *AGENCY* | *DATA SOURCE* |
|---|---|
| *LADOT* | ***Intersection Operation Report***<br>***Minute Detector History Report***<br>***Intersection Status Report***<br>***MP file - Relates Detector Number to Intersection Number and Direction***<br>***Intersection Timing Plan***<br>***Intersection Geometric Plan***<br>***Log Sheets and Loop Detector Data Reports***<br>***CMS and Trailblazers' Log Sheets***<br>***Video tapes (collected for evaluation purposes only)*** |
| *CALTRANS* | ***Mainline Station Data 30 second interval - 5 minute interval***<br>***Mainline Freeway Geometric Plan***<br>***Mainline Freeway Annual ADT and Peak Hour Traffic Volumes***<br>***Mainline Freeway data stations Eastbound 24 Stations, Westbound 21 Stations***<br>***Freeway Traffic Data***<br>***CMS Log Sheets.*** |

The evaluation considered a variety of data types including traffic signal timing plans, time of day plans, flush and special plans, 15-minute traffic arterial volumes, and 5-minute freeway volumes. CHP incident reports and associated data were obtained from LADOT and Caltrans.

## INCIDENT DESCRIPTIONS

Nine incident scenarios were initially considered in this evaluation (see Table 4-2). However, on closer examination of the provided data, it was concluded that insufficient data existed for two incident scenarios (incidents 2 and 3). These incident scenarios were subsequently eliminated from the evaluation. Therefore, the evaluation focused on the remaining 7 incidents. The incidents were designated as freeway (3) and arterial (4) incidents and are briefly described below. Appendix A includes a more detailed description of each incident.

<u>Arterial Incidents:</u>

- Incident No. 1—LaBrea Avenue southbound at Adams encompassing 14 signalized intersections within the impacted area.
- Incident No. 4—LaBrea at Adams, encompassing 14 signalized intersections within the impacted area.

- Incident No. 6—Venice westbound and Fairfax to Cadillac encompassing 8 signalized intersections within the impacted area.
- Incident No. 7—LaBrea Avenue and Venice to Adams encompassing 3 signalized intersections along the impacted area.

Freeway Incidents:

- Incident No. 5—Interstate 10 westbound between Normandie Avenue and Overland Avenue encompassing all freeway mainline segments and 47 signalized intersections along the impacted area.
- Incident No. 8—Interstate 10 eastbound and westbound between La Cienega and Budlong Avenue encompassing all freeway mainline segments and 52 signalized intersections along the impacted area.
- Incident No. 9—Interstate 10 eastbound and westbound between La Cienega and Arlington Avenue east of Crenshaw encompassing all freeway mainline segments and 46 signalized intersections along the impacted area.

Arterial incidents under consideration are located in Exhibit 4-2, together with their respective impact areas. Freeway incidents are similarly depicted in Exhibit 4-3.

## Table 4-2: Synopsis of Incident Data

| *Incident No.* | *Incident Type* | *Location* | *Date of Occurrence* | *Duration* | *Incident Nature* | *Video Tape Log* | *Smart Corridor Response* | *Description* |
|---|---|---|---|---|---|---|---|---|
| 1 | Arterial | ***S/B La Brea Ave. @ Adams*** | 11/09/99 | ***0845-1030*** | Congestion | ***CCTV Cam#19 Counter 0000-0203*** | ***CMS/Trailblazer*** | ***Smart Corridor detected incident under the category of "Possible" Status as opposed to "Outstanding" - No operator was notified. LADOT data files to be analyzed for the traffic signal system response.*** |
| 2 | Freeway | ***10 Fwy E/B 2 lanes blocked at Crenshaw*** | 11/17/99 | ***1643-1715*** | Traffic Accident | ***NA*** | ***NA*** | ***Incident excluded from evaluation due to insufficient data*** |
| 3 | Arterial | ***Pico @ Robertson*** | 11/23/99 | ***14:00-1500*** | Congestion | ***CCTV Cams at Pico & Robertson Counter: 0000-0050*** | ***NA*** | ***Incident excluded from evaluation due to insufficient data*** |
| 4 | Arterial | ***La Brea @ Adams*** | 11/23/99 | ***1400-1500*** | Construction | ***La Brea & Adams Counter: 050-1:26*** | ***CMS/ LADOT's new traffic signal TOD plan*** | ***Flush plans implemented by the Smart Corridor for the congestion due to construction 23rd & La Brea. LADOT data files to be analyzed for the traffic signal system response*** |
| 5 | Freeway | ***10 Fwy E/B & W/B b/w Normandie Ave. & Overland Ave.*** | 12/01/99 | ***0810-1400*** | Recurrent Congestion | ***NA*** | ***HAR/ CMS/ Trailblazer*** | ***Heavy congestion was identified by Caltrans CCTV. LADOT data files to be analyzed for the traffic signal system resp.*** |
| 6 | Arterial | ***W/B Venice Fairfax to Cadillac*** | 12/02/99 | ***0800-16:50*** | Congestion | ***CCTV Cam Counter 0:19:05-0:43:25*** | ***CMS/Trailblazer/ New traffic signal TOD/ Flush Plan 27 at IN-157, Flush Plan 29 at IN-156*** | ***Flush plans 27 & 29 were implemented by the Smart Corridor for the heavy congestion*** |
| 7 | Arterial | ***S/B La Brea, Venice to Adams*** | 12/02/99 | ***0800-16:50*** | Congestion | ***CCTV Cam Counter 0:19:05-0:43:25*** | ***CMS/ New traffic signal TOD/ Flush Plan 43*** | ***The Smart Corridor implemented flush plan 43 for heavy congestion. LADOT data files to be analyzed for the traffic signal system response.*** |
| 8 | Freeway | ***10 Fwy E/B & W/B b/w La Cienega Blvd. to Budlong Ave.*** | 12/14/99 | ***0730-0930*** | Recurrent Congestion | ***NA*** | ***CMS/ Trailblazer/ CIC*** | ***AID congestion detected EB Culver Berryman to Sawtelle CIC activated intersection 5-382. LADOT data files to be analyzed for the traffic signal system response.*** |
| 9 | Freeway | ***10 W/B & E/B b/w La Cienega Blvd. to Arlington Ave. (East of Crenshaw)*** | 12/16/99 | ***1420-1520*** | Traffic Accident | ***NA*** | ***CMS/ Traffic Signal TOD Plan 2*** | ***Smart Corridor TOD Plan 2 was implemented for Washington Blvd. for the Westbound progression. LADOT data files to be analyzed for the traffic signal system response.*** |

**Exhibit 4-2: Santa Monica Freeway Smart Corridor Arterial Incident Location Map**

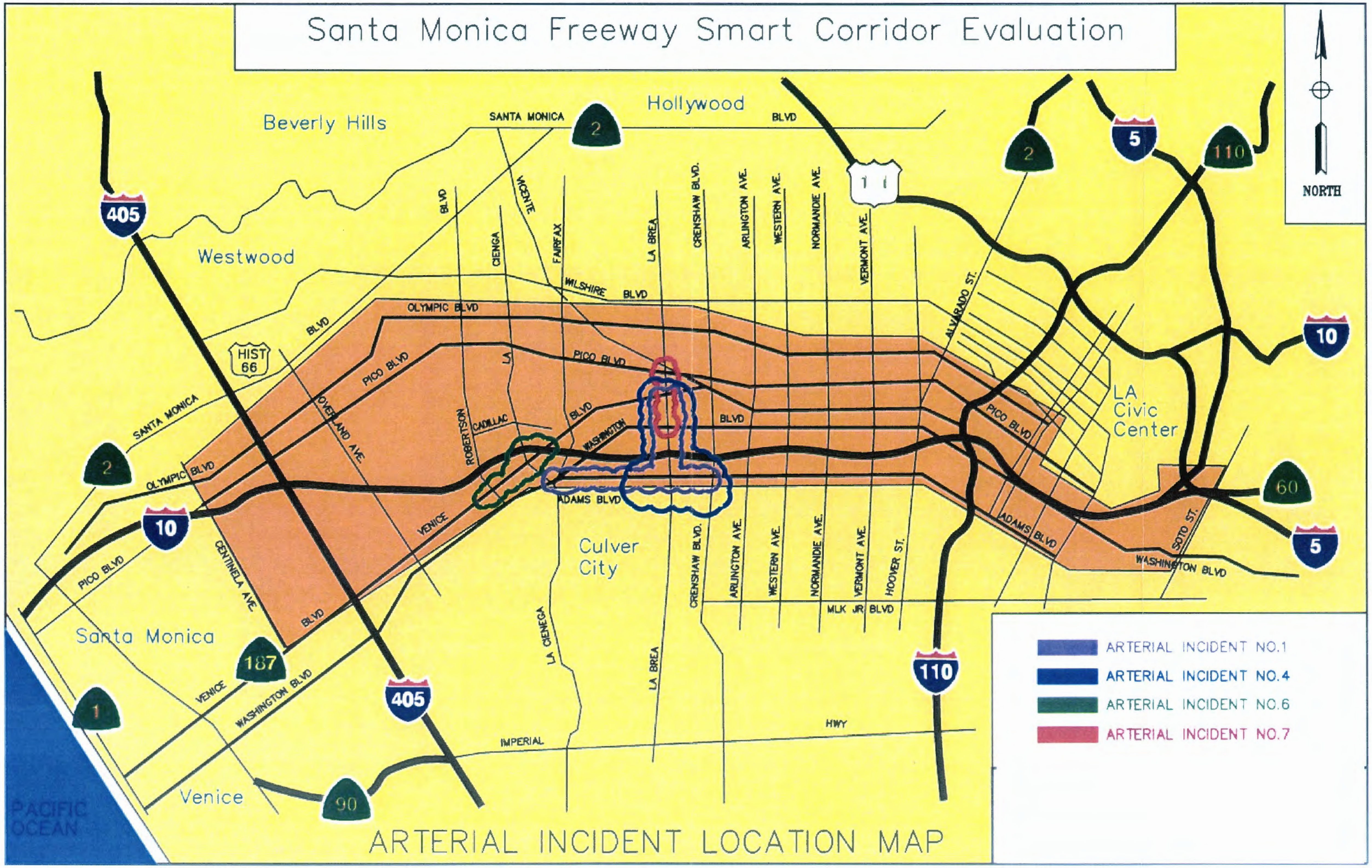
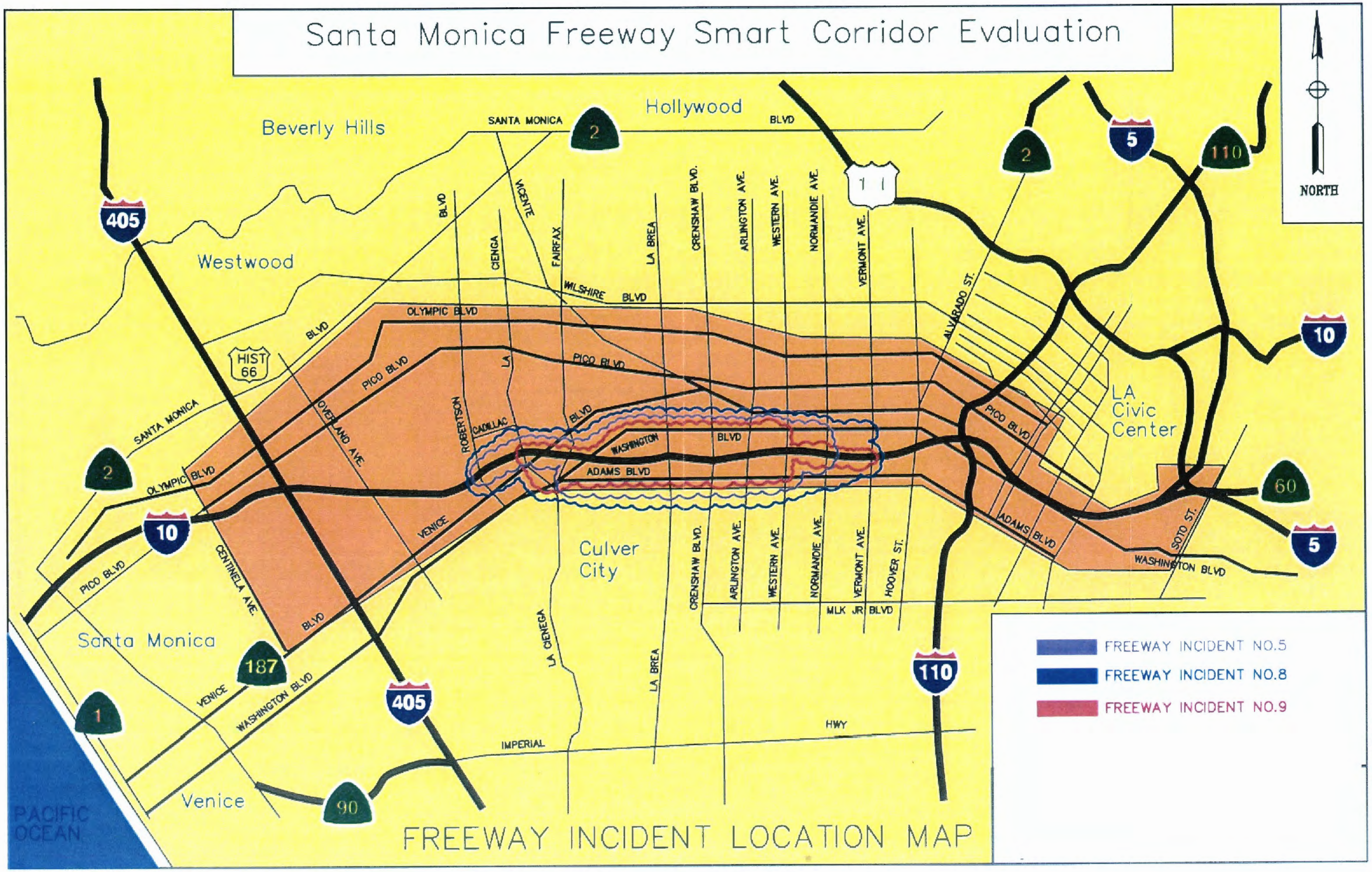


**Exhibit 4-3: Santa Monica Freeway Smart Corridor Freeway Incident Location Map**



## MEASURES OF EFFECTIVENESS

Synchro Plus generates a variety of measures of effectiveness (MOEs) for evaluating system performance. These MOEs can be presented in simulation and report formats depending on the needs of the audience. The reports display quantitative measures regarding the performance of the network nodes and links. These MOEs include delay, stops, fuel consumption, queuing penalty, dilemma vehicles, and emissions. The network reports display information about each approach, intersection, arterial, or the network.

The MOEs produced by Synchro Plus can be divided into primary and secondary categories. The MOEs selected for this evaluation pertained to operational, energy, and emission impacts, and are defined below. The secondary MOEs are surrogate to the primary MOEs and include unserved vehicles, vehicles in the dilemma zone, queuing penalty, performance index, and distance traveled. These MOEs were excluded from consideration in this evaluation.

<u>Operational Impacts</u>

- Percentile Signal Delay/Vehicle—Stopped delay plus time lost due to slowing at each signal per vehicle in seconds. Over the course of an hour, traffic will not arrive at an intersection uniformly. Some cycles will have more traffic and some cycles will have less. Synchro uses Poisson distribution to predict how traffic arrives. 1997 Highway Capacity Manual uses this method.
- Total Percentile Signal Delay—Total Percentile Signal Delay per hour.
- Stops/Vehicle—Number of stops per vehicle per hour.
- Total Stops—Total number of vehicular stops per hour.
- Average Speed—The link distance divided by the travel time including delays. Average speed includes the speed of vehicles in turning lanes and will not match the Average Speed in the Arterial Travel time report of Synchro.
- Total Travel Time—Is the hourly summary of delays and travel time.

<u>Energy Impacts</u>

- Fuel Consumed—Is calculated using the following formulas in gallons:

$$F = \text{Total Travel} * k1 + \text{Total Delay} * k2 + \text{Stops} * k3$$
$$k1 = .075283 - .0015892 * \text{Speed} + .000015066 * \text{Speed}^2$$
$$k2 = .7329$$
$$k3 = .0000061411 * \text{Speed}^2$$

where:

F = fuel consumed in gallons
Speed = cruise speed in mph
Total Travel = vehicles miles traveled
Total Delay = total signal delay in seconds
Stops = total stops in vehicles per hour.

- Fuel Economy—Number of miles traveled per one gallon of fuel consumed in (MPG).

Emission Impacts

- CO Emission—Carbon Monoxide Emission in grams calculated from the following formula: (Fuel consumed)*(69.9 grams)/gallons
- NOX Emission—Nitrogen Oxides Emission in grams calculated from the following formula: (Fuel consumed)*(13.6 grams)/gallons
- VOC Emissions—Volatile Oxygen Compounds Emissions in grams calculated from the following formula: (Fuel consumed)*(16.2 grams)/gallons

## CONSTRAINTS AND ASSUMPTIONS

A number of constraints were imposed on the evaluation for practical reasons beyond the control of the evaluation team:

- Of a total of 9 incidents, the data collected were for 2 accidents, 1 construction, and 6 recurrent congestion over a period of two months. Two of these incidents were subsequently eliminated for reasons of insufficient data. For practical reasons, it was not possible to collect data from more traffic accidents over a longer time period. The findings from this evaluation are therefore indicative only, and cannot be construed as statistically significant.
- Data was collected in November and December 1999, meaning that the findings may be biased towards traffic conditions pertaining to the holiday season.
- All original data collection related to the 9 incidents occurred without the involvement of the evaluation team. While this does not inherently weaken the data, the evaluation team cannot guarantee appropriate quality assurance methods were employed.

During the course of the project, a number of evaluation challenges were encountered pertaining to gaps in data availability. These constrained the evaluation and necessitated analytical assumptions as detailed below.

- For the signalized intersections with no loop detection system (i.e., no reported/logged traffic volume), traffic volumes were utilized from the adjacent intersections by carrying over the thru traffic.
- For the signalized intersections with no left turn loop detection system, traffic volumes were assumed to be 10 percent of the thru traffic.
- For the signalized intersections with no right turn loop detection system, traffic volumes were assumed to be 15 percent of the thru traffic.
- A number of additional hours before and after each incident occurrence were not collected/retrieved. Corresponding hours, days and locations were utilized on different dates for the non-incident assessment.
- The traffic volumes collected for the freeway and arterial were based on a 5-minute and 15-minute interval respectively. Therefore, for the sensitivity assessment of the arterial streets, the nearest 15-minute was utilized as compared with the nearest 5-minute freeway traffic volume.

## Findings

Comparative evaluations of 'after' and 'before' conditions were used to assess the impacts of Smart Corridor system. Eleven MOEs were used to evaluate each of 7 incidents. The MOEs pertained to operational effectiveness, fuel consumption, and fuel emissions. These MOEs and associated findings are summarized in Table 4-3 (arterial incidents) and Table 4-4 (freeway incidents), and presented graphically in Appendix B.

Tables 3 and 4 indicate in green those MOEs for which performance under the after condition, i.e., Smart Corridor control, was improved compared to the before condition, i.e., no Smart Corridor control. Tables 3 and 4 indicate in red those MOEs for which performance under the after condition, i.e., Smart Corridor control, deteriorated compared to the before condition, i.e., no Smart Corridor control. Tables 3 and 4 indicate in gray those MOEs for which performance under the after condition, i.e., Smart Corridor control, was unchanged compared to the before condition, i.e., no Smart Corridor control.

A visual inspection of Tables 3 and 4 indicates that most MOEs are green, i.e. that the after condition was better than the before condition. For arterial incidents, of the 44 total MOEs considered in 4 incidents, 33 (75 percent) improved, 4 (9 percent) remained unchanged, and 7 (16 percent) worsened. For freeway incidents, a similar pattern emerged; of the 33 total MOEs considered in 3 incidents, 19 (58 percent) improved, 7 (21 percent) remained unchanged, and 7 (21 percent) worsened. No explanation is offered for the slightly better performance on arterials, but it is noted that three of the four arterial incidents had 9 or more MOEs for which the evaluation indicated that performance improved under Smart Corridor control.

For all incidents, performance under Smart Corridor control was consistently better for two MOEs; stops/vehicle and total stops. For each MOE except average speed, performance under Smart Corridor control improved for the majority of incidents.

## Table 4-3: MOE Findings (Arterials)

| MOE | Comparison of Measures of Effectiveness (MOEs) Santa Monica Freeway "SMART" Corridor Evaluation | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Incident No. 1 | | | Incident No. 4 | | | Incident No. 6 | | | Incident No. 7 | | |
| | After | Before | % Change | After | Before | % Change | After | Before | % Change | After | Before | % Change |
| Percentile Signal Delay/ Veh (sec) | 31 | 31 | 0.0% | 60 | 62 | 3.2% | 91 | 93 | 2.2% | 98 | 89 | -10.0% |
| Total Percentile Signal Delay (hr) | 344 | 351 | 2.0% | 910 | 950 | 4.2% | 1179 | 1204 | 2.1% | 636 | 577 | -10.2% |
| Stops/Vehicle | 0.89 | 0.96 | 7.9% | 1.18 | 1.21 | 2.5% | 1.45 | 1.48 | 2.1% | 1.3 | 1.55 | 16.1% |
| Total Stops (vehicle/ hour) | 35928 | 38418 | 6.9% | 64494 | 62240 | 2.6% | 67453 | 69049 | 2.4% | 30499 | 36246 | 15.9% |
| Average Speed (mph) | 14 | 14 | 0.0% | 8 | 8 | 0.0% | 6 | 6 | 0.0% | 7 | 8 | 12.5% |
| Total Travel Time (hr) | 586 | 593 | 1.2% | 1193 | 1233 | 3.2% | 1404 | 1430 | 1.9% | 835 | 775 | -7.7% |
| Fuel Consumed (gal) | 845 | 869 | 2.8% | 1537 | 1579 | 2.7% | 1672 | 1703 | 1.9% | 880 | 868 | -1.4% |
| Fuel Economy = (mph) | 10 | 9.7 | 3.1% | 6.5 | 6.3 | 3.2% | 4.7 | 4.6 | 2.1% | 6.8 | 6.9 | 3.1% |
| CO Emissions (kg) | 59.07 | 60.74 | 2.8% | 107.47 | 110.38 | 2.6% | 116.89 | 119.02 | 1.8% | 61.52 | 60.68 | -1.4% |
| NOx Emissions (kg) | 11.49 | 11.82 | 2.9% | 20.91 | 21.48 | 2.7% | 22.74 | 23.16 | 1.8% | 11.97 | 11.81 | -1.4% |
| VOC Emissions (kg) | 13.69 | 14.08 | 2.8% | 24.91 | 25.58 | 2.6% | 27.09 | 27.58 | 1.8% | 14.26 | 14.06 | -1.4% |

Legend
Improved
Unchanged
Deteriorated

**Table 4-4: MOE Findings (Freeways)**

| MOE | Comparison of Measures of Effectiveness (MOEs) — Santa Monica Freeway "SMART" Corridor Evaluation | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Incident No. 5 | | | Incident No.8 | | | Incident No. 9 | | |
| | After | Before | % Change | After | Before | % Change | After | Before | % Change |
| Delay/ Veh (sec) | 20 | 21 | 4.8% | 24 | 25 | 4.0% | 29 | 29 | 0.0% |
| Total Percentile | 1363 | 1435 | 5.0% | 1739 | 1763 | 1.4% | 2324 | 2297 | -1.2% |
| Stops/Vehicle | 0.48 | 0.49 | 7.9% | 0.53 | 0.54 | 1.9% | 0.62 | 0.63 | 1.6% |
| Total Stops | 116332 | 118104 | 1.5% | 137213 | 140080 | 2.1% | 176509 | 179650 | 1.7% |
| Average Speed (mph) | 24 | 26 | 7.7% | 24 | 24 | 0.0% | 22 | 22 | 0.0% |
| Total Travel Time (hr) | 3244 | 2903 | -11.7% | 3288 | 3330 | 1.3% | 4095 | 4068 | -0.7% |
| Fuel Consumed (gal) | 4771 | 4744 | -0.6% | 5247 | 5303 | 1.1% | 6335 | 6346 | 0.2% |
| Fuel Economy = (mph) | 16.1 | 16.1 | 0.0% | 15.1 | 15.1 | 0.0% | 14 | 14 | 0.0% |
| CO Emissions (kg) | 333.52 | 331.61 | -0.6% | 366.74 | 370.68 | 1.1% | 442.82 | 443.57 | 0.2% |
| NOx Emissions (kg) | 64.89 | 64.52 | -0.6% | 71.35 | 72.12 | 1.1% | 86.16 | 86.3 | 0.2% |
| VOC Emissions (kg) | 77.3 | 76.85 | -0.6% | 84.99 | 85.91 | 1.1% | 102.63 | 102.8 | 0.2% |

Legend

Improved
Unchanged
Deteriorated

Looking at the three MOE categories:

Operational Impacts

- Percentile Signal Delay/Vehicle (sec)—This MOE improved between 2.2 percent and 4.8 percent for 4 of 7 incidents.
- Total Percentile Signal Delay (hour)—This MOE improved between 1.4 percent and 5.0 percent or between 7 and 72 hours for 5 of 7 incidents.
- Stops/Vehicle—This MOE improved between 1.6 percent and 16.1 percent for all 7 incidents.
- Total Stops (Vehicle/Hour)—This MOE improved between 1.5 percent and 15.9 percent or between 1,772 and 5,747 vehicle/hour respectively for all 7 incidents.
- Average Speed (MPH)—This MOE improved between 7.7 percent and 12.5 percent for 2 incidents and remained unchanged in 5 incidents.
- Total Travel Time (Hour)—This MOE improved between 1.2 percent and 3.2 percent in 4 incidents.

Energy Impacts

- Fuel Consumption (Gallons)—This MOE improved between 0.2 percent and 2.8 percent for 5 of 7 incidents.
- Fuel Economy (MPG)—This MOE improved between 2.1 percent and 3.2 percent for 4 of 7 incidents while remaining unchanged in 3 incidents.

Emission Impacts

- CO Emissions (Kg)—This MOE improved between 0.2 percent and 2.8 percent for 5 of 7 incidents.
- NOx Emissions (Kg)—This MOE improved between 0.2 percent and 2.9 percent for 5 of 7 incidents.
- VOC Emissions (Kg)—This MOE improved between 0.2 percent and 2.8 percent for 5 of 7 incidents.

An analysis was conducted to assess the energy impacts prior to and after implementation of Smart Corridor technologies. Those impacts relate to the amount of additional heat that is released into the atmosphere during roadway incidents.

The heat content of a fuel is the quantity of energy released by burning a unit amount of that fuel. However, this value is not absolute and can vary according to several factors including temperature and climatic conditions. Automotive gasoline, when burned, releases heat that is measured in British Thermal Units (BTU). This analysis will use the BTU value presented in the latest edition of the USDOT Energy Data Book, which states that there are 115,400 BTUs in a gallon of gasoline. Therefore as each gallon of automotive gasoline is burned, 115,400 BTUs of heat are released into the air.

Combining the fuel consumption MOE results in an overall reduction of 85 gallons of gasoline for the arterial incidents and 40 gallons of gasoline for the freeway incidents. These fuel savings eliminated the release of 11,193,800 BTUs of excess warmth into the atmosphere

Institutional Coordination

# 5.0 INSTITUTIONAL COORDINATION, SYSTEM BENEFITS, AND SYSTEM USERS

## INTRODUCTION

This section summarizes the impact of the Smart Corridor system on institutional coordination, systems benefits and the system users. The institutional coordination assessment looks at the working relationships that were developed among Smart Corridor agencies at the operational, technical and management levels. Similarly, the systems benefit analysis focuses on the effectiveness of the day-to-day operational arrangements established between Smart Corridor agencies. The system user assessment concentrates on the impacts of the Smart Corridor on the people who actually used the system. As a whole, this evaluation seeks to provide insight on how agencies develop and operate complex ITS projects in a climate of constant technological change, and thereby to facilitate future operations, guide policy-making, and support funding directions. This section specifically addresses evaluation goals 2, 3, and 4 of the overall Evaluation Implementation Plan, and provides a description of the evaluation approach for assessing the Smart Corridor system, data sources, incident descriptions, measures of effectiveness, constraints and assumptions, and findings.

## EVALUATION APPROACH

To evaluate the institutional coordination, system benefits, and system user impacts of the Smart Corridor system, a multi-faceted approach was used based on existing data sources supplemented by interviews, surveys, and a focus group.

## DATA SOURCES

A number of key resources were utilized for data collection, specifically:

- *Smart Corridor Lessons Learned* Report and Appendix,
- Smart Corridor Steering Committee Focus Group and Interviews,
- Interviews with key individuals recommended by the Steering Committee,
- Internal project management documents,
- System logs.

These are described below. In addition, a survey was distributed and follow-up interviews conducted with a segment of systems users. However, it should be noted that while data was readily available to address the institutional coordination and systems benefits assessments, there was limited public awareness of the impacts of Smart Corridor on the system users, rendering the evaluation of this element largely inconclusive.

A list of discussion points was developed to drive the focus group proceedings as well as to guide the one-on-one interviews (see Appendix C). These discussion points were circulated to the Steering Committee members prior to the scheduled focus groups and interviews via mail and email. These interviews sought to complement and enhance the information presented in the Lessons Learned report, and other supporting materials.

While the interview and focus group data are qualitative, the review of the system logs in fulfillment of the systems benefits assessment provided somewhat more objective data.

Smart Corridor Lessons Learned Report and Appendix

The *Smart Corridor Lessons Learned* report and appendix, prepared by TransCore, the prime consultant for the duration of the Smart Corridor project, was released on March 31, 1999 close to the conclusion of the project. The report and its appendix address the decision-making processes that occurred during the development of the system configuration, hardware selection, software design, systems integration and the adoption of operating policies. They also examine inter-agency interactions, the processes and procedures followed, and Smart Corridor's individual technical sub-components. The purpose of Lessons Learned was essentially to identify factors to be considered if components of the Smart Corridor were to be transferred or replicated elsewhere.

Specifically relevant to this evaluation in the Lessons Learned exercise are the chapters on "Agency Findings" and "Institutional Considerations" respectively. The "Agency Findings" chapter identifies the project's strengths and weaknesses from the agency perspective. These findings were extrapolated from interviews and workshops, as well as from a detailed survey that was conducted amongst key individuals in the agencies involved. The "Institutional Considerations" section describes what could have made the project more effective from an institutional standpoint.

The Lessons Learned Report and Appendix were reviewed prior to the development of the discussion points. Where appropriate, issues of relevance to this evaluation, but not covered in these documents, were identified and included in the discussion points to be specifically addressed in the focus group and interviews. In this way, areas not (or lightly) addressed in Lessons Learned were explored in greater depth.

This evaluation will thus seek to complement the Lessons Learned report by providing an objective third-party assessment of the Institutional Coordination, Systems Benefits and System Users elements of the Santa Monica Freeway Smart Corridor.

Smart Corridor Steering Committee Focus Group and Interviews

Per the direction of the Smart Corridor Steering Committee, members of this group volunteered to serve as the forum for an informal focus group as well as the basis for the first round of interviews.

The Steering Committee currently includes the following individuals:

- Peter Liu — LACMTA
- Eddie Curtis — LADOT

- Randall Tanijiri LADOT
- Allen Chen Caltrans D-7
- Dick Murphy Caltrans D-7
- Pete Thomson Caltrans D-7
- Jeff Aragaki Caltrans D-7

Representatives from other participating agencies at the cities of Beverly Hills, Culver City and Santa Monica were interviewed as part of the Lessons Learned exercise and were not re-interviewed for this evaluation.

The Discussion Points developed to guide the focus group and one-on-one interviews addressed issues germane to the Institutional Agency and Systems Benefits assessments either not addressed in the Lessons Learned Report and Appendix or to probe for further insight into issues worthy of more in-depth research. Note that, where schedules did not permit for individuals to participate in the focus group, members of the Steering Committee instead elected to either submit their responses in writing or conduct a one-on-one telephone interview.

Four individuals from the Steering Committee participated in one three-hour informal focus group on August 3, 2000. With the exception of one telephone interview, the remainder of the responses was delivered in writing.

Responses were received from all members of the Committee.

<u>Interviews with key individuals recommended by the Steering Committee</u>

A number of key individuals associated with this project at some juncture are no longer members of the Committee or have discontinued their involvement in the Smart Corridor project. It was nevertheless very useful to solicit their input, particularly as some current Steering Committee members have experience only with the latter stages of the project. Recognizing that the working relationships developed amongst the Smart Corridor participating agencies were at the operational, technical and management levels, it was also valuable to expand this evaluation's core constituency beyond the Steering Committee to include other key individuals, especially at the managerial level, to enhance this perspective.

In addition to the Committee members identified above, the individuals identified to participate in evaluation were:

- Carole Inge LACMTA
- Shahrzad Amiri LACMTA
- Pat Perovich Caltrans D-7
- Verej Janoyan LADOT
- Frank Cechini FHWA
- Lt. Commander Bill Pasley CHP

At the recommendation of one of the participants, one additional person with noteworthy project history was contacted for information, as follows:

- Jack Smith	Caltrans D-7

None of these individuals listed was able to participate in the focus group, but the option was provided to conduct in-person or telephone one-on-one interviews, or to provide written responses using the same Discussion Points developed for the Steering Committee. Using the same format developed for the Steering Committee provided a consistent approach to soliciting input from all key individuals.

Two in-person one-on-one interviews and three telephone interviews were conducted with this group. Two individuals elected not to participate.

Internal Project Management Documents

The Draft Smart Corridor Operations Policy Statement was also reviewed as part of this evaluation. The Draft Policy Statement documented policy discussions held with the Smart Corridor agencies. These policies would guide decision-making regarding operations of the Smart Corridor to ensure that traffic management actions were coordinated.

The Technical Report, a precursor to the Policy Statement, provided background relating to participating agencies' operations policies and procedures, and their future policy needs.

System Logs

In addition to the focus group and interviews, Goal #3, the Systems Benefit assessment, also required review of the Smart Corridor system logs. This additional input required for the Systems Benefit assessment provided a somewhat more objective balance to the subjective focus group and interview data alone used in the Institutional Assessment.

A review of the system logs provided some insight into the actual day-to-day operational effectiveness of the Smart Corridor as experienced by the technical operators of the system. A total of 23 log entries between 11/4/99 and 12/22/99 were provided for review for the purposes of this evaluation.

Additional Documentation

The Smart Corridor Incident Response Plan, Operator Workstation Manual and LADOT-Caltrans-CHP Operations manual were also reviewed as part of this task.

System Users Surveys and Follow-Up Interviews

Although a System users element was initially intended as part of the scope of the Santa Monica Freeway Smart Corridor project, it was eliminated later due, in part, to challenges with collecting data. Likewise, the Lessons Learned Report did not address the experiences of the ultimate end-user of the project.

As a result, one of the important challenges encountered in meeting Goal #4, the Systems Users assessment, was to identify and actually reach the System Users group. Indeed, the beneficiaries of Smart Corridor — travelers along the corridor — were likely quite unaware of the positive impacts of the project as it mitigated incidents before they could adversely affect users of the Corridor. However, a small but highly specialized segment of systems users that may have been aware of Smart Corridor was identified. This included local traffic reporters, CHP, Caltrans' Traffic Management Team (TMT)—the operators of the movable arrows and other features that alleviate freeway incidents, members of the Pathfinder team, and regional Employee Transportation Coordinators.

An initial source of data was Caltrans' Transportation Information People (TIP) database. Individuals from this group meet regularly to discuss issues of mutual importance to traffic reporters and various public agencies. Given the project timeline and various other factors, conducting a focus group with members of this group was not possible. As a result, a survey and cover letter were mailed to members of this group, followed-up with phone calls and, where possible, phone interviews (see Appendix D).

Surveys were sent out to 28 key traffic reporters; eight written responses were received, and four additional phone interviews were conducted.

A phone interview was conducted with the CHP to determine whether its officers were able to observe the impacts of Smart Corridor in action or to gauge its perspective on the end-users' experience with Smart Corridor. Similarly, a manager of Caltrans' TMT was also polled to ascertain whether TMT operators had any experience with, or observations about, the Smart Corridor. Other potential Corridor users, including members of the Pathfinder team, the coordinator of local rideshare organizations and its consultant as well as representatives of the Auto Club were also contacted.

In addition to the traffic reporters, the following individuals were also contacted regarding the System Users assessment.

- Ray Higa — Caltrans D-7, TMT
- Terry Wong, Yi Tsau — Caltrans D-7, Pathfinder team
- Karen Solomon — SCAG/Southern California Rideshare
- Bill Huddy — Rideshare consultant
- Representative — Auto Club

Furthermore, some of the observations of the system operators reflected in the interviews were helpful in determining impacts on the traveler.

## CONSTRAINTS AND ASSUMPTIONS

A significant constraint was imposed on the evaluation for practical reasons beyond the control of the evaluation team:

- Project duration has been more than a decade. Consequently, turnover in staff assignments among agencies and consultants, and an absence of a centralized and comprehensive source of institutional history have impacted the availability of primary data. Additionally, much of the primary data is anecdotal, based on the experiences of both current and former project staff, while available secondary data is sparse and limited to approximately two months of system logs. Indeed, many of the core individuals involved in the initial start-up of this project are no longer associated with the project or have since retired. Nevertheless, both the Committee members and the suggested interviewees proved to be invaluable reservoirs of institutional history. We received input from all but two persons targeted for the focus group or interview.

Reaching systems users, as noted earlier, provided a special test. The ultimate system beneficiaries, travelers along this stretch of the I-10, would most likely only notice when the system did not work—if they were aware of the system at all. A limited public education effort was conducted as part of the project, involving a video, press conference and collateral materials development. The project also received publicity from a related article in the Los Angeles Times. Moreover, this outreach effort took place more than five years ago and, in a climate where people were constantly bombarded with information. As a result there is likely little vestige of memory of the Smart Corridor System.

- It was therefore assumed that there is negligible public awareness of the technical details of the Smart Corridor project. As a result, the assessment required that alternative systems users be identified who had knowledge of the project. Thus, the system users targeted for the assessment cover three perspectives of end-user—the traffic expert (traffic reporter), the incident observer (CHP and TMT) and the "traveler professional" (Rideshare). Responsiveness of these target groups to the survey and phone interviews was important to the success of this assessment.

## FINDINGS

Findings are grouped under three headings: institutional coordination, system benefits assessment, and system user assessment.

### Institutional Coordination

The Institutional Coordination assessment investigates the working relationships that were developed among the Smart Corridor participating agencies at the operational, technical and management levels.

The Smart Corridor System required a new inter-agency and inter-jurisdictional organization structure for managing the development, deployment, maintenance and operations of a groundbreaking project. Indeed, getting a project of the magnitude of the Smart Corridor off the ground required significant institutional coordination, inter-agency communication and individual commitment. This component of the evaluation addresses the way various agencies worked together, their roles in the project and how the agencies and individual staff members were able to translate their experiences with the Smart Corridor on to similar projects.

At this juncture it is useful to outline what each agency brought to the table as the project commenced:

- **Caltrans** operated the District 7 Traffic Operations Center (TOC) 24 hours per day. The TOC, in conjunction with the CHP, disseminated information via the commercial radio stations and CMSs. The TOC could also dispatch the Traffic Management Team (TMT) to incident locations to provide continuous monitoring and coordination. The Semi-Automatic Traffic Management System (SATMS) operated by Caltrans included 67 instrumented freeway detector stations and approximately 400 detector loops to provide volume, occupancy and speed information in this corridor. SATMS included 12 CCTV cameras and 8CMSs.

- The **City of Los Angeles** through LADOT maintained its control center, the Automated Traffic Surveillance and Control (ATSAC) Operation Center which controlled approximately 450 signalized intersections in the Smart Corridor area. The center received traffic information from 1600 loop detectors and 30 CCTV cameras at selected intersections on the surface streets. In addition, LADOT operated 5 CMSs and 25 Trailblazer signs within the study area.

- The **California Highway Patrol** (CHP) played an active role in the Smart Corridor Project by providing law enforcement services required to rapidly clear major incidents. In addition, the CHP's computer-aided dispatch system served as a tool for detecting and logging incidents, and for disseminating motorist information to the media.

- **MTA**'s role in the Smart Corridor was project management and oversight.

One of the Smart Corridor's earliest challenges was finding ways to integrate all these elements into a streamlined new system.

**Overall Project Organization**

Before implementation of the Smart Corridor project, agencies along the I-10 Corridor worked independently of one another, sharing only limited traffic information. This practice resulted in a lack of integrated corridor traffic planning. The Smart Corridor, however, encouraged participating agencies to take another look at their institutional processes and procedures, and focus on the transportation and mobility needs of the Corridor as a whole.

From the earliest stages of the project, staff resources at the agencies were shared and coordinated. A Technical Steering Committee was formed which oversaw the project. This committee met on a weekly basis during the project's initial stages but later took place bi-weekly as the project moved forward. Individuals from all agencies involved participated in these meetings and the committee's atmosphere was largely collegial and cooperative throughout the project. The project consultant, TransCore, joined these meetings on an as-needed basis.

A Policy Committee of executive management from each agency was briefed periodically, and met when required to address general policy issues and to make higher-level technical decisions. However, meetings of this group took place infrequently so executive management was not involved on an ongoing basis in inter-agency peer-to-peer decision-making. Responsibility for these activities was delegated to members of the Technical Steering Committee. Members of the Technical Steering Committee mostly reported to their immediate supervisors within their agency, and interacted with each other to a lesser extent.

The difficulty of this organizational structure for the Smart Corridor was two-fold. Firstly, all individuals involved in the project were participating in all aspects of the decision-making at all levels. Put another way, the Technical Steering Committee not only had to focus on more global policy-related or project management issues, but the group as a whole was also responsible for the technical minutiae of everything from software development, to camera angles and other operational issues. Secondly, executive management at the agencies was less actively engaged in the project, so higher level decision-making fell to the Technical Steering Committee.

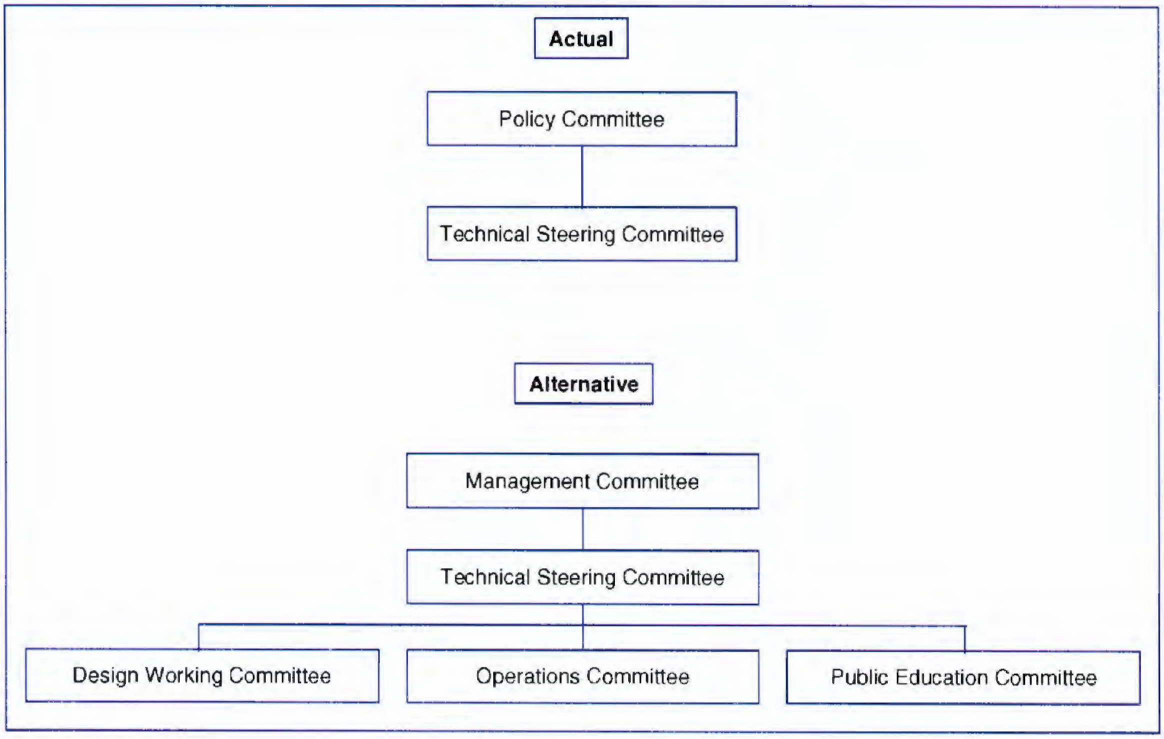
Consensus among most interviewees is that projects could have been organized differently from the larger, more complex phases used in the Smart Corridor. It might have been more productive to break elements of the project down into smaller pieces by executing them in shorter, multiple phases with dedicated teams established to address these specific elements.

For example, a Management Committee see (Exhibit 5-1) responsible for the overall project management supported by a number of Working Committees might have contributed to alleviating the, at times, overwhelming task associated with start-up of such an innovative and pioneering new project. Working Committees might, for example, include:

- Design Committee, to oversee development of the system architecture,
- Operations Committee, comprising traffic engineers and front-line operators, to operate the system and perform signal timing and coordination, system configuration, sign activation and equipment maintenance,
- Public Education Committee, to develop and implement motorist information and public information plans.

This approach allows the project to be broken down into more manageable pieces and proceed on parallel tracks. In this way, the decision-making and planning processes are streamlined and different elements of the project are able to move forward simultaneously.

### Exhibit 5-1: Smart Corridor Organizational Structure




Having a project "champion" at the staff level and at the senior executive level was cited as a key success factor for a project like the Smart Corridor. At the earliest phase of the project, the Smart Corridor had an active, enthusiastic and dedicated staff member attached to the project who worked to involve and coordinate participating agencies, motivate staff, brief stakeholders and key elected officials and help secure additional project funding. It was universally felt that this champion contributed to the ultimate realization of the Smart Corridor project.

Ideally, a project "champion" would keep the project moving forward, and would engage senior staff colleagues in the participating agencies to then feel vested in the project's success. A senior staff "champion" would have the credibility to interface with senior management at other transportation agencies, as well as with regional planning agencies and elected officials. In addition, interviewees noted that the Smart Corridor is not an easy transportation operation concept to "sell" and it is important that potential stakeholders understand the new technologies and concepts. A champion would take the initiative and provide a key project leadership role.

Participants in the subsequent regional ITS projects who were also involved in the Smart Corridor note that decision-making was broken down into smaller, goal-oriented and more manageable elements. This was an important and valuable lesson learned from the Smart Corridor.

## Definition of Project Scope, Objectives and Expectations

By anyone's definition, the Santa Monica Freeway Smart Corridor project was an ambitious undertaking. Inasmuch as it was the first project of this nature embarked on in the country, it required a pioneering approach not only towards inter-agency cooperation and coordination, but also to the development, deployment and operation of an essentially new system. Providing a clear definition and understanding of the project's scope was an important challenge at the outset but, beyond the language of the grant, there were no clearly defined and mutually accepted mission, scope, objectives and agency expectations at the Smart Corridor's inception. Indeed, a Draft Policy Manual addressing the Smart Corridor's mission was circulated only in 1993, well after the project had commenced in earnest. More notably, this mission addressed the project in the most general terms, rather than with clear, achievable goals and timelines.

The Lessons Learned report noted, and the interviews corroborated, that both the agencies and the consultant underestimated the project's complexity and the schedule required to complete it successfully. In an understandable eagerness to move forward with this exciting new project, technical planning issues overtook not only the definition of the Smart Corridor's scope, but also clarifying the expectations of participating agencies. Had the Smart Corridor been anchored with a clear mission and scope, it is anticipated that many of the project's challenges could have been circumvented.

Given the innovative and truly groundbreaking nature of the Smart Corridor, accompanied by the details involved in deploying a project of this size, it is not unexpected that a participant in the project's earliest stages stated: "We bit off more than we could chew". (This was partially attributed to moving ahead with the Smart Corridor before finalizing the project's scope and purpose, and clarifying the agencies' expectations with regard to the technology available at the time.) As another interviewee stated, participants needed to understand "What's the benefit to my agency? What's the benefit to the public?" As a result, there were different levels of expectations for the project amongst agencies and individuals. This led to delays as the project moved forward as the areas of debate were ironed out.

Before kicking off a project like the Smart Corridor, it is important to define and clarify project scope at the inter-agency level before technical issues are addressed. One way to achieve this objective is to convene a workshop prior to the initial project meetings to clarify the project scope and refine participant expectations. Recognizing the somewhat evolutionary characteristics of the Smart Corridor and similar projects, it is appropriate to provide a statement of the project's scope and a blueprint for its development, deployment and operations yet incorporate sufficient flexibility. This would include an understandable strategy for achieving this vision, clear documentation, and communication of this information to all stakeholders. By the same token, given the Smart Corridor experience, it would be very important to provide clear guidelines in the project scope related to technology, timeline and agency responsibilities.

Participants in the subsequent regional ITS projects noted that expectations for the project were defined ahead of time.

## Levels of Cooperation and Coordination Achieved

In working together, many for the first time, significant levels of respect and mutual trust were achieved by agencies with previously uncoordinated agendas for traffic management within the Corridor, and by individuals within these agencies. Indeed, the Smart Corridor provided the foundation for a legacy of improved inter-agency relationships across the region. In addition, the agencies learned to perceive the Corridor as a shared responsibility and how an agency's individual action might impact the system as a whole.

An overwhelming majority of participants noted that, as a result of the Smart Corridor, they had established good working relationships and interpersonal communications with individuals at the partner agencies. To the extent possible, some participants had remained actively involved in the project for extended periods of time and wanted to be perceived as "team players". Clearly, interpersonal communications issues and institutional rigidities on a project of this scope are to be expected and it was acknowledged "it takes time to work though these issues". However, this process was not necessarily considered an impediment because consensus was built as operational and technical issues were worked through.

Another key success factor was that the agencies learned to regard the whole transportation system as a shared responsibility. Instead of making a number of discrete decisions affecting areas under their jurisdictions, the agencies became aware of how elements of the system work in concert towards a collective goal. The agencies also discovered how their individual actions fit into the transportation system as a whole. Thus, Caltrans and LADOT, for example, came to understand how actions by one agency on the freeways impacted the surface streets and vice versa, and were thus able to better appreciate the perspective of the other agency's approach to incident response.

Testament to the success of the Smart Corridor in fostering improved inter-agency coordination was a suggestion by a participant to find additional ways these agencies could cooperate and communicate in the future. At the operational level, introducing an email "bulletin board" where all project staff from all agencies could communicate with each other would provide a continued sense of common purpose, information sharing and morale.

Although there was overwhelming sentiment about the positive experience attained with the Smart Corridor, there was some concern voiced that different agencies demonstrated different levels of commitment to the project. This issue can be partially, though not completely, addressed in clearly defining the project's scope and organizational responsibilities during the earliest stages of a project.

A further challenge to the coordination efforts was the ambitious nature of the project in an environment of ever-changing technology. As a result, the project experienced stops and starts, and project delays as new technologies were implemented and systems retooled. This, in turn, not surprisingly led to either waning interest or frustrations on the part of participants who worked hard to keep interest in the project and momentum going.

As noted, the organizational structure of the project contributed to some delays, but most of the delays were attributed to implementation of new technologies. For example, participants specifically cite that speedier implementation of the central system would have made it easier for agencies to remain committed to the project. At the same time, some of these interruptions in momentum were caused by changes in project scope as a result of new technology. This becomes a "chicken and egg" conundrum. A lesson the agencies learned against the background of ongoing technological advances is to deploy a project fast enough so that incorporating new technologies does not become a hindrance to project deployment. Put another way, one participant recommended that once the scope of the project is defined, "select a project and stick to it".

Most participants are committed to build on the goodwill between agencies and individuals by working together in an environment of mutual respect and trust. They also acknowledge that projects must be quickly and efficiently deployed to maintain project momentum and morale.

**Determining Operational Responsibilities**

Recognizing the number of agencies involved in Smart Corridor, defining operational responsibilities and clarifying organizational roles was essential. At the onset of the Smart Corridor project, the agencies partitioned their areas of operational responsibility based on their jurisdiction:

- Caltrans maintained oversight of elements of the project associated with the freeway;
- LADOT was responsible for the arterials;
- CHP was accountable for freeway incidents; and,
- As the provider of additional project funds, MTA had overall project management oversight.

The agencies were comfortable with this clear partition of responsibilities as they uniformly felt it minimized risk and potential liability issues. These operational responsibilities were articulated in a Draft Operations Policy Statement dated June 1994.

The agencies involved in the actual day-to-day operation of the system were Caltrans and LADOT. Each agency determined which devices or elements of its system would be used to contribute to the Smart Corridor. Because operational roles were strictly defined, it was agreed that each agency would operate its own devices – in effect, they would take the lead depending on the location of the incident. Thus, while the system was capable of cross-control, the agencies chose not to cross-jurisdictional boundaries to operate the other's devices due partially to liability concerns and the sense that "we know our systems best". The agencies perceived this as a control issue but conceded that delegated privileges granted agency-to-agency would be appropriate under special circumstances, e.g., on one occasion, LADOT changed a ramp meter rate from the ATSAC center.

Interviewees almost universally agreed that a lead agency is needed to guide the planning of major projects of this nature, especially for the development, and deployment phases. The agencies reiterated that they should be responsible for operating their own devices, so actual implementation of elements of the project would revert back to the agency's jurisdiction. However, while there was the need for a lead agency, participants agreed that a collaborative effort between agencies as experienced through Smart Corridor should be replicated elsewhere. One participant, however, felt that a multi-agency project should not have a lead agency but rather be managed cooperatively by an oversight committee.

In addition to Caltrans, LADOT, MTA and FHWA, the cities of Beverly Hills, Culver City and Santa Monica became involved in the Smart Corridor, as system components were deployed within their jurisdictions. However, none of these cities maintained software interface, access to the hardware infrastructure or provided the necessary ongoing commitment of resources to the project.

Involving additional jurisdictions mid-way through a project is appropriate for a pilot/demonstration project. However, during deployment and operations of an operational system, it was felt that only agencies which could contribute a functioning software interface, access into the hardware infrastructure and provide a continuing operations and maintenance commitment for the life of the project should be able to partner on future projects.

Indeed, one participant felt that agencies and/or jurisdictions should undergo an interview process to gauge their level of commitment to the project to determine future participation. It was also felt that, at some level, media should be included as a partner in the effort. This may be addressed somewhat by including a public education element in projects of this nature, perhaps by convening a public outreach working group.

The Smart Corridor project did not formally recognize actual operational responsibilities between the partner agencies by adopting a Memorandum of Understanding (MOU) for the project. Although a draft MOU was prepared, it was not actually adopted for a number of reasons. Firstly, the nature of an MOU as a legal document, with built-in clauses would have prevented the flexibility required to successfully proceed with an evolving project like the Smart Corridor. Secondly, it raised the issue of tort liability. The agencies were collectively leery of becoming distracted with developing a legal document which, they felt, would interfere with their first priority which was deployment and eventual operations of the Smart Corridor. As a result, the agencies proceeded to work together in an environment of mutual trust without either an MOU or any other type of legal documentation.

The absence of a MOU actually would have added benefit because agencies would be willing to be flexible in an effort to make the project successful. Although an MOU was not adopted for the project, some participants thought that a "guiding legal document" would instead be more appropriate. For example, a simple Master Agreement conveying a sense of a mutual "we're all in this together" involvement among the agencies should guide future cooperative projects of this nature. A Master Agreement would make financial and other responsibilities clear without placing the agencies in a legal "straitjacket".

An MOU for new start-up projects does not provide sufficient flexibility for a project of this kind. Although some subsequent projects have required MOUs, many also proceed with more flexible Master Agreements.

There was firm reluctance on the part of the agencies to allow another agency to "cross over" into its area of jurisdiction due to liability and control concerns. However, this has been achieved successfully on subsequent ITS projects in other parts of the country. This is partly attributable to institutional rigidities within and between these organizations.

**Information Sharing**

As explored in a previous discussion under "Overall Project Coordination", there is a strong recognition that agencies cannot operate their systems in vacuum, and that they have evolved past the point where they can work alone. First and foremost, therefore, it must be noted that Smart Corridor's considerable achievement is that it broke the barrier of interface between agencies, and between agencies and local municipalities.

On the whole, participants felt that information sharing improved both at the technical and at the personal level. Indeed, in the post-Smart Corridor environment, information sharing on a strictly voluntary basis between agencies has increased (although they remain loath to share information with the private sector).

The Smart Corridor employed a centralized information storage mechanism appropriate for a demonstration/pilot project of this kind. The system collected incident data that was sent to and stored in this shared central depository. An expert system would create, then present, an incident profile that would be forwarded to the Smart Corridor operator for confirmation. Following confirmation, the expert system would develop a response plan using any or all of the system components to mitigate the impact of the incident. If approved by the operator, the expert system would implement the response plan, monitoring the situation and recommending changes until the incident was cleared. Operators, who all had access to the same information provided by the data depository, accessed the Smart Corridor via a common window-oriented graphical user interface (GUI).

The information-sharing component between agencies becomes germane to this evaluation inasmuch as the response plan recommends actions that impact the devices of multiple jurisdictions.

Prior to Smart Corridor, these agencies neither shared their database of information, nor "spoke" to each other via a software interface. Each agency had its own database of information that it would act upon independently. With the Smart Corridor this all changed. A central database of information was set up at Caltrans, while operators at Caltrans and LADOT were able to address traffic incidents through a shared software interface (although jurisdictional requirements still were in place).

From a technical standpoint, there was information that was not shared between agencies, largely for institutional reasons. The agencies were willing to share information, but, as has been well documented in this report, they were averse to ceding control over their devices to another agency. For example, the agencies were prepared to share some information such as video data, but felt that the data's 'owner' should drive the extent to which information is shared. "Each agency must decide what and with whom to share information". This challenge is surmountable by clearly identifying what information the agencies are willing to share by type, format and frequency.

Some of the information sharing challenges were not institutional but rather technical, specifically related to the linking of two large agencies with different computer software. The software incompatibilities between the agencies that occurred throughout the Smart Corridor had to be resolved as keeping apace with software and other technological improvements at one agency rendered the interface with the other outdated. This situation was exacerbated by the fact that software on the Smart Corridor project was custom-designed. This software incompatibility has resulted in a stated desire by all interviewed to standardize similar projects wherever possible. In this way, the interface would more cost effective, and efficient.

One of the lessons learned by all involved is that sharing information via a centralized database, while appropriate for a pilot or demonstration project, is not optimal for day-to-day operation of a larger system. Caltrans is now decentralizing its database that will spearhead the region toward distributed information sources that are available to multiple agencies on an as-needed basis. This system will hold each agency responsible for the information that they make available to others and what controls are needed. Decentralizing the informational database, however, has not diminished in any way these agencies' commitment to continued sharing of information.

Most recently, agencies have built on their past experience with information sharing on the Smart Corridor. The August 2000 Democratic National Convention (DNC) provided a clear case in point where Caltrans, LADOT, CHP and other public agencies all shared information to facilitate traffic flow, street closures and other traffic control elements. In addition, MTA continues to provide information to these agencies on ongoing basis. And, LADOT, by the same token, has assisted MTA with developing and deploying the transponder system for its Rapid Transit buses.

**Unanticipated Challenges to Institutional Coordination**

Launching a project of the scope and innovation of the Smart Corridor presents a number of unforeseen challenges including schedule and cost. While budget proved not to be a major factor affecting the Smart Corridor's completion, the project schedule took longer than anticipated. As noted previously, non-adherence to the project schedule was largely attributed to technology changes and the system design issues arising from these technological advances. The Smart Corridor project was likened to "designing to a moving target" where there was constant adjustment of software systems to keep pace with upgrades at other agencies. Put another way, Smart Corridor required the design and development of complex software that took longer to complete than envisioned. It was suggested that moving towards adopting standards would address this problem. Secondly, delays were also ascribed to turnover at the staff and consultant level. Lastly, schedule non-adherence was also attributed to the sequence of contracting.

Other institutional issues arose at the policy level such as signal timing and length of clearance time, but these were resolved cooperatively between the agencies.

System Benefits Assessment

The Systems Benefit analysis focused on the operational arrangements and protocols adopted among agencies for using the Smart Corridor system. The purpose of this analysis is to draw conclusions and make recommendations that address the operational barriers and challenges encountered during the project, and to suggest possible solutions. Thus, this assessment focused on the day-to-day operational effectiveness of the Smart Corridor.

The smooth day-to-day running of a project of the scope of Smart Corridor requires establishing clearly defined organizational roles. As already noted, all involved agencies participated in the Technical Steering Committee and contributed their various operational strengths. This discussion considers how the Smart Corridor actually worked on a daily basis and, in turn, how it impacted the operations of the participating agencies.

To recap, MTA dedicated a key staff member to manage the Smart Corridor project on a day-to-day basis. MTA managed the project as a whole, and, as such, was the focal point for coordinating, problem solving and maintaining inter-agency cooperation. One agency, MTA, was thus responsible for keeping the overall vision of the project on track but also facilitating the project administration including the systems integrator/manager consultant contract, submitting required reports to FHWA and arranging Committee meetings. At the time of the project, MTA did not have a specific ITS Department so the success of the project was dependent on the Project Manager's authority and autonomy.

LADOT maintained a special internal unit designated for the Smart Corridor with a stable and consistent cadre of staff allocated to the project. Thus, commitment to the Smart Corridor was actually entrenched in the Department's organizational structure. Staff rotation between assignments was minimized, where possible, so there was staff available to work on this project on an ongoing basis. As a result, LADOT maintained a high level on institutional history throughout the project.

Caltrans weighed in with its considerable operational experience to help design the system. A number of key individuals at Caltrans worked on the Smart Corridor for extended segments of the project and also had some ongoing institutional memory.

In terms of day-to-day operations, Caltrans and LADOT were the primary operators of the system. The Smart Corridor was monitored at a dedicated project computer terminal during peak periods by both agencies. The operators at the two agencies were able to communicate with each other via computer terminals. CHP's Computer Aided Dispatching System, however, did not support the system interface and was eventually excluded from linking with the Smart Corridor.

At the agreement of the participating agencies, the Smart Corridor was operational only during peak hours. However, outside these hours, the Smart Corridor was not utilized even if an incident had occurred. This was largely due to project staffing limitations. Without the system operating all day for a consistent period of time, and with minimal system failures, assessing the operational effectiveness of the Smart Corridor posed a challenge to this evaluation.

**Operational Policies and Procedures**

In the multi-jurisdictional environment of the Smart Corridor, it was important to develop policies, procedures and mechanisms in order to effectively respond to a situation so that the system could run efficiently. Not unexpectedly, all participating agencies had distinct policies relating to operational elements of their own transportation system and the challenge lay not only in developing policies and procedures for an inter-agency start-up project but also in resolving which policies would take precedence should inter-agency divergences arise.

Although the partner agencies often had different policies and procedures, as a rule of thumb, the policy/procedure of the agency with jurisdiction took precedence. On the whole, operation of the Smart Corridor system did not directly impact the operational policies and procedures of each agency. For example, the system software was created to make decisions impacting elements of the Smart Corridor at the locus of the incident thereby maintaining the autonomy of each agency; in other words, the self-enforcing software was designed to assign each incident to the responsible agency. As a result, "safeguards" were built into the system to ensure that agencies could not make decisions outside their jurisdictions so there was no flexibility for, or commitment to, rotating responsibilities amongst agencies.

Moreover, the response plans were stored in an expert system so the operators, from either agency, were not called on to make policy recommendations and manipulate the system in response to an incident. Indeed, operators could only respond where they could view the incident through the freeway cameras. Most interviewees cited that this mechanism ensured the safety and reliability of the Smart Corridor system.

Although a Smart Corridor Operations Policy Statement was developed and presented in June 1994 by the project consultant with input and direction from the multi agencies' Steering Committee, like the project goals and objectives, it was not formally adopted. Clearly stated in the overall statement was that the intent of the policies was to develop informal understandings for cooperative operations instead of rigid legal agreements or formal MOUs (see subsection entitled Determining Operational Responsibilities). The Policy Statement addressed a number of specific policies targeted towards:

- General organizational oversight, including Traffic Operation Manager designation, Smart Corridor training and data retention,
- Incident detection, such as transfer of planned event information and detection of planned events,
- Incident confirmation, including recognition of current congestion, CCTV camera operations, email usage, operator confirmation and other agencies, and conditions for operator confirmation of an incident,

- Incident response, such as Traffic Operations Management and Scene Management, signal timing and ramp meter metering, Sig-Alert initiation and cancellation, traffic vision media information, use of freeway CMSs, use of surface street CMSs, use of freeway HAR and use of surface street HAR,
- Response plan execution, including approval of response plan execution by the operator, response plan execution by other agencies and conditions for approval of response resources; and,
- Incident monitoring, including monitoring requirements, resolution of response resource conflicts, conditions for termination and modifications of response plans, and scene information requirements for monitoring.

These policy statements were clear, concise and addressed Smart Corridor's key operating procedures. Although these were presented to the operating agencies for approval as informal inter-agency understandings, the agencies did not formally sign-off on the Policy Statement document. However, according to all interview respondents these policies were followed during the life of the project. Thus, although common policies and procedures were not formally adopted, which was largely attributable to liability issues between the agencies and/or jurisdictions, a level of cooperation was apparent.

The fact that these agencies worked together in an environment of mutual trust and cooperation without formal adoption of policies and procedures was without a doubt a positive consequence of the Smart Corridor. Nevertheless, these project policies were not formally adopted, which again can be attributed to liability concerns but also to the absence of a mutually embraced project scope. A sense of common purpose would be enhanced, however, by formally adopted policies and procedures but these need to be written with sufficient flexibility to afford comfort for all agencies involved. This was reaffirmed by a sense from interviewees that project-specific policies and procedures evolve during a project of this nature so it is important to foster a sense of collective decision-making.

The Corridor Team, through discussion and negotiation, resolved conflicts where different policies and procedures were in place for the cameras and ramp meters. Another area where compromise was reached was with the CMS where policy was relaxed to capture traffic diversion.

However, there were a number of institutional barriers at the policies and procedures level, specifically related to the syntax of CMS and the approval mechanism for message use. Overall, the agencies attempted to be more flexible in their policies and procedures in working on the Smart Corridor. However, they were often precluded from being more flexible because of institutional rigidities.

As operators have moved on to work on other projects, they have learned to respect each agency's independence and jurisdictional responsibility. They understand that while they have common goals in addressing regional congestion relief their policies towards these goals and procedures may not coincide. Most respondents state their experience with the Smart Corridor as being instrumental in assisting with setting up the policies and procedures of subsequent ITS projects. They also state that their approach to developing policies and procedures is inclined to be less rigid reflecting the greater flexibility of agencies and individuals to compromise and change as a result of their experience with the Smart Corridor.

For a number of reasons including duration of the project and staff turnover, many members of the Steering Committee (and, most notably, its most recent operators) were unaware that Smart Corridor operational policies and procedures had been developed. Distribution of the Smart Corridor manual, perhaps as part of an initial training program, was suggested.

**Operational Quality Control Policies and Procedures**

Key to operational effectiveness is introducing and imposing quality control procedures that measure the operational performance of a system as a whole, as well as its individual elements. Like most projects in their teething phase, the system experienced frequent stoppages and malfunctions which varied from non-operating freeway cameras to failure of the software interface between Caltrans and LADOT. On occasion, there were also no operators available to activate the Smart Corridor's response mechanisms during an incident, so no action was taken.

While these procedures are ideally developed prior to the system's performance testing, the Smart Corridor system underwent many changes, so a schedule of performance testing proved difficult to conduct and maintain. As a result, acceptance and other performance tests were often developed after a system element had been developed.

The Smart Corridor system was programmed to always generate response plans. However, it is estimated that 90 percent of the time it reported "false" incidents while the operator was able to verify about 10 percent of the time that a "real" incident had occurred. In addition, for every hour of operation, the system experienced two hours of down time although this improved over time. As a result, the system required considerable troubleshooting.

As the Smart Corridor became operational, operator logs were utilized as a means of project reporting and quality control. In this way, some policies and procedures were in reality developed by the Technical Committee independent of those of the partner agencies.

**Maintenance Policies and Procedures**

While efficient day-to-day operation of a project is vital to its ultimate effectiveness, just as important is its maintenance. For example, a massive power outage on the Smart Corridor system would have the same functional impacts as an earthquake on a bridge. While non-operation of the Smart Corridor would have had significant impacts on the Santa Monica Freeway Corridor as a whole, it is important to examine a project's maintenance procedures to determine its ability to respond to an incident. Indeed, many interviewees felt that sufficient resources should be dedicated to maintenance that was identified as a key factor contributing to the success of projects of this type.

In theory, all key agencies were provided equal access rights to calling in contracted service to address maintenance issues. However, in practice, the Technical Committee defined jurisdictional responsibilities and maintenance needs for the system. As with determining operational accountabilities, each agency agreed to service and maintain the devices it operated and again, no agency's authority superseded that of another in providing maintenance on elements of the system that it did not control. Thus, if the software maintenance function was performed by LADOT, that agency's maintenance policies and procedures would apply and take precedence for this element of the project. If agencies identified conflicting policies or procedures, they were resolved through the Technical Team and had no impact on the policies and procedures of participating agencies.

Although agencies participating on the Smart Corridor Project became comfortable with the system working as an operational whole, separate maintenance policies and procedures were nevertheless followed by each jurisdiction, reflecting ongoing institutional rigidity. Moreover, where elements of the system were shared, maintenance accountabilities were not clearly distinguished.

For an inter-jurisdictional project to really work in integrating elements from difference agencies successfully, it is important that the project is recognized as a discrete entity. Thus, maintenance policies and procedures should be adopted to reinforce the sense of mutual involvement of a number of agencies, separate from those of the participating agencies. This does not mean, however, that maintenance policies should be at odds with those of any agency but rather might be developed through mutual agreement and compromise. Moreover, with a future distributed and de-centralized system, maintenance responsibility will be better distinguished because it will clearly reside in each agency's distinct jurisdiction.

In addition, there was overwhelming support not only for securing maintenance contracts, but also for establishing maintenance reporting mechanisms. This would, for example, provide a centralized depository for maintenance issues including a log that is accessed by dialing in to a workstation. Maintenance protocols should be established ahead of time.

System operators, the individuals who were most impacted by maintenance issues, expressed frustration that maintenance and other related problems were not addressed in a timely manner. The consultant was not located in the immediate geographic area of the Smart Corridor project, so troubleshooting had to take place via long distance telephone communications or, where particularly intractable circumstances warranted, arrangements had to be made for the consultant to fly across country to address the issue. As a result, there were considerable unplanned delays as a result of maintenance.

Realistic maintenance resources, particularly for groundbreaking projects, should be factored in to project budgeting and planning. However, these types of maintenance issues are unlikely to be encountered to this degree on future projects because of the trend towards system software standardization.

As Smart Corridor participants have moved on to other projects, their experience has dictated that they request appropriate and realistic maintenance agreements. Indeed, as a result of the Smart Corridor, in-house software development is currently a priority at one of the agencies so that individuals who understand the system conduct maintenance.

### Operational Expandability & Scalability of Smart Corridor

Given the past resources committed to the project, the expandability and scalability in terms of both organization and operations were investigated. In terms of organization, the success of the inter-agency coordination element of the project is undeniable. Indeed, many agencies and individuals involved in Smart Corridor are working together on subsequent projects with even more jurisdictions involved.

Smart Corridor's expandability and scalability in terms of operations are hazier given the advances in technology since it originally became operational. Indeed, the Smart Corridor ran using software that was not Y2K compatible. Moreover, this software was custom developed and the software architecture is rigid inasmuch as new agencies or jurisdictions cannot be added to the existing system. This picture is further confounded by current trends away from a centralized information system.

The Smart Corridor experience led to consensus that standardized protocols are required which can be modernized to fit with proprietary architecture. In this way, the software interface "can and must work with other local agencies". The region is now moving toward a distributed Information-Coordination Smart Corridor concept that could be applied in the greater Los Angeles area where problems exist that can be relived by this a coordinated traffic flow solution.

Additionally, the Smart Corridor does have a number of universal applications that can be applied to any new project including its operations planning, which may require customization, and how its institutional parameters are encoded.

### Approach to Staffing

Availability of key staff provides project momentum, inspiration and morale. Indeed, as seen previously, having a project "champion" with enthusiasm and leadership qualities is key to the ultimate success of a project to harness momentum and to keep the effort on track.

### Staff Commitment and Continuity

As demonstrated earlier, all agencies participating in the Smart Corridor committed staffing resources to the project. In its earliest phases, key agencies assigned personnel to the development and deployment of the Smart Corridor and, later, staff members were allocated to operate the system on a day-to-day basis. In addition, staff was assigned to participate in the ongoing Technical Committee meetings.

At the project's inception, most partner agencies chose to assign staff to the project while one partner agency elected to actually create a stand-alone department dedicated to the Smart Corridor project. Those agencies that did not establish a separate department for this project thought that providing dedicated staff provided a sufficient allocation of resources. However, it should be pointed out that this project was new territory to the participating agencies which, to an extent, learned as the project moved forward what was required for it to meet its staffing obligations. As a result, a certain level of institutional flexibility was required in terms of staffing resources.

Although some agencies assigned staff to this effort on an ongoing basis and, to the extent possible, did not rotate key project personnel onto other projects, the duration of the project and varying priority levels of the agencies led to considerable staff turnover. As a result, there were some project participants with long-term commitments and institutional knowledge while newcomers to the group would have to be brought up-to-speed. Thus, sporadic addition of new project staff, to some extent, slowed the project's momentum.

The *Lessons Learned* report notes that turnover, both at the consultant level and at the Agencies, impacted the project, as corporate/agency "memory" was lost whenever a key project member moved on. Thus, new project personnel had to overcome a significant learning curve. Not surprisingly, new staff did not have an understanding of the previous decision-making and often wanted to "second-guess" decisions made previously by the Technical Committee.

None of the agencies were comfortable at all with having either Smart Corridor project staff persons or individual agency representatives act on behalf of another agency. Liability issues were cited as the justification, but institutional issues are also an important factor. Possible remedies include:

- Get the right people on the team,
- Encourage agencies to participate in earlier project user requirement exercises so proper staff qualifications can be defined at beginning of the project; and,
- Select a mix of committed staff as well as those with some relevant technical expertise.

**Staff Skills & Training**

Operating the Smart Corridor required a match of technical skills and practical application throughout the life of the project. Because this project was uncharted territory, the agency did not have specialized staff to begin with and most staffing resources started with existing personnel. However, because this was a pilot/demonstration project, it was universally felt that the level of commitment of key staffers in its earliest phases was more crucial than their specific expertise or skill set although it would also have been an enhancement to have a computer systems expert on board.

Put another way, the interviews revealed that participants' enthusiasm and commitment to the project in its initial phase, rather than their specific expertise, was key to moving the project forward. As the project proceeded, however, it became clearer that certain staffing skills would be useful, though not critical to the project's ultimate success, as it moved into the operational phase.

In the project's development and deployment phase, the skill set brought to the table by the Technical and Steering Committee, as well as the consultant's expertise, was sufficient. But as the project moved forward towards the daily operation of the system, it required not only traffic engineering qualifications, but also participation by strong and skilled staff with software expertise. Key qualifications for operators would be a Traffic, Civil or Electrical Engineering background, with specific skills in Operations, Traffics and Incident Management.

Although the consultant contract specified that there would be a training program, by the time that the project was operational, most operators just experienced supervised on-the-job training from their predecessors over one to two days. Operators noted that using the computer system did not require formalized training but rather software training would be an enhancement to help diagnose the system problems experienced by the operators on a regular basis. Troubleshooting for the system was thus identified as the major purpose of training.

A training program should be conducted for staff of all participating agencies together, rather than by each agency, so that personnel have a sense of shared mission and can see how the system works as a whole. The training program would identify duty statements for all project phases and identify specific training needs.

System User Assessment

As noted previously, neither the Santa Monica Freeway Smart Corridor project itself nor the *Lessons Learned* exercise included a System User component. As a result, there was no data available to directly assess motorists' experiences with incidents along the Corridor for the period it operated. Although a Systems User Assessment was initially proposed, it was later omitted due to anticipated challenges related to scheduling and data collection. Instead, contacts were thus made with other sources where we felt we could glean information about the experiences of the end-user with the Smart Corridor, specifically traffic reporters, other appropriate public agencies, rideshare coordinators, representatives of drivers and Pathfinder program users. The findings are summarized below.

**System User 1— The Traffic Expert**

Between 1990 and 1992, as part of Caltrans' TIP group, traffic reporters were briefed about the Smart Corridor project on a regular basis. However, there was little subsequent contact with this group about the project. Moreover, a number of these individuals have either retired or moved on.

Thus, not surprisingly, the traffic reporters surveyed have little memory or awareness about the Santa Monica Smart Corridor project and its technologies. Some, though, have heard about the Showcase projects or have received related information disseminated by Orange County Transportation Authority (OCTA), via Measure M materials sent to them, or have read articles on ITS technology in the Orange County press. One individual had also accessed information about these projects through an icon on the Caltrans Freeway Vision website that links to information on the Showcase projects, but most were hearing about the Santa Monica Smart Corridor project for the first time.

Approximately half of the traffic reporters that responded to the survey were not aviation reporters, so they were unable to view the Santa Monica Freeway Smart Corridor directly from the air. The aviation reporters could not remember observing differences in traffic patterns as elements of the Smart Corridor system responded to an incident because they were not aware of the Smart Corridor. When asked about the response of traffic to the CMSs, as elements of the Smart Corridor for example, the aviation reporters stated that they are oftentimes unable to distinguish if the CMS have messages posted. Consequently, they could not determine whether the signs were causing motorists to change behavior and/or to alter traffic patterns in response to an incident.

Many of the traffic reporters receive calls on a daily basis about the I-10, but none recalled if questions were specifically related to the Smart Corridor. This further confirms the absence of knowledge amongst the public regarding this project.

All of the reporters offered to assist in any way possible to get more information about the Smart Corridor-type projects into the public domain. All were enthusiastic about ITS technologies and thought that these kinds of projects were exactly what are needed to assist with the region's burdensome traffic.

**System User 2 —The Incident Observer**

As managers or observers of incidents, representatives of the CHP and Caltrans' TMT were contacted to try to assess how agencies responsible for managing freeway incidents observed the Smart Corridor in action.

Specifically, the evaluation sought to ascertain whether CHP officers were able to observe the impacts of Smart Corridor in operation or to gauge their perspective on the traveler's interaction with elements of the Smart Corridor system. However, inasmuch as the Smart Corridor is designed to divert traffic away from an incident, it was felt that officers were unlikely to have been able to observe the Smart Corridor as it would be operating at locations away from the locus of the incident while the CHP officers were actually removed from the Smart Corridor at the scene of the incident.

Similarly, a Caltrans TMT manager was also polled to ascertain whether TMT operators had any experience with, or observations about, the Smart Corridor. It was stated that TMT worked independently of the Smart Corridor, and that operators were unable to observe how travelers reacted to the system in operation. Indeed, the Smart Corridor ideally would automate the same functions as the TMT.

We also polled users of the Pathfinder project (essentially an early on-board GIS system that was tested by Caltrans in the early 1990s) who utilized the Santa Monica Smart Corridor, but they were also unable to provide conclusive input.

**System User 3 —"Traveler Professional"**

Per Caltrans' suggestion, Southern California Rideshare was contacted to assist with reaching SCAG's Employee Transportation Coordinator group. Information from this group as well as from the Auto Club was similarly inconclusive.

Costs

# 6.0 COSTS

## INTRODUCTION

This section summarizes the costs associated with the Smart Corridor system, based on an analysis of data provided by LACMTA. This section specifically addresses evaluation goal 6 of the overall Evaluation Implementation Plan, and provides a description of the evaluation approach for assessing costs, data sources, and findings.

## EVALUATION APPROACH

To evaluate the costs associated with the Smart Corridor system, LACMTA's financial tracking records were reviewed and summarized.

## DATA SOURCES

Funding for development, installation, operations, and maintenance of the Smart Corridor system came from two sources. The primary source was the Petroleum Violation Escrow Account (PVEA). PVEA is funded by oil companies as restitution for overcharging U.S. consumers from 1973 to 1981. A secondary source of funds was the Federal Highway Administration (FHWA). Information on both funding sources was provided by LACMTA. Together, these two funding sources enabled the development of the centralized database at the heart of the Smart Corridor system.

In addition to these two sources, local and state agencies used their own funds for agency specific needs, such as field devices. While expenditure on such field devices enhanced the impact of the Smart Corridor system, they provided (and continue to provide) functionality beyond the core requirements of the Smart Corridor system. Consequently, these funding sources have not been considered as part of this evaluation.

## CONSTRAINTS AND ASSUMPTIONS

None.

## FINDINGS

Table 6-1 contains the available PVEA and Federal Highway funds, and Smart Corridor expenditures from project inception through March 20, 2001.

**Table 6-1: Smart Corridor Funding And Expenditure**

| | PVEA | FHWA | Total |
|---|---|---|---|
| Funds Available at Inception | $7,500,000.00 | $1,100,000.00 | $8,600,000.00 |
| Expenditure | $6,546,911.81 | $1,094,940.00 | $7,641,851.81 |

Source: LACMTA

Conclusions

# 7.0 CONCLUSIONS

## INTRODUCTION

This section details conclusions for the Operational, Emissions and Energy Impacts; Institutional Coordination, System Benefits and System Users; and Costs. An overall conclusion for the evaluation is also provided.

## OPERATIONAL PERFORMANCE, EMISSIONS AND ENERGY IMPACTS

The evaluation of operational performance, and emissions and energy impacts associated with Smart Corridor are indicative of small, but widespread improvements for the subject 7 incidents. It is not possible to infer that the same degree of impact would have occurred with incidents in the Smart Corridor at other times in the year, or in other locations that are similarly instrumented and equipped to respond. For reference purposes, in 1999 the Los Angeles County Metro Freeway Service Patrol assisted some third of a million freeway incidents. Many of these assists related to vehicle breakdowns (out of gas, electrical, flat tire). However, nearly 120,000 assists were related to accidents, rollovers, vehicle fires, or debris removal. All of these were in the morning or afternoon peak periods, and could potentially have justified a Smart Corridor type of response. Consequently, this provides an order of magnitude scaling factor for the beneficial impacts of Smart Corridor. Many more incidents, not assisted by the Freeway Service Patrol, would have occurred on the arterial network.

Even though the evaluation findings indicate minor improvements in traffic operations within the network as measured by increased capacity, the actual benefit of the Smart Corridor system may be in more effectively distributing traffic demand within the network. In other words, the benefits of the Smart Corridor system may lie more in demand management than capacity and operations management. If the network has sufficient excess capacity to accommodate increased or redistributed demand, it can do so without needing to change the signal plans and associated cycle lengths. Simulation modeling is simply incapable of measuring this potential demand redistribution improvement at the network level. Thus the evaluation findings may not properly portray this potential benefit of the Smart Corridor System.

The conclusion is that the Santa Monica Freeway Smart Corridor deployment was generally a success as demonstrated by simulation-based comparative evaluations of "after Smart Corridor deployment" and "before Smart Corridor deployment" conditions. This conclusion is supported by documented measures of effectiveness (MOEs) in traffic operations, fuel consumption, and fuel emissions in the majority of incidents (5 of 7) evaluated. The remaining 2 incidents demonstrated partial operational improvements in several related MOEs. This success is indicative that the deployed technologies and strategies of the Smart Corridor (i.e., ATMS and ATIS) effectively responded to incidents. The evaluation demonstrated that the system is capable of improving mobility, throughput and through green, delays, total number of stops at signalized intersections, and total travel time along freeway and arterial systems within the study area.

## INSTITUTIONAL COORDINATION, SYSTEM BENEFITS, AND SYSTEM USERS

**The Santa Monica Freeway Smart Corridor provided a legacy of strengthened institutional and organizational relationships, cooperation and coordination**

Through the process of working together on the Smart Corridor, agencies, and individual staff members from these agencies, established a climate of mutual respect and trust with their colleagues. As individuals moved on from this project, they often maintained contacts with their peers from the other participating agencies and would call on them for input and advice on other inter-agency projects. Individuals who had worked together on the Smart Corridor brought the comfort level of their past cooperative working relations to new inter-agency projects. In short, the Smart Corridor enabled project partners to consolidate and build upon existing institutional relationships.

Partner agencies on the Smart Corridor, for the first time, also learned to regard the transportation system as a shared responsibility, and came to understand how their individual actions fit into the transportation system as a whole. Thus, agencies were able to better understand the context and perspective of the other agency's incident management actions.

**Technical experience learned on the Smart Corridor provided invaluable input to later projects**

The Smart Corridor was a groundbreaking project with a daunting "learning curve" yet enormous technological strides were made that contributed to the success of later ITS projects undertaken in this region. The agencies and individuals involved in the Smart Corridor gained much valuable knowledge and understanding of both technical and operational elements of a new project. All refer to the experience of the Smart Corridor as helping them bring value-added input to both subsequent ITS projects as well as others that require extensive inter-agency coordination and cooperation in order to be a success.

**Utilize a goal-oriented project management structure**

Deployment of projects of the scale and complexity of the Smart Corridor are simplified if they are executed in shorter, multiple phases with dedicated teams established to address these specific phases as opposed to larger, more complex segments. In this way, the project is divided into manageable, "digestible" elements and permits the project to proceed on parallel tracks. The decision-making process becomes more streamlined and its various components tend to move forward at the same time.

**Diminish staff turnover**

Also important to the project administration structure is continuity in team management, staff and consultant ranks. Involvement of committed staff at the senior management level also encourages project schedule adherence, facilitates decision-making and contributes to morale. Turnover, at both the consultant and at the agencies, impacted the project as institutional memory was lost whenever a project member left. New staff thus had to contend with a steep "learning curve" and, not surprisingly, because they did not have the tools necessary to facilitate decision-making, often revisited issues and decisions that had already been accepted by the Steering Committee.

**Cultivate project "Champion" as well as individual commitment and dedication**

Having a project "champion" at staff level but also amongst senior executive level was as a key success factor for the Smart Corridor. Cultivating an active, enthusiastic and dedicated staff member who will actively involve participating agencies, motivate staff, brief stakeholders and key elected officials, and help secure additional project funding contributed to the ultimate realization of the Smart Corridor project. Also contributing to a project's success is for all individuals participating in the project to demonstrate their dedication and commitment. Ongoing enthusiasm helps maintain the project's momentum even as a project encounters various challenges.

**Commitment to the scope & vision at the outset is key to a project's success**

One of the most important elements in the successful implementation of a multi-agency project is to create and maintain a shared strategic vision — by identifying the project goals and how the technical aspects of the project should be carried out to meet those goals. A shared, and clearly articulated, project scope is the point of departure from which all key decisions flow, whether technical, operational or policy-oriented. So, if there is a lack of clarity and/or consensus about the project's scope, this is likely to percolate throughout the duration of the project, distracting from and quite possibly also disrupting the development, deployment and likely operations of the system as well. Mutual understanding about the project's scope will also contribute to agency "buy-in". Commitment to the project may also be demonstrated by the approach to project staffing.

**Ensure quick, efficient & timely project deployment**

System development is a complex and time-consuming process even when not entering uncharted territory. Indeed, because the Smart Corridor was such a groundbreaking project with an ambitious schedule, the project timeline estimates needed revision on an ongoing basis. This, in turn, occasionally led to a sense that the project was losing momentum and impacted team morale. The Smart taught that adherence to project scope and vision could ensure efficient project deployment and maintain its impetus.

**Develop approach to responding to the impacts of technological advances**

Due not only to the length of the project but also because of the advances in ITS technology over the life span of the project, the Smart Corridor experienced "requirements creep" and thus tended to be reactive to technological advances. As a result, the Smart Corridor experienced stops and starts as elements of the system were upgraded — which then rendered other elements of the project outmoded. An approach to how technological developments are to be addressed must be resolved and adhered to if the project is to maintain momentum.

**Decentralized database system more conducive to operational system**

While sharing information via a centralized database may be appropriate for a pilot or demonstration project, is not optimal for day-to-day operation of a larger system. The regional trend now is to decentralize databases toward distributed information sources that are available to multiple agencies. This system will hold each jurisdiction responsible for the information that is made available to others.

**Utilize, where possible, standardized project software**

Software for the Smart Corridor was custom-developed with an eye to creating a prototype system that would serve as a model for future projects. This approach proved costly as the software was essentially written from scratch and unanticipated levels of complexity contributed to schedule overruns. Advances in software sophistication are such that standardized, off-the-shelf software that is readily and relatively cheaply available and that, where necessary, may be tailored to accommodate the system, is recommended.

**Early development and execution of acceptance tests**

Running acceptance tests relatively late in the process further contributed to the protracted schedule of the Smart Corridor from start to finish. Early development and execution of acceptance tests would highlight system challenges earlier on.

**Operator training contributes towards successful project implementation**

Over the life of the project, the Smart Corridor had a number of operators who essentially experienced "on-the-job" training. The jobs required some vital skills, particularly related to software troubleshooting, beyond the scope of their core traffic engineering expertise. The day-to-day operational success of the Smart Corridor was a testament to the dedication, perseverance and motivation of the operators. In addition, although the operators responded to a limited number of the Smart Corridor incidents, they also were required to perform other day-to-day duties that often took precedence over the Smart Corridor. It is thus also important to integrate operators' work task processes into their operation of the Smart Corridor so that the system's effectiveness is optimized.

**Maintenance contract**

Build allowance for ongoing system maintenance into the project so that unnecessary delays are avoided.

**Limited operational expandability & scalability of the Smart Corridor**

Although the Smart Corridor proved to be a constructive organizational and operational experience for the agencies involved, its expandability and scalability were limited. In terms of organization, the success of the inter-agency coordination element of the project is undeniable. However, the Smart Corridor's expandability and scalability in terms of operations are hazier given the advances in technology.

**Low levels of awareness about the Smart Corridor amongst Corridor users**

There is insignificant awareness of the project amongst the general public. While agencies are familiar with the Smart Corridor, other knowledgeable traffic professionals have little recall of the project. They are, however, familiar with ITS technology and the current Corridor projects, and are willing to promote both to the public. However, it is recommended that any public awareness campaign should focus on educating the public about the Smart Corridor and how specific elements of the system can be used to aid motorists rather than a promotion campaign which might artificially heighten expectations about the efficacy of the system.

**Impact of the Smart Corridor on travelers inconclusive**

The absence of any substantive data on the Smart Corridor's impacts on its end-users has made thorough evaluation of this aspect of the project difficult to accomplish.

## COSTS

The total cost of Smart Corridor (using PVEA and FHWA funds) was $7,641,851.81. This level of funding covered costs associated with the core of the Smart Corridor system. Local and state agencies used their own funds for agency specific needs, such as field devices.

## OVERALL CONCLUSION

Overall, the Smart Corridor system positively impacted traffic conditions during the 7 sample incidents. While the improvements for individual incidents were small, the potential impacts across the Los Angeles area are enormous, given the third of a million freeway incidents that occur across the region each year. As the Smart Corridor concept is expanded across the region, it will be an appropriate tool to mitigate the impacts of such incidents, and provide overall congestion relief.

It is important to keep in mind that any incident, freeway or arterial, in a corridor such as this study area is highly likely to lead to deterioration in transportation system performance. This is especially true with major incidents, when freeway traffic will likely spill over onto the arterial network. Smart Corridor provided the means to proactively manage such conditions. For the evaluation of the operational performance of Smart Corridor, 11 measures of effectiveness (MOEs) were identified, e.g., change in average speed, change in total travel time, and change in fuel consumed. The impact of Smart Corridor on each of these 11 MOEs was simulated using the computer based Synchro Plus traffic model. It is particularly interesting to note that, of the 11 MOEs considered in each of the 7 incidents evaluated, 68 percent improved, 14 percent remained unchanged, and 18 percent worsened. Put simply, there are very strong indications that for the subject incidents, Smart Corridor control improved conditions compared to no Smart Corridor control.

For Smart Corridor to succeed, new institutional relationships were needed. Not only were these relationships developed during development of Smart Corridor, the strengthened institutional relationships ultimately outlived the Smart Corridor system. Subsequent deployments of ITS type projects in the region have undoubtedly benefited from this.

From an operational standpoint, Smart Corridor showed that a centralized database was appropriate to this pilot effort covering an 11-mile section of the Santa Monica freeway. However, it became apparent that this was not a viable avenue to explore for future expansion across the more than 400 miles of freeway in the Los Angeles region. Distributed systems where local jurisdictions retain responsibility for their respective systems are considered more practical. One local example of this concept is the ongoing Southern California Priority Corridor ITS Network, which conforms to the National ITS Architecture (see http://www.odetics.com/itsarch), and is expected to become partially operational during 2001. Further, integrated solutions, and not standalone systems such as Smart Corridor, are preferred to maximize resource efficiency; e.g., operators should work using the minimum number of workstations.

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7. Los Angeles City Department of Transportation - ATSAC Plan Number Assignments (2000)

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10. LADOT ATSAC 100 MB Zip Diskette: Smart Corridor Traffic Volume, Timing Plan, Incident Description, Incident Response Reports, Post mile listing for CCTV Cameras, CMS, Freeway Ramps, etc.

11. Minagar, Fred and Eddie Curtis; Minutes and Memo of LADOT ATSAC Meeting and Mutual Understanding of Smart Corridor Project (May & June 2000)

12. Park, Douglas K.; the Smart Corridor Project (November 1995)

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Appendices

# APPENDIX A INCIDENT DESCRIPTIONS

Appendix A describes each of the incidents considered for evaluation.

**Incident 1** occurred southbound along the arterial of La Brea Avenue at Adams on November 9, 1999 from 8:45 AM - 10:30 AM. The most critical peak period of 9:00 AM - 10:00 AM was used for the computer simulation of the data. The nature of the incident was congestion, which was viewed by CCTV camera # 19. The Smart Corridor response utilized a trailblazer. According to data analysis, the sphere of influence by this incident was on Adams from Fairfax to Crenshaw, and on La Brea from Adams to Venice. A total of 14 signalized intersections were within the influence sphere of incident number 1. These locations were analyzed based on operational simulation.

**Incident 2** occurred eastbound along Interstate 10 at Crenshaw on November 17, 1999 from 4:43 PM - 5:15 PM. The nature of the incident was a traffic accident blocking two lanes, which was not viewed by a CCTV camera. Insufficient data were available to include this incident in the evaluation.

**Incident 3** occurred at Pico and Robertson on November 23, 1999 from 2:00 PM - 3:00 PM. The nature of the incident was congestion, which was viewed by CCTV cameras at Pico and Robertson. The Smart Corridor response utilized for this incident was CMS/LADOT's new traffic signal TOD plan. An analysis of incident 3 was not conducted since traffic volumes from the City of Los Angeles were not available. Insufficient data were available to include this incident in the evaluation.

**Incident 4** occurred at La Brea and Adams on November 23, 1999 from 2:00 PM - 3:00 PM. This time period was used for the computer simulation of the data. The nature of the incident was construction, which was viewed by CCTV cameras at La Brea at Adams. The Smart Corridor response utilized for this incident was CMS/LADOT's new traffic signal TOD plan. According to data analysis, the influence sphere of this incident was on Adams from Hauser to Crenshaw, on La Brea from Adams to Washington, and on Crenshaw from Adams to the westbound I-10 on/off ramp. A total of 14 signalized intersections were within the influence sphere of this incident. These locations were analyzed using operational simulation of arterial and intersections.

**Incident 5** occurred westbound along Interstate 10 between Normandie and Overland on December 1, 1999 from 8:10 AM - 2:00 PM. The most critical timing period between 8:30 AM - 9:30 AM was selected for the computer simulation. The nature of the incident was recurrent congestion, which was not viewed by a CCTV camera. The Smart Corridor response utilized for this incident was an HAR/CMS/Trailblazer. According to data analysis, the influence sphere of this incident encompassed all intersections between and along the arterials of Adams and Washington from Fairfax to Western, on Washington from Western to Normandie, and on I-10 from Normandie to Overland. A total of 47 signalized intersections were within the influence sphere of this incident. These locations were analyzed using operational simulation of arterial and intersections.

**Incident 6** occurred westbound along the arterial of Venice from Fairfax to Cadillac on December 2, 1999 from 8:00 AM - 4:50 PM. The most critical peak period between 8:00 AM - 9:00 AM was used for the computer simulation. The nature of the incident was congestion. The Smart Corridor response utilized a CMS/ trailblazer/new Traffic Signal TOD/Flush Plan 27 at In157/Flush Plan 29 at In - 156. According to data analysis, the influence sphere of this incident was on Venice from Robertson to Shenandoah, and on La Cienega from Shenandoah to Venice. A total of 8 signalized intersections were within the influence sphere of this incident. These locations were analyzed using operational simulation of arterial intersections.

**Incident 7** occurred southbound along La Brea from Venice to Adams on December 2, 1999 from 8:00 AM - 4:50 PM. The most critical peak period was during 4:30 PM - 5:30 PM. The nature of the incident was congestion. The Smart Corridor response utilized a CMS/trailblazer/new Traffic Signal TOD/Flush Plan 43. According to data analysis, the influence sphere of this incident was on La Brea from Pico to Washington. A total of 3 signalized intersections were within the influence sphere of this incident. These locations were analyzed using operational simulation of arterial intersections.

**Incident 8** occurred southbound along La Brea from Venice to Adams on December 2, 1999 from 7:30 AM - 9:30 AM. The most critical peak period of 8:15 AM- 9:15 AM was used for computer simulation. The nature of the incident was recurrent congestion, which was not viewed by a CCTV camera. The Smart Corridor response utilized a CMS/trailblazer/CIC. According to data analysis, the influence sphere of this incident encompassed all intersections between and along the arterials of Adams and Washington from La Cienega to Western, on Fairfax from Adams to Apple, and on I-10 from Vermont to Robertson. A total of 52 signalized intersections were within the influence sphere of this incident. These locations were analyzed using operational simulation of arterial intersections.

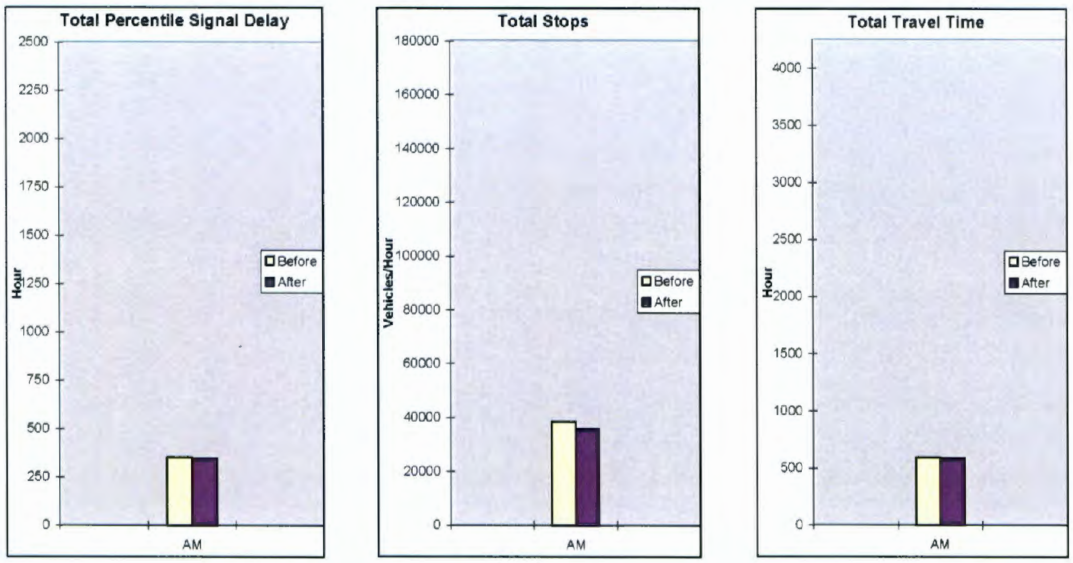
**Incident 9** occurred along I-10 eastbound and westbound on December 16, 1999 from 2:20 PM - 3:20 PM. The most critical peak period of 2:45 PM - 3:45 PM was used for the computer simulation of data. The nature of the incident was a traffic accident, which was not viewed by a CCTV camera. The Smart Corridor response utilized a CMS/Traffic Signal TOD Plan. According to data analysis, the influence sphere of this incident encompassed all intersections between and along the arterials of Adams and Washington from La Cienega to Western, and on I-10 from Vermont to La Cienega. A total of 46 signalized intersections were within the influence sphere of this incident. These locations were analyzed using simulation of arterial intersections.

# APPENDIX B MEASURES OF EFFECTIVENESS

Appendix B documents all the aforementioned results and findings depicted pictorially to compare the critical and major MOEs for each and every incident that was simulated and analyzed.

Sheet 1 of 3

**Santa Monica Freeway Smart Corridor Evaluation**
**Incident No. 1 - Operational Performance**



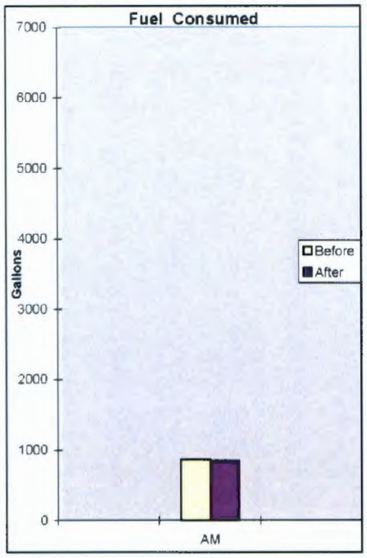

Graphic Comparison of Measures of Effectiveness (MOE's)

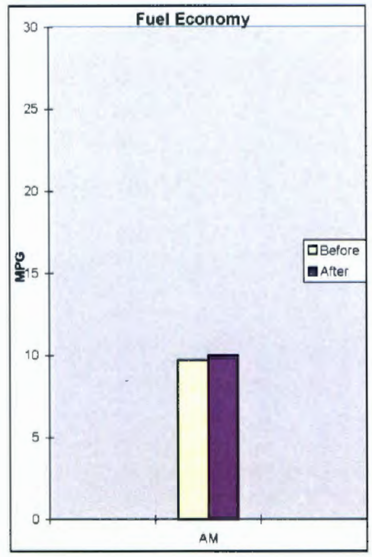
Note: 'After' represents system performance under Smart Corridor control during each incident (as simulated using actual capacity, signal timings, and traffic volumes in effect during each incident)

'Before' represents hypothetical system performance without Smart Corridor control during each incident (as simulated using actual capacity and signal timings during incident-free conditions in a comparable time period, superimposed with actual traffic volumes during the subject incident)

Sheet 2 of 3

**Santa Monica Freeway Smart Corridor Evaluation**
**Incident No. 1 - Energy Impact**



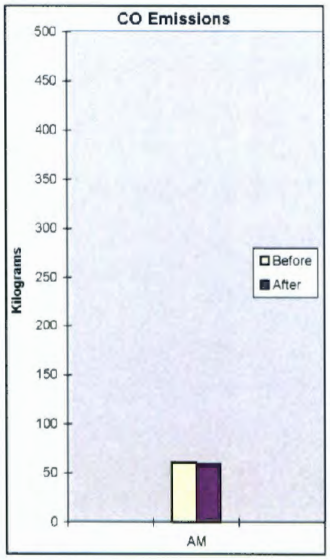

Graphic Comparison of Measures of Effectiveness (MOE's)

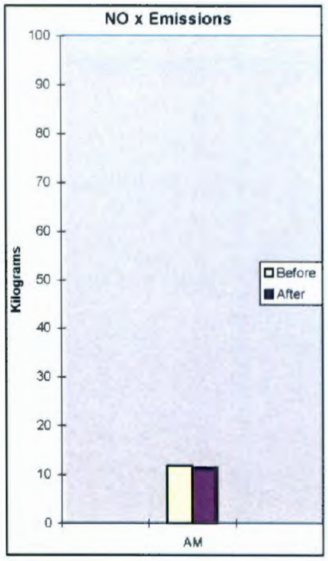
Note: 'After' represents system performance under Smart Corridor control during each incident (as simulated using actual capacity, signal timings, and traffic volumes in effect during each incident)

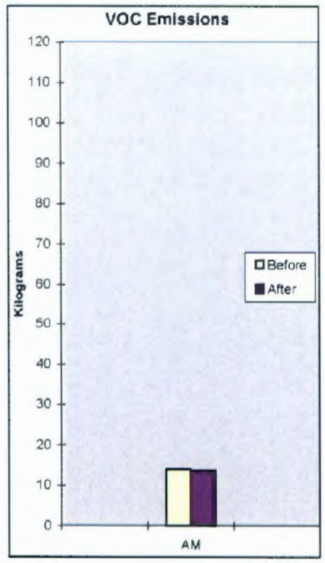
'Before' represents hypothetical system performance without Smart Corridor control during each incident (as simulated using actual capacity and signal timings during incident-free conditions in a comparable time period, superimposed with actual traffic volumes during the subject incident)

Sheet 3 of 3

**Santa Monica Freeway Smart Corridor Evaluation**
**Incident No. 1 - Emissions Impact**



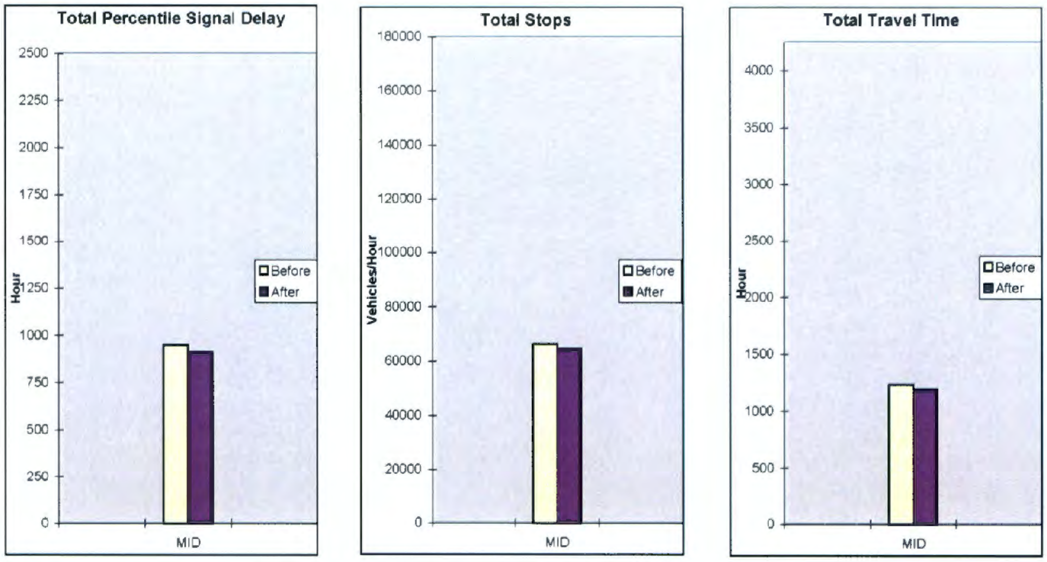

Graphic Comparison of Measures of Effectiveness (MOE's)

Note: 'After' represents system performance under Smart Corridor control during each incident (as simulated using actual capacity, signal timings, and traffic volumes in effect during each incident)

'Before' represents hypothetical system performance without Smart Corridor control during each incident (as simulated using actual capacity and signal timings during incident-free conditions in a comparable time period, superimposed with actual traffic volumes during the subject incident)

Sheet 1 of 3

**Santa Monica Freeway Smart Corridor Evaluation**
**Incident No. 4 - Operational Performance**



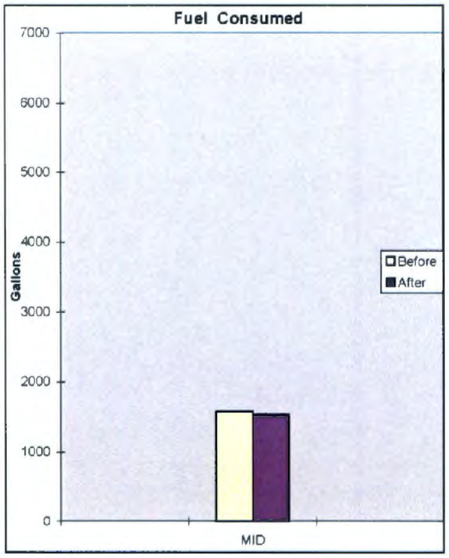

Graphic Comparison of Measures of Effectiveness (MOE's)

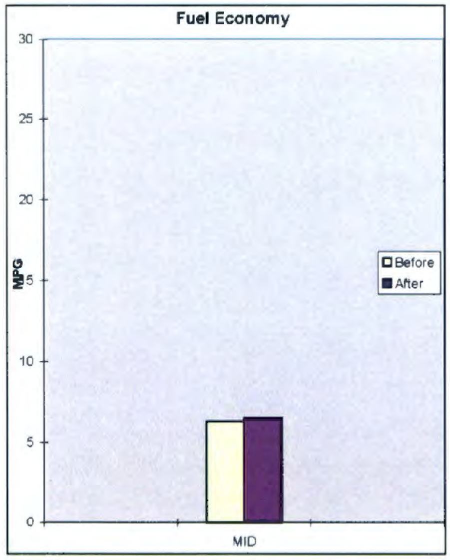
Note: 'After' represents system performance under Smart Corridor control during each incident (as simulated using actual capacity, signal timings, and traffic volumes in effect during each incident)

'Before' represents hypothetical system performance without Smart Corridor control during each incident (as simulated using actual capacity and signal timings during incident-free conditions in a comparable time period, superimposed with actual traffic volumes during the subject incident)

Sheet 2 of 3

**Santa Monica Freeway Smart Corridor Evaluation**
**Incident No. 4 - Energy Impact**



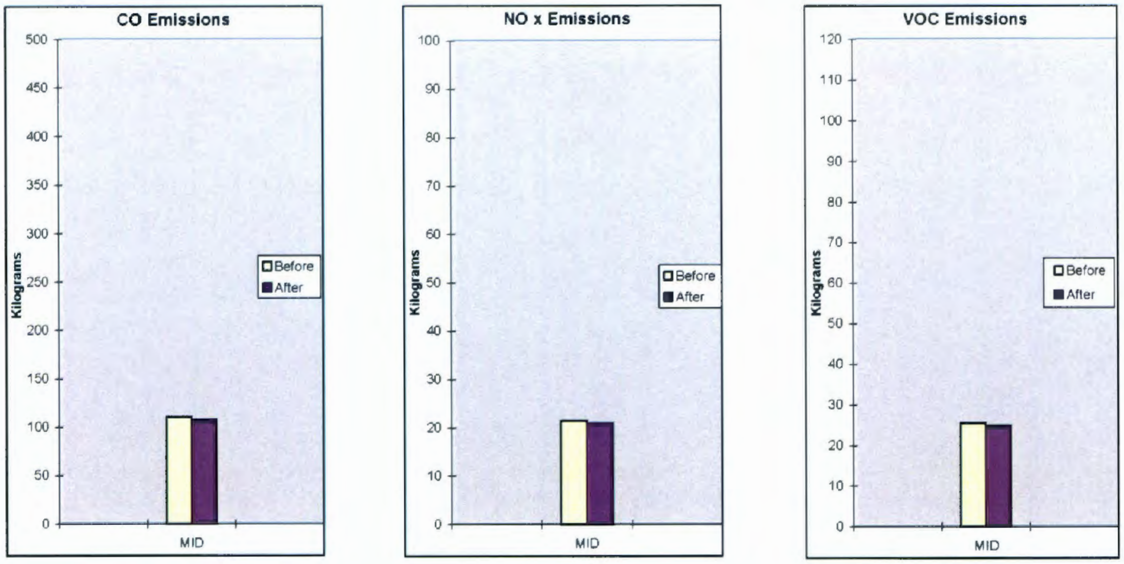

Graphic Comparison of Measures of Effectiveness (MOE's)

Note: 'After' represents system performance under Smart Corridor control during each incident (as simulated using actual capacity, signal timings, and traffic volumes in effect during each incident)

'Before' represents hypothetical system performance without Smart Corridor control during each incident (as simulated using actual capacity and signal timings during incident-free conditions in a comparable time period, superimposed with actual traffic volumes during the subject incident)

Sheet 3 of 3

**Santa Monica Freeway Smart Corridor Evaluation**
**Incident No. 4 - Emissions Impact**




Graphic Comparison of Measures of Effectiveness (MOE's)

Note: 'After' represents system performance under Smart Corridor control during each incident (as simulated using actual capacity, signal timings, and traffic volumes in effect during each incident)

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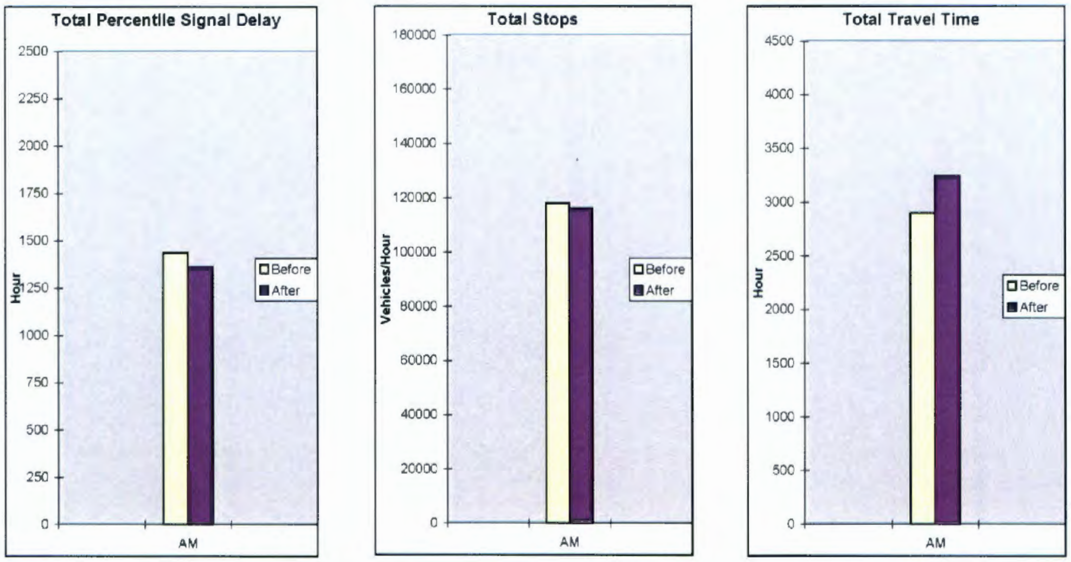
Sheet 1 of 3

**Santa Monica Freeway SmartCorridor Evaluation**
**Incident No. 5 - Operational Performance**



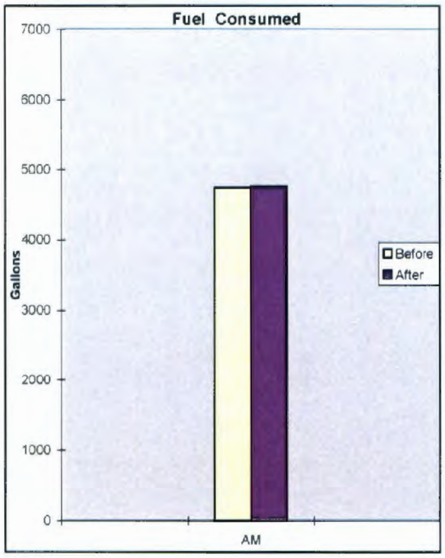

Graphic Comparison of Measures of Effectiveness (MOE's)

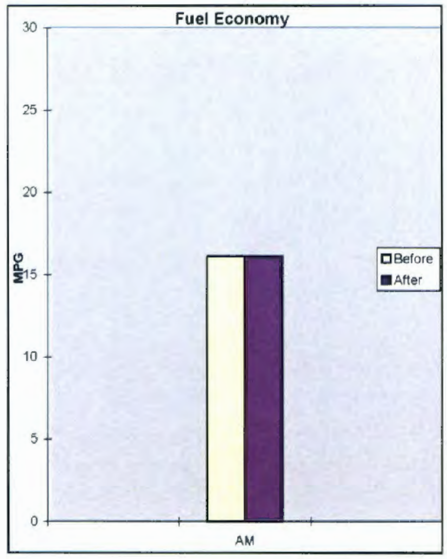
Note: 'After' represents system performance under Smart Corridor control during each incident (as simulated using actual capacity, signal timings, and traffic volumes in effect during each incident)

'Before' represents hypothetical system performance without Smart Corridor control during each incident (as simulated using actual capacity and signal timings during incident-free conditions in a comparable time period, superimposed with actual traffic volumes during the subject incident)

Sheet 2 of 3

**Santa Monica Freeway Smart Corridor Evaluation**
**Incident No. 5 - Energy Impact**




Graphic Comparison of Measures of Effectiveness (MOE's)

Note: 'After' represents system performance under Smart Corridor control during each incident (as simulated using actual capacity, signal timings, and traffic volumes in effect during each incident)

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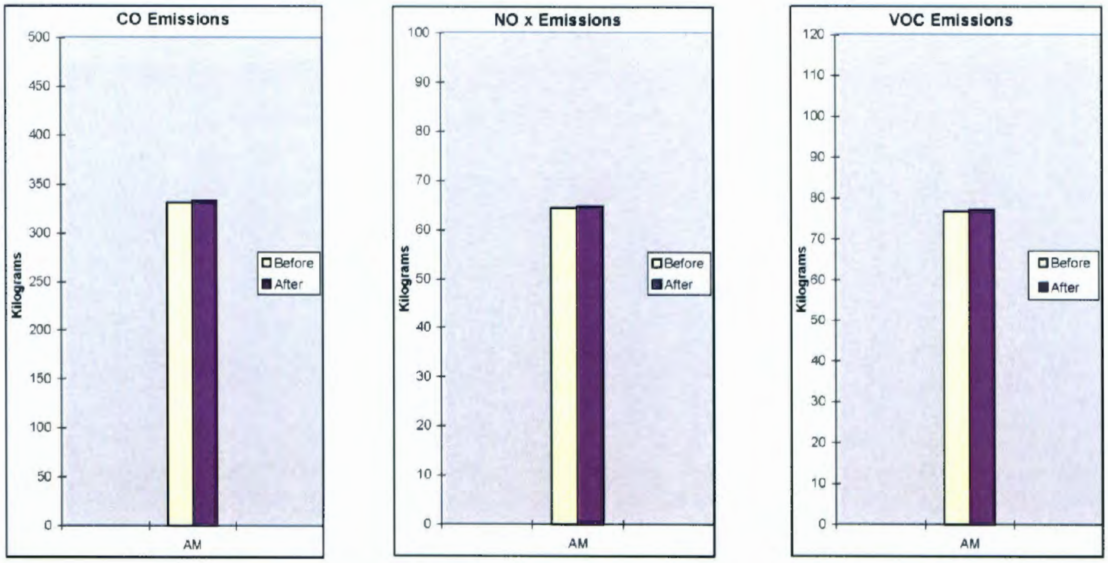
Sheet 3 of 3

**Santa Monica Freeway Smart Corridor Evaluation**
**Incident No. 5 - Emissions Impact**




Graphic Comparison of Measures of Effectiveness (MOE's)

Note: 'After' represents system performance under Smart Corridor control during each incident (as simulated using actual capacity, signal timings, and traffic volumes in effect during each incident)

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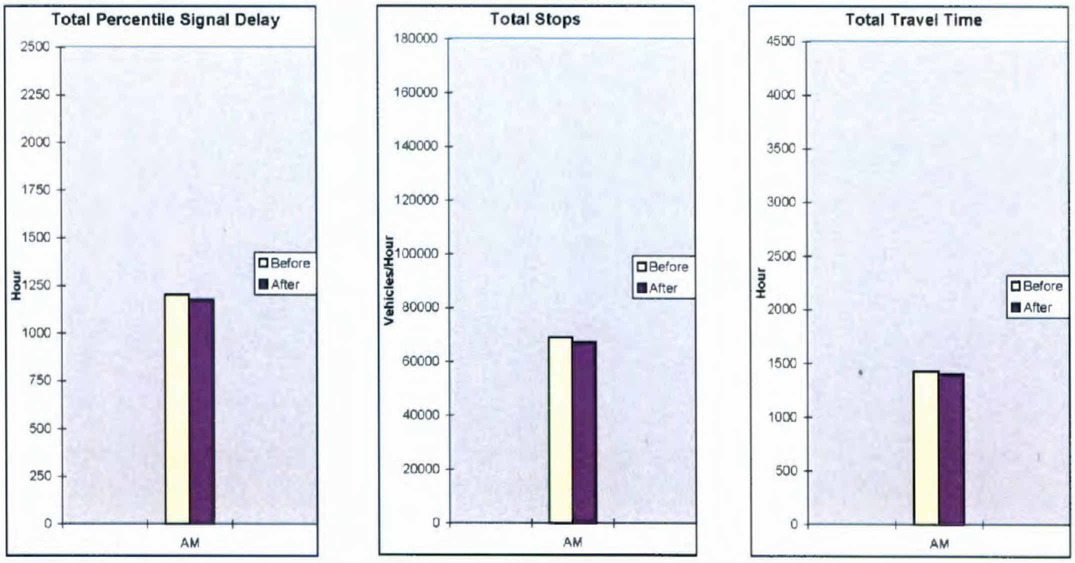
Sheet 1 of 3

**Santa Monica Freeway Smart Corridor Evaluation**
**Incident No. 6 - Operational Performance**



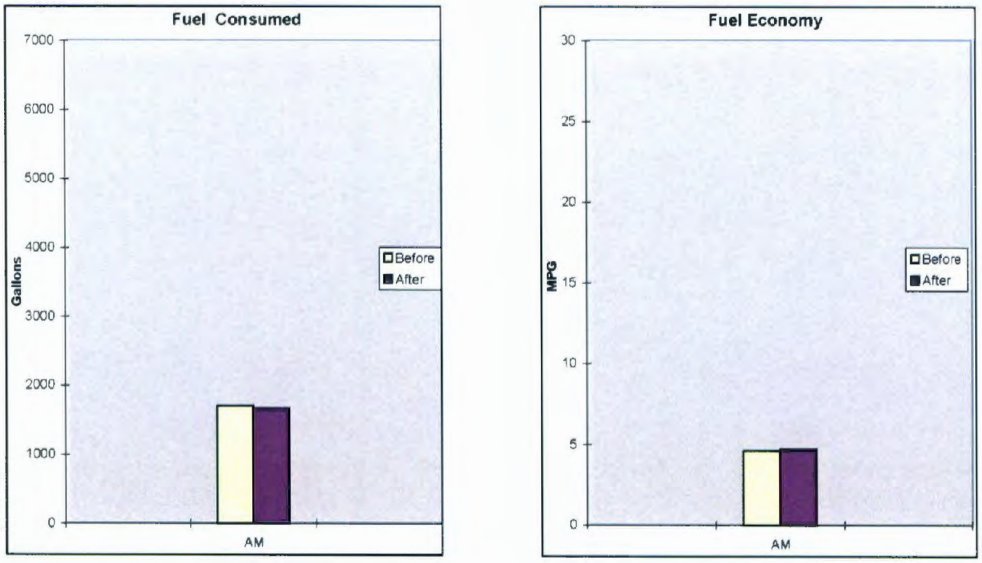

Graphic Comparison of Measures of Effectiveness (MOE's)

Note: 'After' represents system performance under Smart Corridor control during each incident (as simulated using actual capacity, signal timings, and traffic volumes in effect during each incident)

'Before' represents hypothetical system performance without Smart Corridor control during each incident (as simulated using actual capacity and signal timings during incident-free conditions in a comparable time period, superimposed with actual traffic volumes during the subject incident)

Sheet 2 of 3

**Santa Monica Freeway Smart Corridor Evaluation**
**Incident No. 6 - Energy Impact**



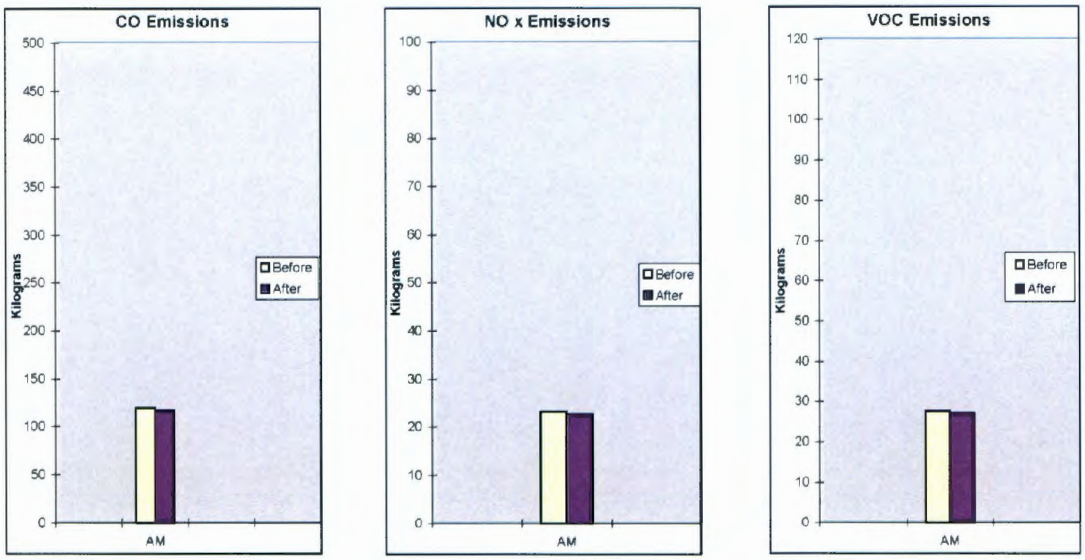

Graphic Comparison of Measures of Effectiveness (MOE's)

Note: 'After' represents system performance under Smart Corridor control during each incident (as simulated using actual capacity, signal timings, and traffic volumes in effect during each incident)

'Before' represents hypothetical system performance without Smart Corridor control during each incident (as simulated using actual capacity and signal timings during incident-free conditions in a comparable time period, superimposed with actual traffic volumes during the subject incident)

Sheet 3 of 3

**Santa Monica Freeway Smart Corridor Evaluation**
**Incident No. 6 - Emissions Impact**




Graphic Comparison of Measures of Effectiveness (MOE's)

Note: 'After' represents system performance under Smart Corridor control during each incident (as simulated using actual capacity, signal timings, and traffic volumes in effect during each incident)

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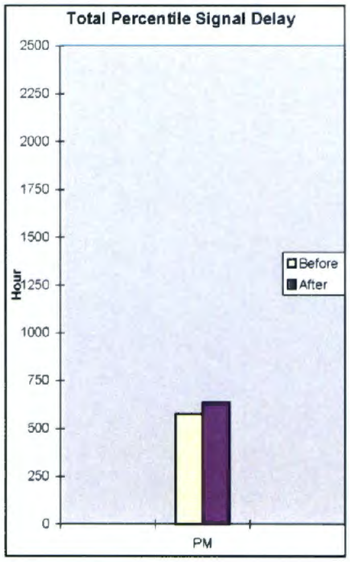
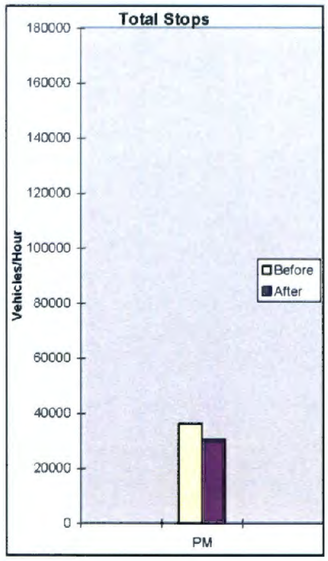
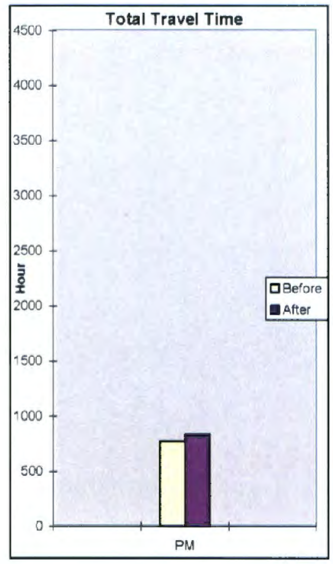
Sheet 1 of 3

**Santa Monica Freeway Smart Corridor Evaluation**
**Incident No. 7 - Operational Performance**




Graphic Comparison of Measures of Effectiveness (MOE's)

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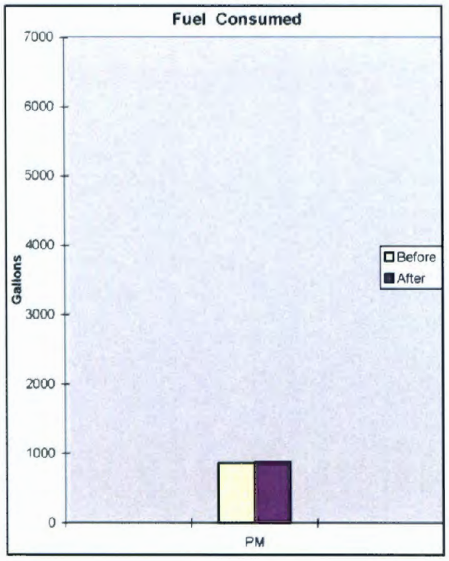
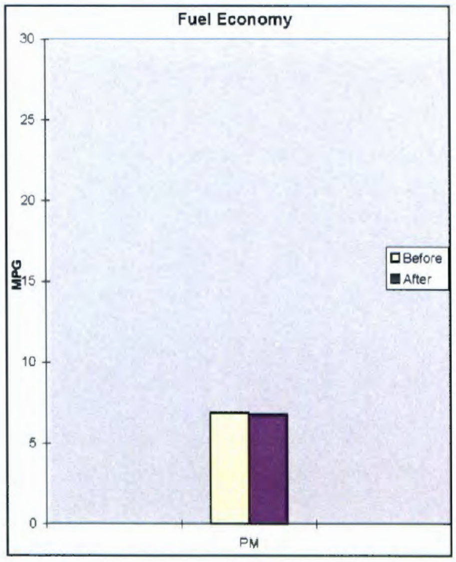
Sheet 2 of 3

**Santa Monica Freeway Smart Corridor Evaluation**
**Incident No. 7 - Energy Impact**




Graphic Comparison of Measures of Effectiveness (MOE's)

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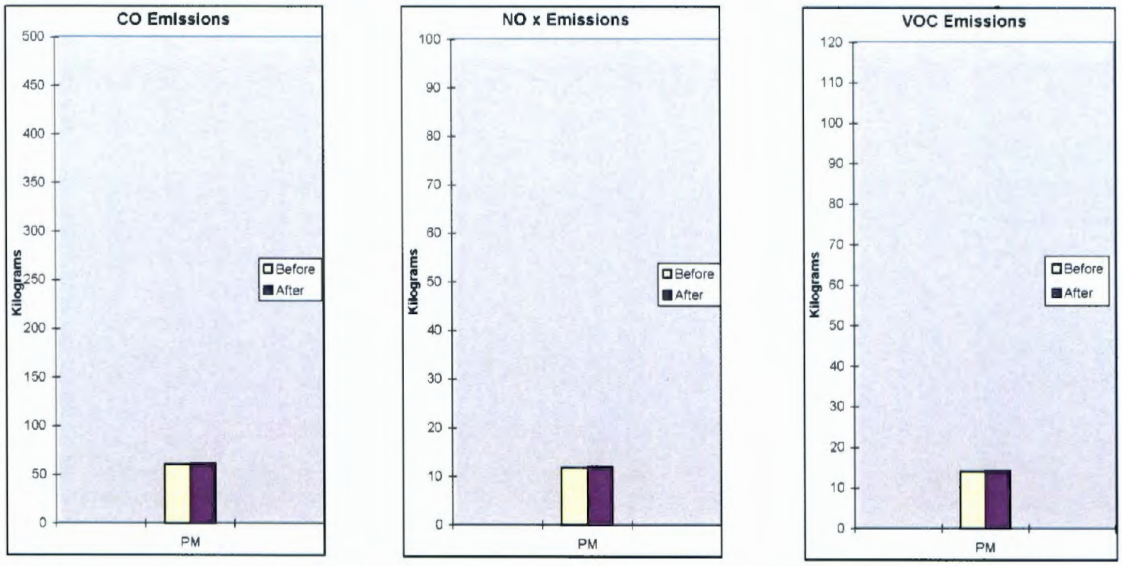
Sheet 3 of 3

**Santa Monica Freeway Smart Corridor Evaluation**
**Incident No. 7 - Emissions Impact**




Graphic Comparison of Measures of Effectiveness (MOE's)

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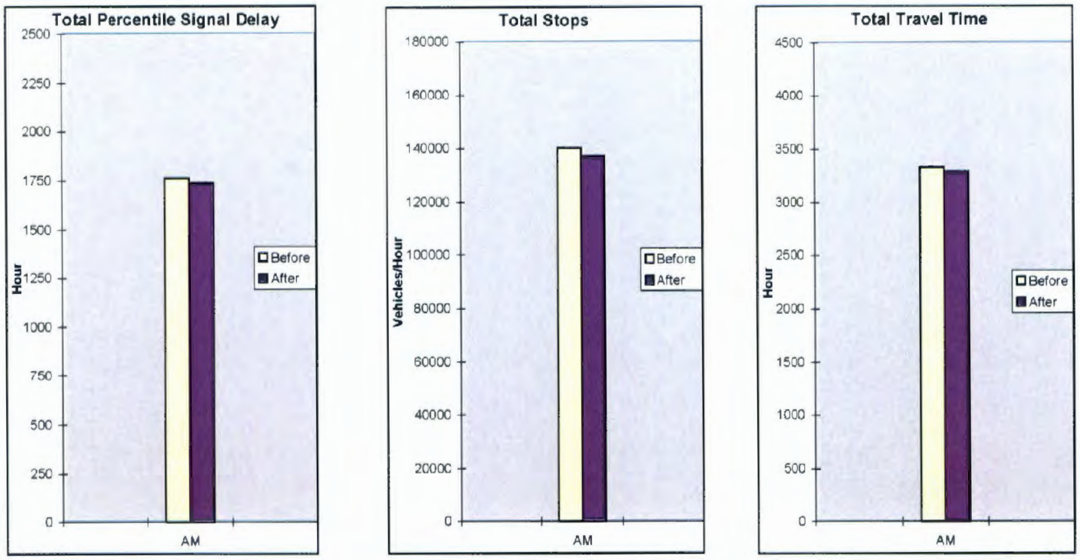
Sheet 1 of 3

**Santa Monica Freeway Smart Corridor Evaluation**
**Incident No. 8 - Operational Performance**



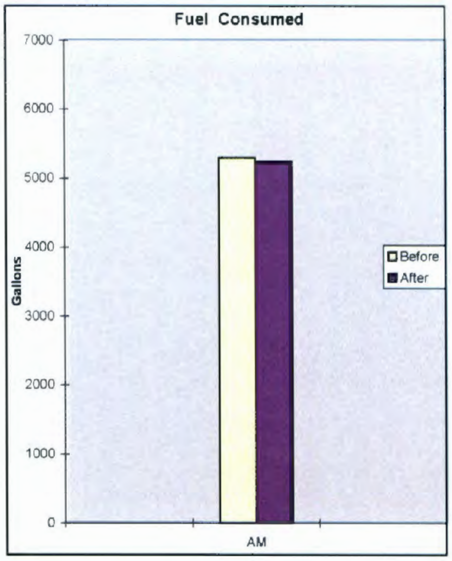

Graphic Comparison of Measures of Effectiveness (MOE's)

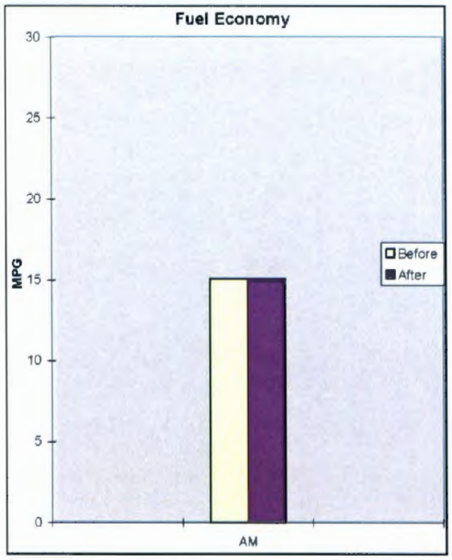
Note: 'After' represents system performance under Smart Corridor control during each incident (as simulated using actual capacity, signal timings, and traffic volumes in effect during each incident)

'Before' represents hypothetical system performance without Smart Corridor control during each incident (as simulated using actual capacity and signal timings during incident-free conditions in a comparable time period, superimposed with actual traffic volumes during the subject incident)

Sheet 2 of 3

**Santa Monica Freeway Smart Corridor Evaluation**
**Incident No. 8 - Energy Impact**



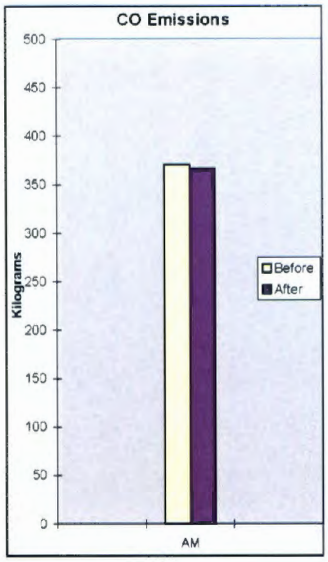

Graphic Comparison of Measures of Effectiveness (MOE's)

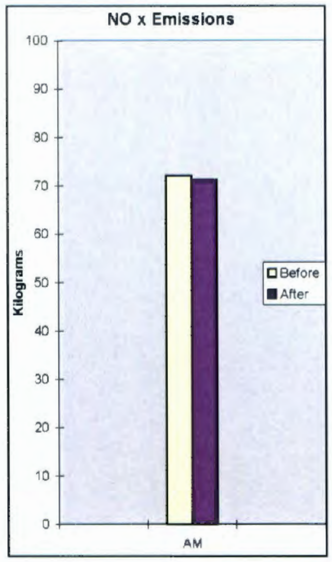
Note: 'After' represents system performance under Smart Corridor control during each incident (as simulated using actual capacity, signal timings, and traffic volumes in effect during each incident)

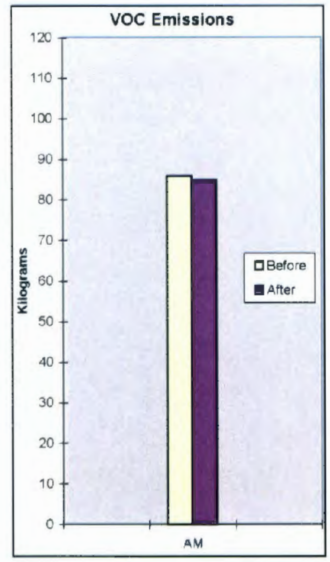
'Before' represents hypothetical system performance without Smart Corridor control during each incident (as simulated using actual capacity and signal timings during incident-free conditions in a comparable time period, superimposed with actual traffic volumes during the subject incident)

Sheet 3 of 3

**Santa Monica Freeway Smart Corridor Evaluation**
**Incident No. 8 - Emissions Impact**



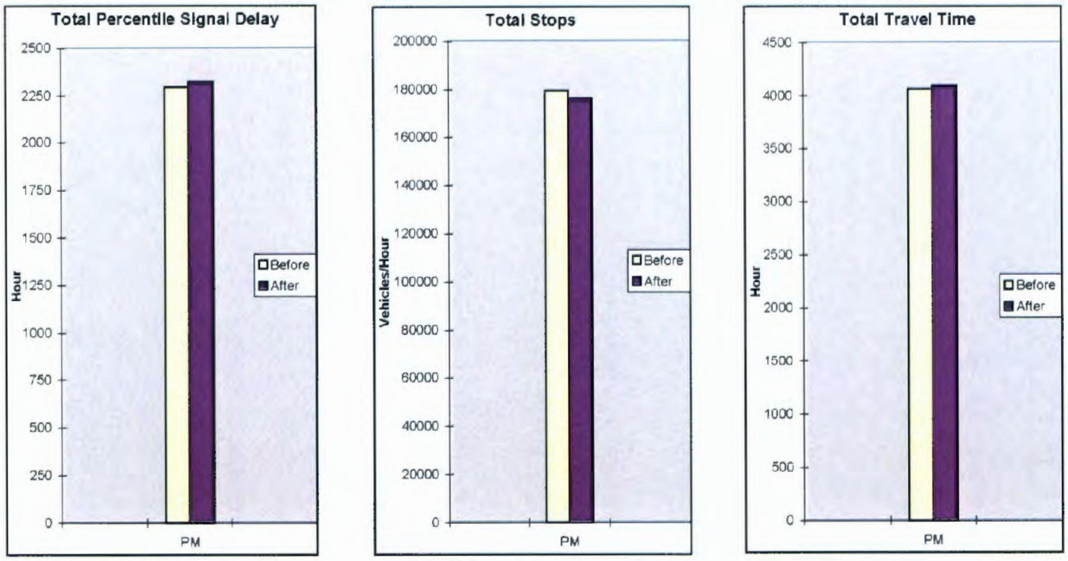

Graphic Comparison of Measures of Effectiveness (MOE's)

Note: 'After' represents system performance under Smart Corridor control during each incident (as simulated using actual capacity, signal timings, and traffic volumes in effect during each incident)

'Before' represents hypothetical system performance without Smart Corridor control during each incident (as simulated using actual capacity and signal timings during incident-free conditions in a comparable time period, superimposed with actual traffic volumes during the subject incident)

Sheet 1 of 3

**Santa Monica Freeway Smart Corridor Evaluation**
**Incident No. 9 - Operational Performance**




Graphic Comparison of Measures of Effectiveness (MOE's)

Note: 'After' represents system performance under Smart Corridor control during each incident (as simulated using actual capacity, signal timings, and traffic volumes in effect during each incident)

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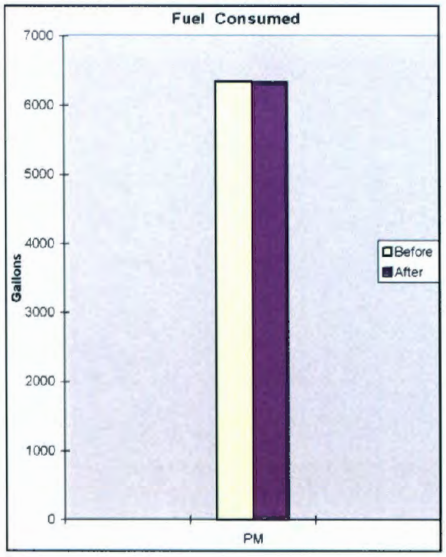
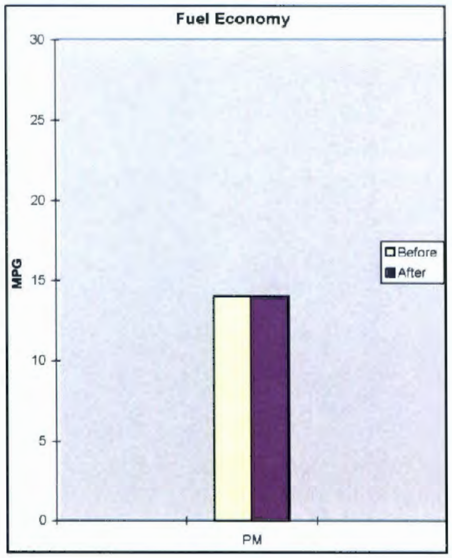
Sheet 2 of 3

**Santa Monica Freeway Smart Corridor Evaluation**
**Incident No. 9 - Energy Impact**



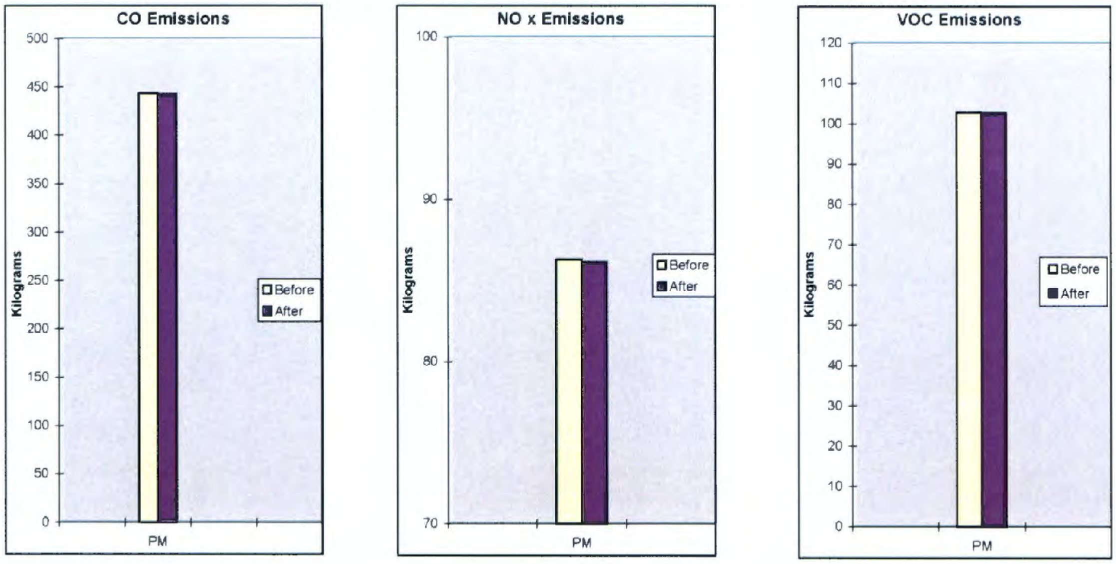

Graphic Comparison of Measures of Effectiveness (MOE's)

Note: 'After' represents system performance under Smart Corridor control during each incident (as simulated using actual capacity, signal timings, and traffic volumes in effect during each incident)

'Before' represents hypothetical system performance without Smart Corridor control during each incident (as simulated using actual capacity and signal timings during incident-free conditions in a comparable time period, superimposed with actual traffic volumes during the subject incident)

Sheet 3 of 3

**Santa Monica Freeway Smart Corridor Evaluation**
**Incident No. 9 - Emissions Impact**




Graphic Comparison of Measures of Effectiveness (MOE's)

Note: 'After' represents system performance under Smart Corridor control during each incident (as simulated using actual capacity, signal timings, and traffic volumes in effect during each incident)

'Before' represents hypothetical system performance without Smart Corridor control during each incident (as simulated using actual capacity and signal timings during incident-free conditions in a comparable time period, superimposed with actual traffic volumes during the subject incident)

# APPENDIX C FOCUS GROUP

Appendix C documents the list of discussion points developed to drive the focus group proceedings as well as to guide the one-on-one interviews.

METRO

**Santa Monica Freeway SMART Corridor Evaluation**

**INSTITUTIONAL COORDINATION**

**AND**

**SYSTEMS BENEFITS**

**DISCUSSION GROUP**

Metropolitan Transportation Authority ▪
Booz - Allen & Hamilton Inc ▪ The Robert Group

# Santa Monica Freeway SMART Corridor Evaluation

Date: August 3, 2000
Time: 9:00 AM
Location: MTA, San Marino Room, 7th Floor

## AGENDA

| | |
|---|---|
| 9:00 - 9:15 | Existing Business |
| 9:15 - 10:30 | Institutional Coordination Discussion |
| 10:30 - 10:45 | Break |
| 10:45 - 12:00 | Systems Benefits Discussion |
| 12:00 PM | Adjournment |

# Santa Monica Freeway SMART Corridor Evaluation

Thank you for your attendance today.

Enclosed please find some questions that will lead our discussion. Please feel free make any comments that you were unable to make during the discussions and/or you find would be helpful to us in the development of the evaluation. Use the blank spaces under each question in the "workbook" to record your additional input.

Your comments will be treated confidentially, but will be incorporated into the final report. Please feel free to contact Chris Robert or Clarissa Filgioun at The Robert Group at 213.381.5700, if you would like to discuss your comments further.

Your cooperation is greatly appreciated in making this report a success.

## Overall Project Coordination

To get a project of the magnitude of the SMART Corridor off the ground required significant institutional coordination, inter-agency communication and individual commitment — as well as enthusiasm and dedication.

*Please specify and evaluate your experience with inter-agency coordination on SMART.*

- Were institutional policies and procedures established at the project's inception?

- Did inter-agency coordination improve as the project moved ahead?

- What, if anything, could have been done to improve overall coordination efforts between the agencies?

- And, how have you approached the overall project coordination element on subsequent projects given what you have learned from SMART?

**Determining Operational Responsibilities**

Recognizing the number of agencies involved in the SMART Corridor, defining responsibilities and clarifying roles was important.

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- Did the Agencies participating in SMART clearly partition the areas of operational responsibility between them? How were areas of responsibility allocated? For example, was a Memorandum of Understanding (MOU) prepared? Could areas of operational responsibility have been differently allocated to be more efficient?

- How did the Agencies build and maintain consensus through the project's duration?

- From your perspective, is there a need for a lead agency on projects of this type? What is your feeling about one agency "controlling" another agency?

- How have you applied your SMART experience to determine operational responsibilities on subsequent projects?

## Information Sharing

Providing a mechanism to ensure that information is shared both inter-agency and intra-agency is key to the success of any project, including SMART Corridor.

*Describe the information sharing process or mechanism employed during the project.*

- Was this mechanism effective? Could anything have been done differently to facilitate the flow of information?

- Was there a situation where information was available but, for some reason (perhaps institutional or technological), it wasn't shared in a timely fashion; if so, how was this overcome?

- Have communications between the Agencies improved overall?

- Has your experience with SMART influenced how you address information sharing on other projects?

## Schedule, Cost and Unanticipated Challenges

Launching a project of the scope and innovation of SMART presents a number of unforeseen challenges such as schedule and cost.

- What factors contributed to schedule adherence/non-adherence on SMART?

- How were you able to stay within budget?

- Were schedule and cost challenges attributable to inter-agency coordination issues?

- Did you encounter any unexpected challenges like legal or liability issues?

- How have you applied your SMART experience to avoid schedule or cost overruns on subsequent projects?

- Did your work on SMART provide you a "heads-up" on challenges you may not have anticipated prior to your work on SMART?

## Lessons Learned

The SMART Corridor project provided the participating Agencies with invaluable experience in start-up and actual operations of this type of project.

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- Given your experience with the SMART Corridor and acknowledging current technological advances, how would you go about planning, funding, procuring and deploying a new project of this nature? How would this be different from your experience with SMART?

- Would you add or subtract any Agencies or Agency types from such a project?

- What are your thoughts about the expandability and scalability of the SMART Corridor project? Please describe the organizational challenges you may encounter with expanding the SMART Corridor concept.

**Overall Operational Assessment**

The smooth day-to-day running of a project of the scope of SMART Corridor requires establishing clearly defined organizational roles.

- What roles(s) did each agency maintain?

- How did each individual agency's organizational structure contribute to SMART, or what adjustments were made to better support the project?

- What, if any, institutional barriers are in existence? Please highlight efforts the participating Agencies used to adapt to working on a successful, cooperative, multi-jurisdictional project.

- And, how have you applied your SMART experience towards operational effectiveness on subsequent projects?

## Operational Policies and Procedures

*The efficient operation of the SMART Corridor also requires developing policies, procedures and mechanisms in order to effectively respond to a situation.*

- How was the operational decision-making process developed and enacted? How was compliance monitored and maintained? For example, were quality control procedures adopted?

- Given the participating Agencies' different policies and procedures, did any specific Agency's policies and procedures take precedence? If Agencies identified conflicting policies or procedures, how were they resolved?

- How, if at all, did SMART impact the policies and procedures of your agency?

- What improvements to the SMART Corridor's operational policies and procedures might you recommend?

- Has your experience with SMART influenced how you develop operational policies and procedures on other projects?

## Maintenance

While effective and efficient day-to-day operation of a project is vital to its ultimate success, just as important is its maintenance. For example, a power outage on the SMART system would have the same functional impacts as an earthquake on a bridge.

*Please describe the SMART Corridor's maintenance policies, procedures and mechanisms.*

- How were decisions about program maintenance developed and enacted? How was compliance monitored and maintained?
- Given the participating Agencies' different policies and procedures, did any Agency's maintenance policies and procedures take precedence? If Agencies identified conflicting policies or procedures, how were they resolved?
- How, if at all, did SMART impact the maintenance policies and procedures of your agency?
- What improvements would you bring to the maintenance process?
- Did the SMART Corridor experience "down time" as a result of maintenance issues? If so, for how long? How were these issues resolved?
- Once established, could maintenance levels be reduced?
- Was maintenance conducted in-house? Could this function be contracted out on future projects?
- Again, has your experience with SMART influenced how you develop maintenance policies and procedures on other projects?

## Staffing

Staffing on the SMART Corridor was especially important inasmuch as specific technical skills were required and, in the longer term, a sense of institutional project history was developed.

*Please specify the staffing allocation and requirements for SMART.*

- Was this the right mix of staffing skills? Did it effectively combine staffing resources with the quality of skills and experience?

- How were these skills allocated amongst agencies?

- What staffing resources and skills are needed to provide the level of service required to operate SMART?

- Did you experience staff turnover and, if so, how was this addressed?

- Did salary levels match skill levels? In other words, were salaries sufficient to attract the skills you needed to operate and maintain the system?

- Would it be appropriate to identify/ designate an individual from one agency to act on the behalf of another Agency?

- How has your experience with staffing the SMART Corridor framed your subsequent experiences?

### Staff Training

Operating SMART requires a match of technical skills and practical application throughout the life of the project. However, if there is staff turnover, there needs to be a mechanism in place to address this so that a potential loss of institutional history and program experience is minimized.

- Did the SMART Corridor project include a staff training program component? If so, what kind of training program was developed?

- How would you characterize the effectiveness of a SMART training program?

- What type of staff training is required to operate SMART, if any? If so, should this be conducted prior to commencement of work on the project or is on-the-job training sufficient? Should training be tailored by task or should all operators receive the same training?

- Would training programs be conducted for staff of all participating Agencies or by each individual Agency?

- Given your experience on SMART, please describe the type of training program you would adopt for future projects of this nature.

# APPENDIX D SURVEY

Appendix D provides a survey and cover letter that were mailed to members of the Caltrans' Transportation Information People (TIP) database.

August 17, 2000

Dear:

Los Angeles has consistently ranked as one of the most congested cities in the nation — something you know a lot about!

An amazing array of new, "intelligent" technologies is now becoming available to deal with our traffic problems. From changeable message signs and ramp-meters through on-vehicle transponders, new ways to improve traffic flow and alert motorists about incidents are being developed on an on-going basis. Much of the credit for these advances is due to the City of Los Angeles, Caltrans and MTA which pioneered SMART Corridor, the first project in the country which actually demonstrated how Intelligent Transportation Systems (ITS) could be used to alleviate congestion.

The goal of the SMART Corridor project was to maximize the efficiency of the Santa Monica Freeway (I-10), one of the most heavily traveled corridors in the nation, and the adjacent network of surface streets west of downtown Los Angeles. The project integrated a number of then-new technologies to alert Corridor users about incidents in the SMART Corridor so that they would be able to take corrective action. For example, we were able to provide route alternatives on the variable message signs as well as change the timing of ramp-meters to accommodate traffic flows.

As a traffic reporter, you literally had a "bird's eye view" of how the SMART Corridor worked; in other words, how users of the I-10 and its adjacent arterials might have responded to the SMART system. My firm is assisting with an evaluation report on the project and we're eager to hear your thoughts on the effectiveness of SMART.

Recognizing your very tight schedule, I have developed a very brief questionnaire to receive your input. If you could take just five minutes to fill it out and return to me either by faxing it over or dropping it in the mail, I would be very appreciative. Please note that should you have more detailed comments on SMART, I would be pleased to conduct a one-on-one interview with you at your office.

Thanks in anticipation for all your assistance!
Sincerely,
Clarissa A. Filgioun
Senior Vice President
The Robert Group

# SMART Corridor Evaluation Questionnaire

How did you learn about the SMART Corridor project? What is your recollection about this project?

Were you able to observe the SMART Corridor as a whole in operation during a traffic incident? For example, did you notice shifts in traffic patterns in response to an incident? In your opinion, could this shift have been attributable to SMART?

Were you able to observe elements of SMART in action? For example, did you observe a pattern of cars responding to the changeable message signs?

If you noticed motorists responding to SMART, how did this impact traffic on the Freeway? Arterials?

Did your station receive calls from the public about the SMART Corridor? Or, did they receive calls about traffic in the project area?

If we were to implement a project similar to SMART in the region, how best could we work with you to get information out to the public? How would you like to be involved?

| | | |
|---|---|---|
| **Please mail/fax return to:** | Clarissa Filgioun<br>The Robert Group<br>3780 Wilshire Boulevard, Suite 1010<br>Los Angeles, CA 90010 | 213.381.5857 — fax |

| FIRST NAME | LAST NAME | COMPANY | STREET ADDRESS | CITY | ST | ZIP CODE | PHONE |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| ROSIE | ROLDAN | AIRWATCH | 1551 N. TUSTIN AVE.,SUITE 570 | SANTA ANA | CA | 92701 | (714) 647-0117 |
| DAVID J. | RIZZO | DR. ROADMAP | P.O. BOX 2683 | FULLERTON | CA | 92633 | (213) 525-5628 |
| CLINT | BRADFORD | REPORTERS USERS GROUP | 5085 TRAIL CANYON DR. | MIRA LOMA | CA | 91753 | (909) 681-6210 |
| BILL | THOMAS | SHADOW BROADCAST SERVICES | 6420 WILSHIRE BLVD., 4TH FLOOR | LOS ANGELES | CA | 90048 | (323) 782-6150 |
| DONNA | PAGE | KNX RADIO STATION | 6121 SUNSET BLVD. | LOS ANGELES | CA | 90028 | (323) 460-3321 |
| MEGHAN | REYES | SHADOW BROADCAST SERVICES | 6420 WILSHIRE BLVD., 4TH FLOOR | LOS ANGELES | CA | 90048 | (323) 782-6150 |
| STEVE | CUSAK | SHADOW BROADCAST SERVICES | 6420 WILSHIRE BLVD., 4TH FLOOR | LOS ANGELES | CA | 90048 | (323) 782-6150 |
| JIM | THORTON | KNX RADIO STATION | 6121 SUNSET BLVD. | LOS ANGELES | CA | 90028 | (323) 460-3321 |
| CHRISTINA | GRIEGO | KNX RADIO STATION | 6121 SUNSET BLVD. | LOS ANGELES | CA | 90028 | (323) 460-3321 |
| PAT | HASLAM | SHADOW BROADCAST SERVICES | 6420 WILSHIRE BLVD., 4TH FLOOR | LOS ANGELES | CA | 90048 | (323) 782-6150 |
| PETE | DEMERTRIO | SHADOW BROADCAST SERVICES | 6420 WILSHIRE BLVD., 4TH FLOOR | LOS ANGELES | CA | 90048 | (323) 782-6150 |
| RHONDA | KRAMER | SHADOW BROADCAST SERVICES | 6420 WILSHIRE BLVD., 4TH FLOOR | LOS ANGELES | CA | 90048 | (323) 782-6150 |
| ALLEN | LEE | SHADOW BROADCAST SERVICES | 6230 YUCCA STREET | LOS ANGELES | CA | 90028 | (323) 871-4612 |
| JEFF | BAUGH | SHADOW BROADCAST SERVICES | 6230 YUCCA STREET | LOS ANGELES | CA | 90028 | (323) 871-4612 |
| TOM | STORY | SHADOW BROADCAST SERVICES | 6230 YUCCA STREET | LOS ANGELES | CA | 90028 | (323) 871-4612 |
| RADINE | COOK | SHADOW BROADCAST SERVICES | 6230 YUCCA STREET | LOS ANGELES | CA | 90028 | (323) 871-4612 |
| PAUL | JOHNSON | NBC TELEVISION | 3000 WEST ALAMEDA ST. | BURBANK | CA | 91523 | (818) 840-4444 |
| BOB | PETTY | NBC TELEVISION | 3000 WEST ALAMEDA ST. | BURBANK | CA | 91523 | (818) 840-4444 |
| JUDY | ABLE | KFI RADIO STATION | 610 SOUTH ARDMORE BOULVEVARD | LOS ANGELES | CA | 90005 | (323)385-0101 |
| MIKE | NOLAN | KFI RADIO STATION | 610 SOUTH ARDMORE BOULVEVARD | LOS ANGELES | CA | 90005 | (323)385-0101 |
| | | TRAFFIC REPORTERS HELINET CORPORTATION | 16425 HART STREET | VAN NUYS | CA | 91406 | |
| SCOTT | REIFF | KLOS RADIO STATION | 3321 SOUTH LA CIENEGA | LOS ANGELES | CA | 90016 | (310) 840-4800 |
| JORGE | JARRIN | METRO NETWORKS | 6420 WILSHIRE BLVD., 4TH FLOOR | LOS ANGELES | CA | 90048 | (323) 782-6100 |
| JENNIFER | YORK | KTLA TELEVISION STATION | 5800 SUNSET BLVD. | LOS ANGELES | CA | 90028 | (323) 460-5500 |
| ROD | BERSEN | KTTV TELEVISION STATION | 1999 SOUTH BUNDY DRIVE | LOS ANGELES | CA | 90025 | (310) 584-2000 |
| CHUCK | STREET | KIIS FM RADIO STATION | 3710 ARTESIA BLVD. | FULLERTON | CA | 92633 | (818) 845-1027 |
| RUDY | GRANDE | METRO NETWORKS | 6420 WILSHIRE BLVD., 4TH FLOOR | LOS ANGELES | CA | 90048 | (323) 782-6100 |
| DONA | DOWER | METRO NETWORKS | 6420 WILSHIRE BLVD., 4TH FLOOR | LOS ANGELES | CA | 90048 | (323) 782-6100 |