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Los Angeles Congestion Reduction Demonstration (Metro ExpressLanes) Program

National Evaluation:
Cost Benefit Analysis Test Plan

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U.S. Department of Transportation
Research and Innovative Technology Administration

LOS ANGELES CONGESTION REDUCTION DEMONSTRATION (METRO EXPRESSLANES) PROGRAM

NATIONAL EVALUATION: COST BENEFIT ANALYSIS TEST PLAN

By

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16. Abstract

This report presents the Cost Benefit Analysis Test Plan for the national evaluation of the Los Angeles County Congestion Reduction Demonstration (LAC CRD) under the United States Department of Transportation (U.S. DOT) Congestion Reduction Demonstration (CRD) Program. The LAC CRD projects focus on reducing traffic congestion by employing strategies consisting of combinations of tolling, transit, telecommuting/travel demand management (TDM), and technology, also known as the 4Ts. Tolling (pricing) strategies include converting high occupancy vehicle (HOV) lanes on the two freeway corridors to variably-priced high occupancy toll (HOT) lanes, adding a second HOT lane to portions of one corridor, and implementation of a downtown LA intelligent parking management system featuring demand-based pricing and real-time parking availability information. Transit improvements include increased bus service, transit station security improvements, expansion of two transit stations, creation of an El Monte Busway/Union Station bus service connection, and the expansion of downtown LA transit signal priority. TDM strategies aim to establish 100 new registered vanpools. This Cost Benefit Analysis Test Plan is one of ten test plans being developed. The other nine test plans consist of the following: traffic; tolling; surveys, interviews and workshops; ridesharing, safety; environmental; content; transit, and exogenous factors. Each test plan is based on the LAC CRD National Evaluation Plan. This test plan describes the cost and benefit data sources, data availability, and possible risks associated with the data. The methods for analyzing the cost and benefit data are discussed. The schedule and responsibility for collecting, analyzing, and reporting the cost and benefit data are presented.

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LIST OF ABBREVIATIONS

4Ts	Tolling, Transit, Telecommuting, and Technology
CBA	Cost Benefit Analysis
CHP	California Highway Patrol
CO_2	Greenhouse Gas
CRD	Congestion Reduction Demonstration
Caltrans	California Department of Transportation
ExpressLanes	Component of LA CRD, pilot converted HOT lanes
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
HOT	High-occupancy tolling
HOV	High-occupancy vehicle
I-10	Interstate 10 (El Monte Busway between Alameda St and I-605)
I-110	Interstate 110 (Harbor Transitway between Adams Blvd and Harbor Gateway Transit Center)
IPM	Intelligent Parking Management
L.A.	Los Angeles
LA Express Park	Component of LA CRD, pilot LA parking management system
LADOT	Los Angeles Department of Transportation
MOE	Measure of effectiveness
Metro	Los Angeles County Metropolitan Transportation Authority
Metro Model	Metro's Travel Forecasting Model
Metrolink	Southern California Regional Rail Authority
NHTSA	National Highway Traffic Safety Administration
NO_x	Nitrogen Oxide
O&M	Operation and Maintenance
$PM_{2.5}$	Fine Particulate Matter
SBCCOG	South Bay Cities Council of Governments
SCAG	Southern California Association of Governments
SGVCOG	San Gabriel Valley Council of Governments
SOV	Single Occupancy Vehicle
TDM	Travel demand management
UPA	Urban Partnership Agreement
U.S. DOT	U.S. Department of Transportation
VMT	Vehicle miles traveled
VOC	Volatile Organic Compounds

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1.0 INTRODUCTION

This report presents the test plan for collecting and analyzing cost and benefit data for the national evaluation of the Los Angeles County Congestion Reduction Demonstration (LA CRD (Metro ExpressLanes) Program) under the United States Department of Transportation (U.S. DOT) CRD program. The LA CRD is one of several large field deployments around the United States that are receiving U.S. DOT funding and which are intended to demonstrate congestion pricing and supporting strategies. The LA CRD (Metro ExpressLanes) Program national evaluation will address the four primary U.S. DOT evaluation questions shown in Table 1-1.

Table 1-1. U.S. DOT National Evaluation "Objective Questions"

Objective Question #1	How much was congestion reduced in the area impacted by the implementation of the tolling, transit, technology, and telecommuting strategies? It is anticipated that congestion reduction could be measured by one of the following measures, and will vary by site and implementation strategy: • reductions in vehicle trips made during peak/congested periods; • reductions in travel times during peak/congested periods; • reductions in congestion delay during peak/congested periods; and • reductions in the duration of congested periods.
Objective Question #2	What are the associated impacts of implementing the congestion reduction strategies? It is anticipated that impacts will vary by site and that the following measures may be used: • increases in facility throughput during peak/congested periods; • increases in transit ridership during peak/congested periods; • modal shifts to transit and carpools/vanpools; • traveler behavior change (e.g., shifts in time of travel, mode, route, destination, or forgoing trips); • operational impacts on parallel systems/routes; • equity impacts; • environmental impacts; • impacts on goods movement; and • effects on businesses.
Objective Question #3	What are the non-technical success factors with respect to the impacts of outreach, political and community support, and institutional arrangements implemented to manage and guide the implementation?
Objective Question #4	What are the overall costs and benefits of the deployed set of strategies?

The questions shown in Table 1-1 will be addressed by carrying out the following 11 "evaluation analyses" described in the LA CRD (Metro ExpressLanes) Program National Evaluation Plan[1]: tolling, technology, transit, travel demand management (TDM), congestion, safety, equity, environment, business impacts, non-technical success factors, and cost benefit. Each of these 11 analyses relies upon various evaluation measures of effectiveness.

[1] Los Angeles County Congestion Reduction Demonstration National Evaluation Plan, January 13, 2010, U.S. DOT.

"Test plans" are the evaluation planning documents that describe how specific data will be collected and processed to yield the evaluation measures of effectiveness required for the various analyses. Whereas evaluation analyses are categorized according to related evaluation questions or types of impacts, for example all equity-related impacts are addressed in the equity analysis, test plans are categorized according to common data types or sources. For example, the "Traffic System Data Test Plan" collects and processes all of the traffic data required for the national evaluation. There are a total of ten test plans for the LA CRD (Metro ExpressLanes) Program national evaluation. In addition to this Cost Benefit Analysis Test Plan, there are test plans focusing on the following types of data: traffic; tolling; ridesharing; safety; environmental; content analysis; surveys, interviews, and workshops; transit; and exogenous factors.

The relationship between test plans and evaluation analyses is discussed in Section 1.2. In short, analyses describe the evaluation questions and hypotheses to be investigated and the test plans describe how the data and measures of effectiveness needed to support the evaluation will be collected and processed. Most test plans collect data and provide measures of effectiveness that will be used in multiple analyses and most analyses rely upon data and measures developed through several different test plans.

The remainder of this introduction chapter identifies the LA CRD (Metro ExpressLanes) Program deployments and elaborates on the relationship between test plans and evaluation analyses. The remainder of the report is divided into three sections. Chapter 2.0 presents the data sources, data availability, and risks associated with evaluating the cost benefit of the LA CRD (Metro ExpressLanes) Program. Chapter 3.0 describes the techniques that will be used in the cost benefit analysis. Chapter 4.0 presents the schedule and responsibilities for completing the cost benefit analysis.

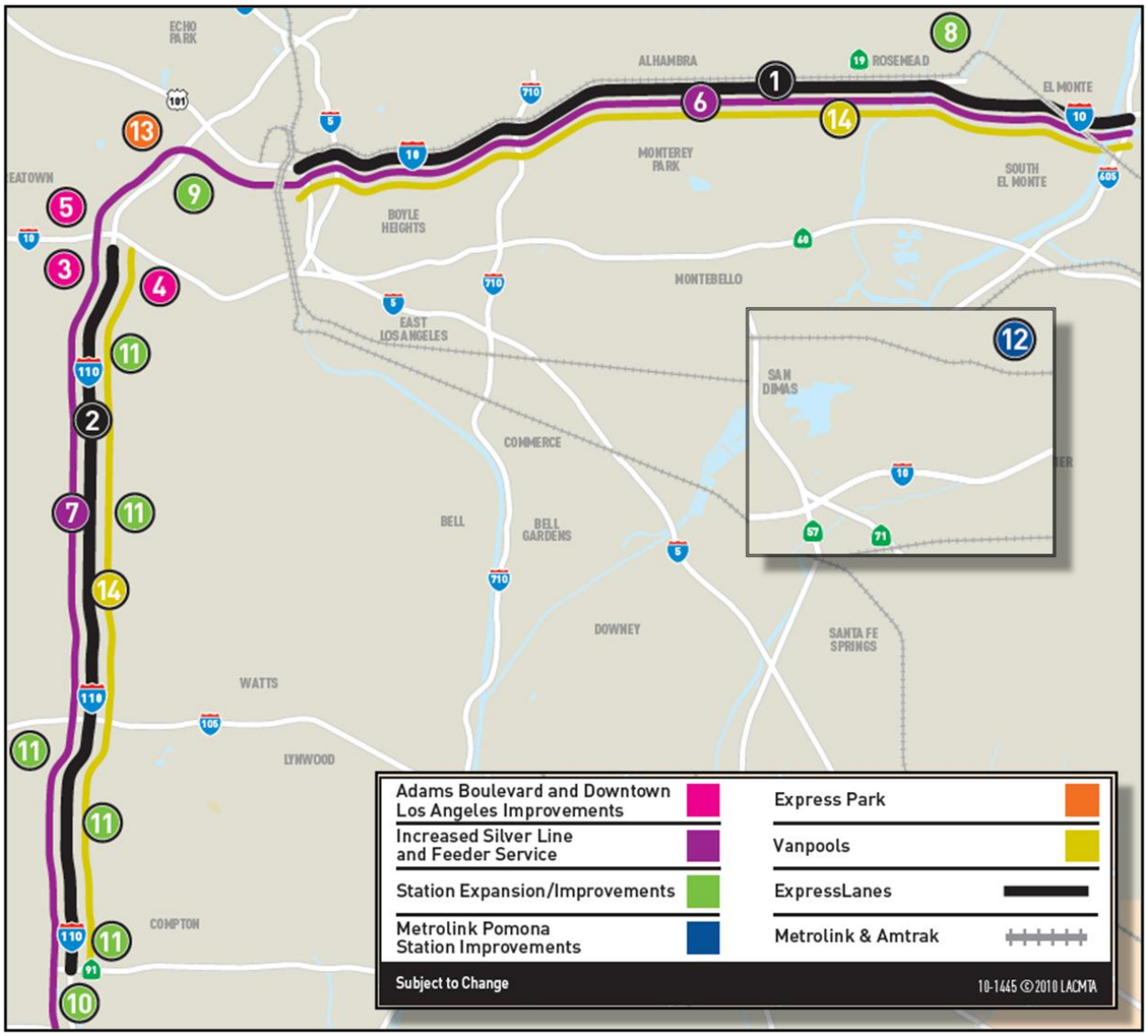
1.1 The LA CRD (Metro ExpressLanes) Program Projects

The LA CRD (Metro ExpressLanes) Program was selected by the U.S. DOT as an Urban Partner to implement projects aimed at reducing congestion based on four complementary strategies known as the 4Ts: Tolling, Transit, Telecommuting/TDM, and Technology. Under contract to the U.S. DOT, a national evaluation team led by Battelle is assessing the impacts of the projects in a comprehensive and systematic manner in Los Angeles (L.A.) County and other sites. The national evaluation will generate information and produce technology transfer materials to support deployment of the strategies in other metropolitan areas. The national evaluation will also generate findings for use in future Federal policy and program development related to mobility, congestion, and facility pricing.

The LA CRD (Metro ExpressLanes) Program effort is led by the Los Angeles County Metropolitan Transportation Authority (Metro). The CRD projects are being implemented with the assistance of a number of supporting agencies especially the California Department of Transportation (Caltrans); and the Los Angeles Department of Transportation (LADOT). Other participating agencies include the Southern California Association of Governments (SCAG); the San Gabriel Valley Council of Governments (SGVCOG); the South Bay Cities Council of Governments (SBCCOG); the Southern California Regional Rail Authority (Metrolink); Foothill Transit; the California Highway Patrol (CHP); and the Los Angeles County Sheriff's Department. The LA CRD (Metro ExpressLanes) Program projects are intended to reduce

congestion, promote throughput, and enhance mobility in the Interstate-10 (I-10) and Interstate-110 (I-110) corridors, and in downtown Los Angeles. Figure 1-1 shows the location of the LA CRD (Metro ExpressLanes) Program projects and Figure 1-2 provides short summaries of the numbered projects on Figure 1-1.

Derived from Metro ExpressLanes project map



Note: See Figure 1-2 for the explanation of each numbered project on this map.

Figure 1-1. LA CRD (Metro ExpressLanes) Program Project Locations

Derived from Metro ExpressLanes project map.

1 EXPRESSLANES ON I-10
This project will convert existing HOV lanes on the I-10 from Alameda Street/Union Station to I-605 into ExpressLanes (44 lane miles). The budget will cover the toll technology, toll infrastructure and operational improvements required to complete the conversion. This project will also provide additional ExpressLanes capacity on the El Monte Busway between I-710 and I-605 through re-striping and buffer changes. No general purpose lanes are taken away to create the second ExpressLane between I-710 and I-605.

2 EXPRESSLANES ON I-110
This project will convert existing HOV lanes on the I-110 from 182nd Street/Artesia Transit Center to Adams Boulevard into ExpressLanes (38 lane miles). The budget will cover the toll technology, toll infrastructure and operational improvements required to complete the conversion.

ExpressLanes is a one-year demonstration project. Buses, motorcycles, vanpools, and carpools that currently use HOV lanes will not be charged a toll. General purpose lanes will continue to remain toll-free. The following projects will provide additional access and capacity to the I-10 and I-110 ExpressLanes, to encourage movement of more people rather than more vehicles.

ADAMS BOULEVARD AND DOWNTOWN LOS ANGELES IMPROVEMENTS

3 I-110 ADAMS/FIGUEROA FLYOVER STUDY
The Adams/Figueroa Flyover Study will investigate how the construction of a new structure – connecting the I-110 northbound HOV lane off-ramp directly to Figueroa Street – could improve traffic flow at the end of the I-110 HOV lane.

4 ADAMS BOULEVARD STREET WIDENING
Adams Boulevard will be widened between the Harbor Freeway off-ramp and Flower Street – adding an additional westbound right-turn-only lane to the HOV bypass connecting to Figueroa Street. Re-striping will also add one extra lane to the HOV off-ramp approaching Adams Boulevard to increase capacity.

5 TRANSIT SIGNAL PRIORITY IN LOS ANGELES
This project will install bus-signal priority technology on Figueroa Street between Wilshire Boulevard and Adams Boulevard (15 signals), and Flower Street between Wilshire Boulevard and Olympic Boulevard (5 signals) to enhance transit operations. It will also extend the existing AM peak-period northbound bus-only lane on Figueroa Street between 23rd Street and 4th Street to cover the PM peak-period.

INCREASED SILVER LINE AND FEEDER SERVICE

6 NEW BUSES FOR THE I-10 EL MONTE BUSWAY CORRIDOR
Before adding ExpressLanes to the corridor, Metro and its transit partner – Foothill Transit – will purchase 30 new buses and increase Silver Line and feeder service on the I-10 El Monte Busway, with a goal of providing service every three to seven minutes during rush hour.

7 NEW BUSES FOR I-110 HARBOR TRANSITWAY CORRIDOR
Before adding ExpressLanes to the corridor, Metro and its transit partners – Torrance Transit and Gardena Transit – will purchase 29 new buses to improve Silver Line and feeder service on the I-110 Transitway, with a goal of providing service every three to seven minutes during rush hour.

STATION EXPANSION/IMPROVEMENTS

8 EL MONTE TRANSIT STATION EXPANSION
The El Monte Station is the eastern terminus of the El Monte Busway, and is currently the busiest bus terminal west of Chicago. Given that the El Monte Station will now also be the eastern terminus of the ExpressLanes, expansion of the terminal will be required to accommodate additional high-capacity buses, passenger parking and bike lockers.

9 PATSAOURAS PLAZA/UNION STATION CONNECTION
A new Union Station stop will be created for the El Monte Busway, allowing direct access to the station's Patsaouras Transit Plaza. This will eliminate the long walks, operational delays and insufficient lighting and information displays passengers currently have to contend with when transferring at Alameda Street to Metro's Red and Gold lines, Metrolink and Amtrak.

10 IMPROVED ARTESIA TRANSIT CENTER SECURITY
Improvements at the largest transit center on the I-110 Harbor Transitway include bike lockers to promote non-motorized access and a law enforcement substation to assist with station security.

11 I-110 HARBOR TRANSITWAY PARK & RIDE AND TRANSIT STATION IMPROVEMENTS
Improvements to these facilities will include enhanced signage, lighting and security. Other benefits to customers include new bus stops under Slauson and Manchester stations for Lines 108/115, and improved signage and security for existing Harbor Transitway Park and Ride lots at Slauson, Manchester, Harbor Green Line, Rosecrans, Artesia, Carson, PCH and Harbor/Beacon in San Pedro.

METROLINK POMONA STATION IMPROVEMENTS

12 ADDITIONAL COMMUTER RAIL CAPACITY
This station on Metrolink's San Bernardino Line will undergo several improvements, including the addition of 143 new parking spaces and the expansion of platforms to accommodate longer eight-car trains.

EXPRESS PARK

13 DOWNTOWN PARKING MANAGEMENT
This project will use new parking technology to provide motorists alternative payment options and real-time parking availability information for nearly 13,000 on-street and off-street parking spaces in Downtown Los Angeles. The information will aid motorists in understanding their parking options and will guide them to available parking spaces – eliminating the need to search for parking and reducing traffic congestion.

New parking meters will be installed at approximately 5,500 on-street metered parking spaces in the downtown area. These meters will be capable of charging motorists demand-based parking rates – which change depending on the time of day and traffic congestion levels. They will also provide alternative payments options, allowing motorists to pay for parking using their credit card or cell phone and to receive a text message when their paid parking time is about to expire.

VANPOOLS

14 I-10/I-110 COMMUNITY-BASED VANPOOL FORMATION
This program will provide vanpool formation services to any community where ExpressLanes are implemented. This includes a dedicated vanpool representative that will actively train community groups to form vanpools and provide support to ensure that vanpools are created and retained.

In addition to receiving the incentive of free access to the new ExpressLanes, vanpoolers along those corridors will also be eligible for vanpool start-up assistance, which may cover the cost of driver and back-up driver training and exams, as well as special training on how best to keep existing vanpools together.

Figure 1-2. LA CRD (Metro ExpressLanes) Program Project Descriptions

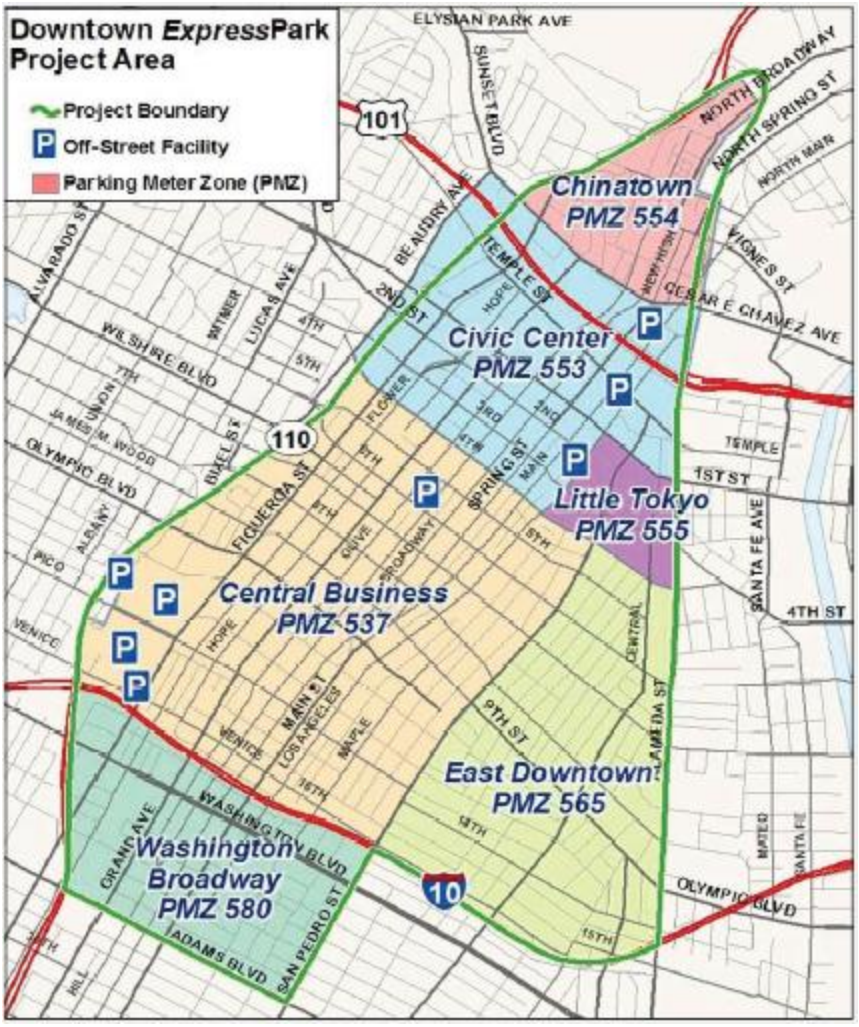
The U.S. DOT is allocating $210.6 million in Federal grant funding for the LAC CRD projects, drawn from the Federal Transit Administration (FTA) 5309 Bus and Bus Facilities Program. The LAC CRD projects consist of the following:

- **Transit Improvements** to increase the frequency of Metro bus rapid transit service through the acquisition of 59 new clean fuel expansion buses (30 buses in the I-10 El Monte Busway corridor and 29 buses in the I-110 Harbor Transitway corridor) and increased service: to one bus every seven minutes along the I-10 corridor and to one bus every ten minutes along the I-110 corridor. Various security upgrades will be made to the Harbor Gateway Transit Center (better lighting, new security cameras, bicycle lockers and a new L.A. County Sheriff's substation). Expansion of the El Monte Transit Center includes reconstruction of the existing transit passenger terminal, additional surface parking, and a new administration facility. A new El Monte Busway stop will be created at Union Station that will allow for direct pedestrian access to Union Station's Patsaouras Transit Plaza and thus promote transfers to/from the El Monte Busway and other transit services. Expansion of the Pomona (North) Metrolink station includes 143 new parking spaces and extended platforms to accommodate additional rail cars for the San Bernadino Line. Improvements to Harbor Transitway Park-and-Ride lots and Transit Stations include enhanced signage, lighting, and closed-circuit television cameras for existing lots at Slauson, Manchester, Harbor Green Line, Rosecrans, and Harbor Gatway as well as the relocation of bus stops for Lines 108 and 115 to the Slauson and Manchester Transitway stations. The 37th Street Station will also be fitted with translucent and architectural sound attenuation panels to reduce noise levels for waiting customers on the Harbor Transitway. Implementation of transit signal priority technology on Figueroa Street (15 signals between Wilshire Boulevard and Adams Boulevard) and Flower Street (5 signals between Wilshire Boulevard and Olympic Boulevard) in downtown Los Angeles. Lastly, to facilitate HOT traffic movement where the I-110 freeway enters downtown Los Angeles, Adams Boulevard will be widened and the Adams Boulevard off ramp will be restriped, both providing an additional lane of high occupancy vehicle (HOV) capacity.
- **High Occupancy Toll (HOT) Lanes** ("ExpressLanes") to expand freeway capacity by permitting toll-paying, single occupancy vehicles or those that do not meet the carpool occupancy requirement to use slack, HOT lane capacity on the I-10 and I-110 freeways. ExpressLanes will be created by converting existing HOV lanes into HOT lanes along the I-10 (from I-605 to Alameda Street) and along the I-110 (from 182nd Street to Adams Boulevard). In addition, a second HOT lane will be created (via restriping; no loss of general purpose lanes will occur) on I-10 from I-605 to I-710 where there is no slack HOV lane capacity during peak periods. All vehicles will pay to use the HOT lanes with the exception of transit vehicles, motorcycles and multiple-occupant private vehicles (three or more occupants on I-10 during peak hours, two or more all other times; two or more occupants on I-110). All tolls will be collected electronically, requiring all vehicles entering HOT lanes to be equipped with a transponder. Vehicles satisfying the ExpressLane occupancy requirements and therefore eligible to use the lane free of charge will "self declare" by setting a switch on their transponders. ExpressLane enforcement will be carried out manually through on-site law enforcement observation. Tolls will range from a minimum $0.25 per mile to a maximum $1.40 per mile depending on

congestion levels. When travel speeds in the HOT lanes fall below 45 mph for more than ten minutes, the ExpressLanes have reached capacity. At this point, the lanes will revert to HOV lanes and vehicles that do not meet the carpool occupancy requirements will not be permitted to "buy" their way into the lanes. Low income commuters[2] will receive cost reductions through the Equity Account Discount, consisting of a $25 discount for toll account set-up and waiver of the $3 non-usage maintenance fee.

- **Intelligent Parking Management (IPM)** ("LA ExpressPark") consists of a variable, demand-based parking pricing system coupled with a parking guidance system that will include real-time parking availability information. The IPM is intended to reduce traffic congestion, reduce air pollution, and improve transit efficiency by reducing parking search times by achieving 10 to 30 percent parking availability for on-street parking. The LA ExpressPark system will cover approximately 13,500 City of Los Angeles-owned or operated parking spaces (about 6,000 on-street, metered spaces and about 7,500 off-street spaces in an area of downtown Los Angeles bounded by the I-10 and I-110 freeways, Alameda Street and Adams Boulevard. The project area is shown in Figure 1-3. LA ExpressPark meter capabilities include demand-based parking rates based on time of day and length of stay; alternate payment options (coins, credit card, smart phone, cell phone); and increased convenience (text messages when paid parking time is about to expire). Vehicle sensors placed in the on-street metered parking spaces provide real-time occupancy and parking duration information. Parking conditions and availability in off-street parking locations will be determined using vehicle sensors, cordon counting systems and/or advanced revenue control systems. The parking guidance component of the IPM will provide information via a limited number of on-street dynamic message signs when not in use for active traffic management, an Internet web site, mobile phones using Metro's 511 interactive voice response system, smart phones and, pending industry support, in-vehicle navigation systems.
- **Ridesharing Promotion (travel demand management)** to increase the number of registered vanpools (with a goal of 100 new vanpools on the I-10 and I-110 corridors), and major employer-based ridesharing through the use of promotional methods including subsidies to travelers and vanpool operators and promotional outreach to major employers. In addition, a Metro ExpressLanes Carpool Loyalty Program is being developed which will incentivize vanpool trips by offering monthly drawings for gift cards on each corridor. Vanpools will be automatically entered into the drawing every time they use the Metro ExpressLanes and the toll system detects their FasTrak at the 3+ setting.

[2] The Equity Account Discount defines low income commuters as Los Angeles residents with an annual household income (family of 3) of $35,000 or less.

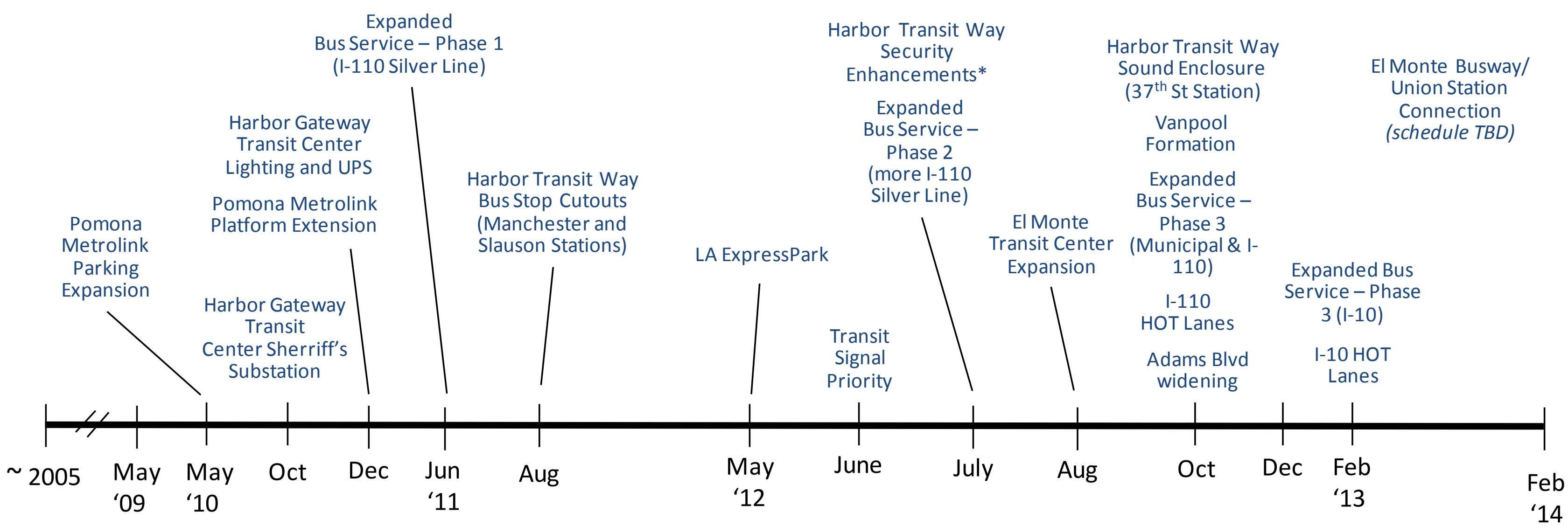


Derived from "LA Express Park Intelligent Parking Management: Downtown" Los Angeles Department of Transportation Pamphlet http://ladot.lacity.org/pdf/PDF217.pdf

Figure 1-3. LA Express Park Project Area

Schedule for the LA CRD (Metro ExpressLanes) Program. As shown in Figure 1-4, the LA CRD (Metro ExpressLanes) Program projects will become operational in a phased manner. Tolling on I-110 is scheduled to begin in October 2012, and tolling on I-10—the last project to be completed—is scheduled to begin in February 2013. Most of the LA CRD (Metro ExpressLanes) Program projects will be coming on line in advance of I-110 and I-10 tolling. One project will come on line after tolling begins on the I-10.

Based on information provided by Metro; July 2012



**Stations: Slauson, Manchester, Harbor Green Line, Rosecrans, Harbor Gateway*

Figure 1-4. LA CRD (Metro ExpressLanes) Program Project Completion ("Go Live") Schedule

1.2 LA CRD (Metro ExpressLanes) Program National Evaluation Plan Use of Cost Benefit Data

Table 1-2 shows which of the various LA CRD (Metro ExpressLanes) Program test plans will contribute data to each of the evaluation analyses. The "flow" between test plans is "one way" in the sense that test plans feed data and measures to the analyses rather than the reverse. The solid circles show where data from a given test plan constitutes a major input to an analysis; the open circles show where data from a given test plan constitutes a supporting input to an analysis. As shown in Table 1-2, the Cost Benefit Analysis Test Plan will be used only in the cost benefit analysis.

Within a test plan, data are grouped by type into various "data elements." Table 1-3 lists the LA CRD (Metro ExpressLanes) Program cost benefit analysis data elements and, by associating those elements with the measures of effectiveness and the hypotheses/questions from the related evaluation analyses, summarizes why these data are important.

Table 1-2. Relationship Among Test Plans and Evaluation Analyses

LA CRD (Metro ExpressLanes) Program Test Plans	Evaluation Analyses										
	Tolling	Technology	Transit	Travel Demand Management (TDM)	Congestion	Safety	Environmental	Equity	Business Impact	Non-Technical Factors	Cost-Benefit
Traffic System Data Test Plan	●		○		●	●	●	○			●
Tolling Test Plan	●	●			○			○	○		●
Transit System Data Test Plan			●		○			○			○
Ridesharing Test Plan				●				○			○
Safety Test Plan					○	●		○			●
Environmental Data Test Plan							●	○			○
Surveys, Interviews, Workshops Test Plan	●	●	●	●	○	○	○	●	●	●	○
Content Test Plan										●	
Cost Benefit Test Plan											●
Exogenous Factors Test Plan	○	○	○	○	○	○	○	○	○	○	

● — Test Plan Data Constitutes a Major Input to the Evaluation Analysis

○ — Test Plan Data Constitutes a Supporting Input to the Evaluation Analysis

Table 1-3. Cost Benefit Analysis Test Plan Data Elements

LA CRD (Metro ExpressLanes) Program Data Element	Data Source	LAC CRD Measure of Effectiveness	LAC CRD Hypotheses/ Questions
1. ***Transit Facility Improvements***		Net Benefits Benefit Cost Ratio	LACBA-1 What is the net benefit (benefits minus costs) of the Los Angeles CRD projects?
1.1 New investment in transit (park and ride lots, buses, station improvements, etc.)	Metro		
1.2 New investment in Pomona Station.	Metrolink		
1.3 Operation and maintenance (O&M) costs for transit	Metro		
1.4 Operation and maintenance (O&M) costs for Pomona Station.	City of Pomona (Metro to get costs from city)		
2. ***New Buses***			
2.1 Investment in new buses	Metro and participating Municipal Bus Operators		
2.2 O&M costs for the new buses	Metro and participating Municipal Bus Operators		
3. ***Carpooling and Ridesharing***			
3.1 Operations costs for promoting carpooling and ridesharing	Metro		
4. ***I-10 and I-110 HOT Lanes***			
4.1 New investment in the tolling system for the I-10 and I-110 HOT lanes	Metro		
4.2 Maintenance costs for the tolling system for the I-10 and I-110 HOT lanes	Metro / CalTrans		
4.3 Operations costs for the tolling system for the I-10 and I-110 HOT lanes	Metro		
4.4 Replacement costs for the tolling system for the I-10 and I-110 HOT lanes	Metro		
5. ***Transit Signal Prioritization***			
5.1 New investment in the transit signal prioritization system	LADOT		
5.2 Maintenance costs for the transit signal prioritization system	LADOT		
5.3 Operations costs for the transit signal prioritization system	LADOT		
5.4 Replacement costs for the transit signal prioritization system	LADOT		

Table 1-3. Cost Benefit Analysis Test Plan Data Elements (Continued)

LA CRD (Metro ExpressLanes) Program Data Element	Data Source	LAC CRD Measure of Effectiveness	LAC CRD Hypotheses/ Questions
6. ***Intelligent Parking Management***			
6.1 New investment in the intelligent parking management system	LADOT		
6.2 Maintenance costs for the intelligent parking management system	LADOT		
6.3 Operations costs for the intelligent parking management system	LADOT		
6.4 Replacement costs for the intelligent parking management system	LADOT		
7. ***Travel Time Benefits***			
7.1 Commercial vehicle travel time savings	Metro		
7.2 Personal vehicle travel time savings	Metro		
7.3 Transit rider travel time savings	Metro		
8. ***Vehicle Operating Cost Savings***			
8.1 Commercial vehicle operating cost savings	Metro		
8.2 Personal vehicle operating cost savings	Metro		
8.3 Transit vehicle operating cost savings	Metro		
9. *Air Quality Improvements*			
9.1 Reduction in emissions	Metro		
10. ***Safety Improvements***			
10.1 Reduction in crashes	Evaluation Team Test Plan for Safety		

2.0 DATA SOURCES, AVAILABILITY, AND RISKS

This section describes the cost benefit data sources, data availability, potential risks associated with obtaining the data, and the schedule and responsibility for data collection.

2.1 Data Sources

The Cost Benefit Analysis Test Plan will use data drawn from three major sources. The first source is the detailed costs associated with the LA CRD (Metro ExpressLanes) Program projects. These data will be provided by the agencies that implement, operate, and maintain the CRD projects, which include Metro, Metrolink, CalTrans, LADOT, Foothill Transit, Gardena Transit, Torrance Transit, and the City of Pomona. The second source is the forecasts generated by Metro's Travel Forecasting Model (Metro Model), which will likely provide most of the benefits data used in the cost benefit calculations. The third source is data collected through other test plans, which will be used to calibrate the Metro model to observed, post-deployment, year one national evaluation findings. Consistent with standard practice, the cost benefit analysis will consider a 10-year timeframe, comparing "with LA CRD (Metro ExpressLanes) Program projects" to "without CRD projects" scenarios. Thus, in addition to observed/actual costs and benefits, forecasted costs and benefits will also be required. Year one of the 10-year analysis period will be January 2013 to December 2013 since most of the CRD projects, including the I-10 and I-110 HOT lanes, are scheduled to be operational by January 2013 or February 2013. Data from each of the three major data sources are described below.

Cost Data from Participating Agencies. Cost data will mainly be obtained from state and local government agencies participating in the LA CRD (Metro ExpressLanes) Program. Data includes the implementation costs associated with various projects, the operating and maintenance costs, and the replacement and re-investment costs. Table 2-1 provides a cost reporting scheme with detailed cost categories by type of project and by reporting agency.[3] Benefits are listed in Table 2-2.

The costs to be considered in the cost benefit analysis should only include those annual expenditures up to December of 2022 incurred as a result of implementing the LA CRD (Metro ExpressLanes) Program projects and allocated to those CRD projects. In other words, only the marginal costs should be recorded and reported as the costs of the CRD projects. For instance, suppose that Metro currently operates a bus fleet on the I-10 corridor with an annual operating budget of $1 million. Further, suppose that with the investment from the CRD projects, Metro's annual operational budget for the bus fleet on I-10 increases to $1.5 million. For the purpose of reporting the costs for the cost benefit analysis, only the newly increased costs of $0.5 million should be reported. Another example would be the tolling customer service center. The costs of this service center will be allocated to all toll facilities using the center services. These will include the I-10 and I-110 HOT lanes and any additional tolling facilities that are planned to open by 2022. For example, if the annual cost of the service center was $3 million and one-third of the costs of this center could be attributed to I-10 and I-110 HOT

[3] To convert these future year marginal costs to year 2010 dollars a real discount rate of 7 percent per year will be used (based on guidance from http://www.whitehouse.gov/omb/assets/a94/a094.pdf (page 9) and current FHWA guidance (Federal Register, Vol. 75, No. 104, p. 30476)).

Lanes then a cost of $1 million would be attributed to this cost element of the LA CRD (Metro ExpressLanes) Program for that year.

Metro's Travel Forecasting Model. This model will provide all of the benefits data related to congestion reduction resulting from the LA CRD (Metro ExpressLanes) Program projects. The model will be run using 2014 and 2023 traffic[4], area, and network data for two scenarios in each of those years:

1. Assuming none of the LA CRD (Metro ExpressLanes) Program projects were implemented
2. With all of the CRD projects implemented as planned with the model calibrated to correspond to first year results as found in the test plans listed below.

Both scenarios will include other planned projects for the area. A comparison of the two scenarios will provide the benefits data listed in Table 2-2 (including travel time savings, change in vehicle operating costs, and changes in health benefits due to reduced emissions). The change in crashes will be based on observed data from the safety data test plan. These benefits will then be converted to monetary terms based on the standard values noted in Section 3.0. Benefits in intermediate years will be assumed to change uniformly (linearly) from year 1 to year 10.

Other LA CRD (Metro ExpressLanes) Program Test Plans. Another important source of data for the cost benefit analysis is the other test plans. The data from the test plans include both pre- and post-deployment and will be used to validate (or calibrate) the Metro model. These data are critical since the benefits calculation relies on the Metro model's estimate of future traffic conditions for the 10 years following deployment of the CRD projects in 2013. Therefore, proper calibration of year one model results to observed data from the test plans is an essential initial step in benefit calculation. The data from other test plans that will be used for model calibration include:

- Traffic System Data Test Plan – Data will include vehicle miles-traveled (VMT), vehicle occupancy rates, number of vehicles, and travel times. Data for both personal vehicles and commercial vehicles will be needed.
- Transit System Data Test Plan – Data will focus on the change in transit travel time and the number of transit riders.
- Environmental Data Test Plan – Data will focus on the change in (1) emissions from vehicles, including ozone precursors (specifically volatile organic compounds [VOC] and nitrogen oxide [NO_x]), greenhouse gas (CO_2) and fine particulate matter ($PM_{2.5}$), and (2) fuel consumption.
- Safety Test Plan – Data will include the number and severity of crashes along I-10 and I-110.

[4] 2014 and 2023 were the closest years to the CBA start and end dates (2013 and 2022) for which METRO has developed models.

Table 2-1. Cost Reporting Scheme for the CRD Projects

Data Element	Reporting Agency	Data Sub-Element	Cost Description	Year(*)					
				2010	2011	2012	2013	…	2022
1. *Transit Facility Improvements*									
1.1	Metro	Implementation Costs	All costs required to design and build/install the: • El Monte Transit Center Expansion • El Monte Busway / Union Station Connection • Harbor Gateway transit center security improvements • I-110 Harbor Transit Way Park & Ride Improvements Includes capital costs, engineering design and planning, construction labor, management, other. Notes: 1. Subtract salvage value.						
1.2	Metrolink	Implementation Costs	All costs required to design and build/install the Metrolink Pomona Station improvements. Includes capital costs, engineering design and planning, construction labor, management, other. Notes: 1. Subtract salvage value.						
1.3	Metro	Operation and Maintenance Costs	Marginal cost of repair, maintenance, operations, labor, etc. of the transit improvements listed above in item 1.1.						
1.4	Metrolink	Operation and Maintenance Costs	Marginal cost of repair, maintenance, operations, labor, etc. of the Metrolink Pomona Station improvements (item 1.2).						
2. *New Buses*									
2.1	Metro and participating Municipal Bus Operators	Implementation Costs	All costs required to purchase the new buses for the I-10 El Monte Busway Corridor and the I-110 Harbor Transitway Corridor. Note 1: subtract salvage value.						
2.2	Metro and participating Municipal Bus Operators	Maintenance Costs	Marginal cost of repair, maintenance, labor, etc. of the new buses.						
3. *Carpooling and Ridesharing*									
3.1	Metro	Operation Costs	All costs required to operate the campaign to increase ridesharing (community based vanpool formation). This will include advertising, outreach, etc.						

Table 2-1. Cost Reporting Scheme for the CRD Projects (Continued)

Data Element	Reporting Agency	Data Sub-Element	Cost Description	Year(*)					
				2010	2011	2012	2013	…	2022
4. *I-10 and I-110 HOT Lanes*									
4.1	Metro	Implementation Costs	All costs required to design and build the new HOT Lanes. Includes: • Expanded capacity of I-10 • Tolling equipment on I-10 and I-110 • Enforcement equipment on I-10 and I-110 • Signage on I-10 and I-110						
4.2	Metro and CalTrans	Maintenance Costs	Cost of maintaining the new tolling system attributable to the HOT lanes on I-10 and I-110. Includes toll, violation, and gantry equipment maintenance, hardware and software maintenance.						
4.3	Metro	Operations Costs	Cost of operating the tolling and HOT lane system attributable to I-10 and I-110. Items such as banking, oversight, labor, education, outreach. *Collections:* Account management, communication, payment processing, and labor. *Compliance:* Enforcement (both electronic and added law enforcement costs), violation processing, dispute resolution, labor.						
4.4	Metro	Reinvestment Costs	Cost of replacement equipment for the tolling system. Includes computer upgrades / replacement, labor.						
5. *Transit Signal Prioritization*									
5.1	LADOT	Implementation Costs	Implementation of the transit signal prioritization project. Includes capital costs, engineering design and planning, labor, etc.						
5.2	LADOT	Maintenance Costs	Maintenance costs of the transit signal prioritization project.						
5.3	LADOT	Operations Costs	Operations costs of the transit signal prioritization project.						
5.4	LADOT	Reinvestment Costs	Cost of replacement equipment for the transit signal prioritization system. Includes computer upgrades / replacement, sensor replacement, labor, etc.						
6. *Intelligent Parking Management*									
6.1	LADOT	Implementation Costs	Implementation of the intelligent parking management project. Includes capital costs, engineering design and planning, labor, etc.						
6.2	LADOT	Maintenance Costs	Maintenance costs of the intelligent parking management project.						
6.3	LADOT	Operations Costs	Operations costs of the intelligent parking management project.						
6.4	LADOT	Reinvestment Costs	Cost of replacement equipment for the intelligent parking management project. Includes computer upgrades / replacement, sensor replacement, labor, etc.						

Table 2-2. Benefit Reporting Scheme for the CRD Projects

Major Data Element	Reporting Agency	Major Benefit Category	Benefit Sub-category	Year(*)					
				2010	2011	2012	2013	…	2022
7. *Travel Time Benefits*									
7.1	Metro	Commercial Vehicle Travel Time Savings	Includes travel time saved by commercial vehicles						
7.2	Metro	Personal Vehicle Travel Time Savings	Includes travel time saved by personal vehicles						
7.3	Metro	Transit Rider Travel Time Savings	Includes travel time saved by transit riders						
8. *Vehicle Operating Cost Savings*									
8.1	Metro	Commercial Vehicle Operating Cost Savings	Includes both the fuel savings (minus taxes) and other operating cost savings for commercial vehicles due to congestion reduction.						
8.2	Metro	Personal Vehicle Operating Cost Savings	Includes both the fuel savings (minus taxes) and other operating cost savings for personal vehicles due to congestion reduction.						
8.3	Metro	Transit Vehicle Operating Cost Savings	Includes both the fuel savings (minus taxes) and other operating cost savings for transit vehicles due to congestion reduction.						
9. *Air Quality Improvements*									
9.1	Metro / Environmental Test Plan	Reduction in Emissions	Monetized value of reduced ozone precursors, (specifically VOC and NO_x), greenhouse gas (CO_2) and fine particulate matter ($PM_{2.5,}$). Metro model for personal and commercial vehicles. Environmental test plan for transit vehicles.						
10. *Safety Improvements*									
10.1	CHP & Safety Test Plan	Reduction in Crashes	Monetized value of reduced crashes. Fatality, injury, or property damage only.						

(*) The shaded cells indicate that cost and benefit data will be collected for those selected years.

All benefits are for the 10-year, post-implementation period of the HOT lanes. All costs are from the start of any costs incurred, even if that is before 2010, until the end of the 10-year period post-implementation period.

Three additional benefit categories will be documented in the cost benefit report but not monetized and not included in the net benefit calculation. These benefits will be quantified as discussed below:

- Toll Revenues (from the Tolling Data Test Plan): Tolls collected from vehicles paying to use the HOT lane.
- Mode Shifting Data (from the Transit System Data Test Plan and Surveys and Interviews Test Plan): Number of people changing from driving to riding transit.
- Telecommuting Condition Data (from the Rideshare Test Plan and Surveys and Interviews Test Plan): Number of people changing from driving to telecommuting

2.2 Data Availability

Metro, Metrolink, CalTrans, LADOT, and local transit agencies will provide the cost data. The cost data from these agencies should cover the pre- and post-deployment time periods. The operating and maintenance costs and the replacement and re-investment costs need to cover a 10-year time period after the LA CRD (Metro ExpressLanes) Program projects are completed (January 2013 to December 2022). Agency staff will need to develop forecasts of these costs using their normal budgeting methods. Other data needed for the cost benefit analysis will be available from the other test plans and Metro's travel forecasting model.

2.3 Potential Risks

There do not appear to be any significant risks associated with obtaining cost information from the sources outlined previously. Other potential issues may arise during the data collection process, including delays in gathering data, inconsistency or duplication in the data, inability to accurately separate costs related to the new LA CRD (Metro ExpressLanes) Program projects from other costs, and cost accounting methods. To address potential issues with obtaining cost information, national evaluation team members will work with partnership agency staff to initiate the data request early in the evaluation process and follow up with any specific questions.

The one specific potential risk is if the Metro travel forecasting model can correctly estimate the impact of:

- the new rules (such as single occupancy vehicle [SOV] travel allowed for a toll) on the I-10 and I-110 HOT lanes,
- the pricing on the HOT lane,
- the pricing of parking, and
- the new and expanded park and ride lots/transit centers and the other transit improvements causing mode, time-of-day and route shifting.

There is a risk that the traffic forecast generated by the model may not fully capture travelers' behavior changes (including using new routes, modes and traveling at different times of day) due to LA CRD (Metro ExpressLanes) Program projects. To address the possible concerns with the

travel demand forecast model, National evaluation team members will send Metro staff observed year one data collected through the various national evaluation test plans so that Metro can compare year one model output to the actual field observations. In the event the model results are inaccurate, it will be necessary for Metro to calibrate the model so that it accurately reproduces observed year one data. In effect, it will be telling the model what impacts the CRD projects are having on travel in year one and relying on the model to distribute these effects network wide and over the 10-year analysis period.

If the Metro model cannot be made to reproduce observed year one data, the fallback approach will be to manually monetize observed year one benefits and then multiply those observed year one benefits by 10 to represent the 10 years of operational benefits. Note that there could be a significant ramp-up period where many travelers are changing their behavior due to the CRD projects. If this does happen, then the time-frame after the ramp-up period will be used as representative of impact of the CRD projects for years 2 through 10.

In theory, using year 1 changes would represent a conservative estimate of benefits since many key benefits of the CRD projects would increase over time given the expected continued increase in regional traffic volumes and health care costs (which will equate to greater benefits associated with emissions reductions). The data analysis procedures discussed in Chapter 3 assume that the Metro model will be capable of providing the forecasted data.

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3.0 DATA ANALYSIS

This chapter describes how the data described in Chapter 2 will be used to develop the net benefits of the LA CRD (Metro ExpressLanes) Program project deployment.

The cost benefit analysis timeframe will begin with the first expenses incurred and end after 10 full years of operation in December 2022. The 10-year timeframe was selected since many aspects of all CRDs and UPAs are technology- or pricing-related. Both technology and pricing systems have relatively short life spans. For example, the three U.S road pricing systems that have been open long term (10+ years) have changed considerably in their relatively short life-spans:

- SR-91 Express Lanes: changed ownership, changed charging of HOV3+ (twice), and significantly changed pricing
- I-15 San Diego HOT Lane: changes in length, number of lanes, and pricing system
- Lee County Variable Priced Bridges: went from two-directional tolling to one-way tolling.

The few LA CRD (Metro ExpressLanes) Program projects with useful lives longer than 10 years, such as major improvements to a park and ride lot or new buses, will be accounted for by including their salvage value at the 10 year point.

Within this evaluation time frame, the cost benefit analysis will estimate and compare net benefits and costs between two scenarios—without implementation of the LA CRD (Metro ExpressLanes) Program projects and with implementation of the CRD projects. All costs and benefits will be calculated in real terms (dollars) based on discount factors discussed below.

The basic procedure for calculating the net benefit is to monetize the benefits experienced by travelers due to the CRD projects and then subtract the costs incurred by the LA CRD (Metro ExpressLanes) Program projects. The major components outlined below briefly describe how the net benefit will be calculated. Note that, as discussed in Section 2.3, the model results will be calibrated using observed data collected as part of the national evaluation test plans. The calibrated model will then be used to estimate 10 years of post-deployment benefits for travel time savings, vehicle operating cost savings, and emissions benefits. The values shown below are the most recent available at the time this test plan was developed. If there are updates to the reference documents at the time of the cost benefit calculation (in early 2014) the updated values will be used.

- **Travel time savings resulting from improvement in traffic conditions experienced by drivers and transit riders.** The following details the computation:
    - Metro's travel forecasting model will provide the amount of travel time saved associated with travel in personal vehicles. This amount of time will be converted to a monetary value using standard values of time supplied by the FHWA in Table 4 from http://ostpxweb.dot.gov/policy/reports/vot_guidance_092811c.pdf . The value of time for the year 2009 was $12.50 based on local travel, weighted by the average of both business and other travel. This value will be adjusted for future values of time using procedures outlined in the FHWA document

http://ostpxweb.dot.gov/policy/reports/vot_guidance_092811c.pdf or updates to this value as supplied by FHWA.

  - Metro's travel forecasting model will provide the amount of travel time saved for transit riders. Again, these time savings will be converted to monetary units using standard values of time supplied by the FHWA and are the same as those for travel in personal vehicles discussed above.
  - Metro's travel forecasting model will provide the amount of travel time saved for commercial vehicles. Again, these time savings will be converted to monetary units using standard values of time supplied by the FHWA in http://ostpxweb.dot.gov/policy/reports/vot_guidance_092811c.pdf. In Table 4 of that report, the value of time for truck drivers of $24.70 will be used. This figure was derived using the national occupational employment and wage estimates. Current year (2010) and future year values of time will be adjusted using updated values of those figures.

- **Vehicle operating cost savings experienced by drivers as a result of the reduction in congestion.** The vehicle operating cost savings include two components: fuel costs and non-fuel costs, which include "wear-and-tear" costs. The computation of fuel cost reduction depends on fuel, fuel efficiencies under different driving speeds, and miles traveled. Metro 's travel forecasting model can provide disaggregate information on vehicle travel distance under different driving speeds as well as some portion of distance-based vehicle operating costs experienced by drivers. The non-fuel costs rely on average repair and maintenance costs (identified by the U.S. DOT) and miles traveled. For fuel cost savings, the cost of fuel (minus taxes) for 2013 will be obtained from actual values as supplied by the U.S. Energy Information Administration on their website: http://tonto.eia.doe.gov/dnav/pet/pet_pri_gnd_dcus_r1z_w.htm. Future year estimates for fuel prices will be obtained from Table VIII-4, page VIII-21 in the following document (or the best available estimate of future year prices available at the time of the BCA calculation):

  Final Regulatory Impact Analysis: Corporate Average Fuel Economy for MY 2011 Passenger Cars and Light Trucks," Office of Regulatory Analysis and Evaluation, National Center for Statistics and Analysis, National Highway Transportation Safety Administration, March 2009 (http://www.nhtsa.gov/DOT/NHTSA/Rulemaking/Rules/Associated%20Files/CAFE_Final_Rule_MY2011_FRIA.pdf).

Table 3-1 presents future year gas prices based on that document.

Table 3-1. Future Year Gas Prices

Year	Forecast Gasoline Price Excluding Taxes (2007 $/gallon)
2012	2.558
2013	2.611
2014	2.668
2015	2.688
2016	2.736
2017	2.801
2018	2.846
2019	2.909
2020	2.975

- **Improvement in air quality.** The benefits from the improved environment depend on emission rate per mile traveled and the dollar cost per ton of emission. The current year value per ton was derived from Environmental Protection Agency estimates of the value of health and welfare-related damages (incurred or avoided) and are recommended for use in current FHWA guidance (Federal Register, Vol. 75, No. 104, p. 30479). The values are found in the report:

  "Final Regulatory Impact Analysis: Corporate Average Fuel Economy for MY 2011 Passenger Cars and Light Trucks," Office of Regulatory Analysis and Evaluation, National Center for Statistics and Analysis, National Highway Transportation Safety Administration, March 2009 (http://www.nhtsa.gov/DOT/NHTSA/Rulemaking/Rules/Associated%20Files/CAFE_Final_Rule_MY2011_FRIA.pdf, Table VIII-5, page VIII-60).

Table 3-2. Current Values of Reduced Emissions

Pollutant	Cost (2007 $)
CO	$ -
VOC	$1,700 per ton
CO_2	$21 per metric ton[5]
NO_X	$4,000 per ton
$PM_{2.5}$	$168,000 per ton
SO_2	$16,000 per ton

Future year values are taken from the Highway Economic Requirements System[6] documentation. Metro's travel demand model will supply the change in emissions amounts for: ozone precursors (specifically volatile organic compounds [VOC] and nitrogen oxide [NO_x]), greenhouse gas (CO_2) and fine particulate matter ($PM_{2.5}$,). These values will be provided for the 10-year timeframe of the analysis. The total value of this change will be calculated using the values in Table 3-2 and Table 3-3 multiplied by the emissions amounts.

Table 3-3. Future Values of Reduced Emissions (in 2007 $)

Pollutant	Cost in 2015	Cost in 2020
CO	$ -	$ -
VOC	$1,200 per ton	$1,300 per ton
CO_2	$24 per metric ton[3]	$26 per metric ton[2]
NO_X	$4,900 per ton	$5,300 per ton
$PM_{2.5}$	$270,000 per ton	$290,000 per ton
SO_2	$28,000 per ton	$31,000 per ton

[5] The CO_2 estimates are based on figures from "SOCIAL COST OF CARBON FOR REGULATORY IMPACT ANALYSIS UNDER EXECUTIVE ORDER 12866" http://www1.eere.energy.gov/buildings/appliance_standards/commercial/pdfs/sem_finalrule_appendix15a.pdf

[6] Highway Economic Requirements System, Federal Highway Administration, http://www.fhwa.dot.gov/infrastructure/asstmgmt/hersdoc.cfm

- **Safety benefits from the improvement in safety conditions.** Reduced vehicle miles of travel and reduced congestion can both lead to a reduction in crashes. The computation of the safety benefits depends on the number of crashes by crash severity levels and the cost associated with each crash. The number and severity of crashes will be provided by the Safety Data Test Plan. The Safety Data Test Plan relies primarily on actual reported crashes before and after the implementation of the LA CRD (Metro ExpressLanes) Program projects. The observed year one change in crashes will be assumed to be the same for the remaining 10 years of post-deployment time frame. The cost of a crash, by crash severity, will be estimated using guidance from the National Highway Traffic Safety Administration (NHTSA) (e-mail correspondence with DOT) as shown in Table 3-4, with the value of a statistical life equal to $6 million in year 2009 dollars. For this cost benefit analysis (CBA), the final column values (comprehensive cost of crash avoidance) will be used.

Table 3-4. Unit Costs for Police-Reported Injury Scale (KABCO) (2008 $)

Police-Reported Injury		Economic Cost		Comprehensive Cost*	
		Crashworthiness	Crash Avoidance	Crashworthiness	Crash Avoidance
O	No Injury	$68,185	$74,129	$198,819	$204,764
C	Possible Injury	$109,001	$115,088	$300,950	$307,037
B	Non Incapacitating	$263,973	$273,270	$732,628	$741,925
A	Incapacitating	$1,663,924	$1,701,826	$4,740,561	$4,778,463
K	Killed	$1,248,086	$1,272,912	$6,314,875	$6,339,701
U	Injury Severity Unknown	$100,776	$102,832	$291,925	$293,982

*Based on $6.0 million value of a statistical life (http://ostpxweb.dot.gov/policy/reports/vsl_guidance_072911.pdf)

- **Implementation costs, operating and maintenance costs, and replacement and re-investment costs (see Table 2-1).** The costs under each of the major categories will be summed for the purpose of calculating the total cost. To convert all costs to 2010 dollars a real discount rate of 7 percent will be used (based on guidance from the webpages http://www.whitehouse.gov/omb/assets/a94/a094.pdf (page 9) and http://www.whitehouse.gov/omb/circulars_a004_a-4/ (see Discount Rates section) and current FHWA guidance (Federal Register, Vol. 75, No. 104, p. 30476)).
- **Salvage value.** Several items that will be purchased under this CRD have useful lives longer than the 10-year evaluation timeframe. Therefore, the salvage value of the items at the end of year 10 should be subtracted from their initial cost. The methodology is outlined at http://www.dot.state.mn.us/planning/program/benefitcost.html and is calculated as follows:

$$\text{Salvage Value} = \frac{(1+r)^n \times \left[\left(\frac{(1+r)^L - 1}{r(1+r)^L}\right) - \left(\frac{(1+r)^n - 1}{r(1+r)^n}\right)\right]}{\left(\frac{(1+r)^L - 1}{r(1+r)^L}\right)}$$

Where r = the discount rate (0.07)

n = number of years in the analysis period (10)

L = useful life of the asset

The CRD investments to which salvage values will be applied are:

- **Transit Centers.** A park and ride lot has a useful life (L) of 40 years and, using the above formula, will have a salvage value of 93% of the original cost in 2023. The list of items with salvage value at the end of this 10-year analysis period includes:
  - El Monte Transit Center Expansion
  - El Monte Busway / Union Station Connection
  - Harbor Gateway transit center security improvements
  - I-110 Harbor Transit Way Park & Ride Improvements
  - Metrolink Pomona Station improvements
- **The New Transit Buses.** The buses have a useful life of 12 years and will therefore have a salvage value of 22.8 percent in the year 2023.

For the last step, the net benefit will be calculated by summing the benefits and then subtracting all costs in year 2010 dollars using a real discount rate of 7 percent.

Another item of interest, mode shifts, will be calculated but is not part of the cost benefit analysis. This includes shifting between driving alone, riding transit, telecommuting and carpooling. Similarly, benefits from an improvement in travel time reliability will not be monetized. There are certainly benefits from improved travel time reliability. However, the United States does not have a standard method of incorporating them into the cost benefit analysis. Therefore, reductions in travel time variability, as developed by METRO's travel demand model, will be reported but not included in the cost benefit analysis.

Two other items that will not be included in the benefit cost analysis are the HOT lane tolls and any construction impacts. Toll revenue is a transfer of wealth (from the traveler to the toll authority) and, as such, is not a net societal cost or benefit and is not in the equation. This analysis is focused on the net societal benefits and costs of tolling, transit, technology, and TDM. It is assumed that the tolls collected are put to good use (and are thus a transfer of wealth and not simply a waste). What is done with those toll revenues (for example, a new rail line, hospital, etc.) would be the subject of a separate benefit cost analysis. Construction impacts on current travelers are expected to be minimal (for example, the gantries that will be used for tolling should not cause delays to travelers) and not worth including in this analysis.

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4.0 SCHEDULE AND RESPONSIBILITY

The schedule for collecting data for the cost benefit analysis is shown in Table 4-1. The schedule is based on the deployment schedule for the Los Angeles County CRD projects. The cost benefit analysis will be initiated prior to deployment of the Los Angeles County CRD projects and will be completed after the HOT Lanes on I-10 and I-110 have been in operation for one year. Operation of the HOT lane is scheduled to begin in December 2012. As indicated in Table 4-1, data will be collected periodically, tied to CRD deployment milestones.

Table 4-1. Cost Benefit Data Collection Schedule

Data Category	Reporting Schedule
Costs	
• Implementation Costs (data elements 1.1, 1.2, 2.1, 4.1, 5.1 and 6.1)	Upon Completion of Installation: 1.1 Transit Improvements Throughout 2011 and 2012. Data from Metro 1.2 Pomona Station Improvements End of 2010. Data from Metrolink 2.1 New Buses for I-10 and I-110 Routes February 2012. Data from Metro 4.1 New HOT Lanes on I-10 and I-110 End of 2012. Data from Metro 5.1 Transit Signal Prioritization Project August 2011. Data from Metro 6.1 Intelligent Parking Management System October 2011. Data from LADOT
• Operation and Maintenance Costs (data elements 1.3, 1.4, 2.2, 3.1, 4.2, 4.3, 5.2, 5.3, 6.2 and 6.3)	Report for each data element after fiscal year end books completed: 1.3 Transit Improvements, Metro: September 2011, 2012 1.4 Transit Improvements, Metrolink: September 2011, 2012 2.2 New Buses, Metro: September 2011, 2012 3.1 Carpooling, Metro: September 2011, 2012 4.2 and 4.3 – New HOT lane tolling system, Metro: September 2013 5.2 and 5.3 – Transit Signal Prioritization, Metro, September 2011, 2012 6.2 and 6.3 – Intelligent Parking System, LADOT, September 2012, 2013
• Reinvestment Costs (data elements 4.4, 5.4, 6.4)	Estimate by each agency regarding future reinvestment costs near the end of CRD evaluation: 4.4 – I-10 and I-110 Tolling Systems, Metro, December 2013 5.4 – Transit Signal Systems, Metro, December 2013 6.4 – Parking Management Systems, LADOT, December 2013

Table 4-1. Cost Benefit Data Collection Schedule (Continued)

Data Category	Reporting Schedule
Benefits	
• Travel Time Savings (data elements 7.1, 7.2, and 7.3)	Future year travel time savings from the (recalibrated) Metro travel forecast model: May 2014
• Vehicle Operating Cost Savings (data elements 8.1, 8.2, and 8.3)	Future year cost savings from the (recalibrated) Metro travel forecast model: May 2014
• Reduction in Emissions (data element 9.1)	Future year emissions changes from the (recalibrated) Metro regional travel forecast model for personal and commercial vehicles: May 2014. Future year emissions changes from the environmental test plan for transit vehicles: May 2014.
• Reduction in costs associated with vehicle crashes (data element 10.1)	Future year crash reductions from the Safety Test Plan: January 2014

The responsibility for this test plan includes:

- Metro, Metrolink, CalTrans and LADOT will provide the cost information on the Los Angeles County CRD projects. National evaluation team members will sum these costs to develop the total cost of the CRD projects.
- Metro will run its travel forecast model to generate the travel forecasts for the 10-year post-deployment time frame. Metro will compare the model output to the observed year one post-deployment results developed by the national evaluation team. If the model results are inaccurate, Metro will recalibrate and rerun the model to reflect observed results. Using the model, the local partners will supply a long term (10 year) estimate of travel time savings, vehicle operating cost reductions, and emissions reductions caused by the CRD projects.
- The national evaluation team will use the data from the traffic safety test plan to calculate the change in crashes in year one. This change in crashes will be assumed constant over the 10-year time frame of the analysis.
- The national evaluation team will convert the above estimates (change in travel time savings, vehicle operating cost changes, emissions changes and crash changes) to dollar values using the most recent values from sources noted in Section 3.0. The summation of these dollar values are the total benefits of the CRD projects.

APPENDIX A – COMPILATION OF HYPOTHESIS/QUESTIONS FROM THE LOS ANGELES CRD NATIONAL EVALUATION PLAN

Evaluation Analysis	Hypothesis/ Question Number	Hypothesis/Question
Congestion	LACong-1	Deployment of the CRD improvements will reduce the travel time of users in the I-10 and I-110 corridors.
	LACong-2	Deployment of the CRD improvements will improve the reliability of user trips in the I-10 and I-110 corridors.
	LACong-3	Deployment of the Downtown LA Intelligent Parking Management Project will reduce congestion in the downtown.
	LACong-4	Deploying the CRD improvements will result in more vehicles and persons served in the I-10 and I-110 corridors during peak periods.
	LACong-5	Will surveyed travelers perceive a noticeable reduction in travel times in the treatment corridors?
	LACong-6	Will surveyed travelers perceive a noticeable improvement in trip-time reliability in the treatment corridors?
	LACong-7	Will surveyed travelers perceive a noticeable reduction in the duration of congested periods in the treatment corridors?
	LACong-8	Will surveyed travelers perceive a noticeable reduction in the length of peak congestion periods in the treatment corridors?
	LACong-9	Relative travel times for HOV/HOT lanes vs. general purpose lanes will either remain the same or (more likely) improve for HOV/HOT travelers as a result of the CRD deployments.
	LACong-10	The introduction of tolled SOV traffic into the HOT lanes in the deployment corridors will not negatively impact HOV or transit traffic in terms of average travel times or travel reliability.
	LACong-11	The CRD deployment will not cause traffic congestion to increase in the HOV/HOT lanes.
	LACong-12	Because of latent demand in the deployment corridors, the CRD deployments are not likely to impact traffic congestion on the general purpose lanes.
	LACong-13	Because of the CRD deployments, congestion on the arterials streets paralleling the corridors will be reduced.

Evaluation Analysis	Hypothesis/ Question Number	Hypothesis/Question
Tolling	LATolling-1	The HOT lanes will regulate vehicular access to the I-10 and I-110 and improve their operation.
	LATolling-2	Some general-purpose lane travelers will shift to the HOT lanes, while HOV lane travelers will continue to use them after they are converted to HOT.
	LATolling-3	After ramp-up, the HOT lanes on I-10 and I-110 pricing will maintain operating improvements on I-10 and I-110 after the initial ramp-up period.
	LATolling-4	The downtown IPM project will result in 70-90% of the parking spaces on each block occupied throughout the day.
	LATolling-5	The downtown IPM project may increase parking revenues that can be used to fund system expansion in other high-demand areas.
	LA Tolling-6	Implementing the HOT lanes will reduce the HOV violation rate.
	LA Tolling-7	Will CRD HOT and transit improvements lead to unintended breakups of current carpools/vanpools?
Transit	LATransit-1	CRD projects will enhance transit performance within CRD corridors through reduced travel times, increased service reliability, and increased service capacity.
	LATransit-2	User perceptions of security at transit stations/park-and-ride lots will be improved by CRD projects.
	LATransit-3	CRD projects will increase ridership and facilitate a mode shift to transit within CRD corridors.
	LATransit-4	Increased ridership and mode shift to transit will contribute to increased person throughput, congestion mitigation, and transit cost-effectiveness within CRD corridors.
	LATransit-5	What was the relative contribution of each CRD project element to increased ridership/ transit mode share/person throughput?
Ridesharing	LARideshare-1	CRD vanpool promotion will result in at least 100 new Metro-registered vanpools.
	LARideshare-2	Which factors were most effective in promoting ridesharing?
	LARideshare-3	Will CRD HOT and transit improvements lead to unintended breakups of current carpools/vanpools?
Technology	LATech-1	Travelers will access the IPM website and telephone information system.
	LATech-2	IPM will improve LADOT's ability to reconfigure parking restrictions and rates.
	LATech-3	IPM will improve LADOT's ability to enforce parking regulations.

Evaluation Analysis	Hypothesis/ Question Number	Hypothesis/Question
Safety	LASafety-1	The collective impacts of CRD improvements7 will be safety neutral or safety positive.
	LASafety-2	The addition of transition zones will not increase incidents.
	LASafety-3	Will boundary jumping cause incidents?
	LASafety-4	Will the additional law enforcement presence (associated with speed and toll enforcement) coupled with enhancement of the dedicated tow truck vehicle removal services associated with the CRD impact incident response and/or clearance time?
	LASafety-5	Will adjusted enforcement procedures affect the number of incidents?
Equity	LAEquity-1	What is the socio-economic and spatial distribution of the direct social effects of the CRD projects?
	LAEquity-2	Are there any differential environmental impacts on certain socio-economic groups?
	LAEquity-3	Will the potential HOT and IPM net revenues be reinvested in an equitable manner?
Environmental	LAEnvironmental-1	Vehicle-related air emissions will decrease in the treatment corridors.
	LAEnvironmental-2	Vehicle-related fuel consumption will decrease in the treatment corridors.
Business Impacts	LABus-Imp-1	How will the downtown IPM project affect retailers and similar businesses that rely on customers' ability to access their stores?
Non-Technical Success	LANon-Tech-1	What role did factors related to these five areas play in the success of the deployment? 1. People: Sponsors, champions, policy entrepreneurs, neutral conveners, legislators 2. Process: Forums (including stakeholder outreach), meetings, alignment of policy ideas with favorable politics and agreement on nature of the problem), legislative and Congressional engagements 3. Structures: Networks, connections and partnerships, concentration of power & decision making authority, conflict mgt. mechanisms, communications strategies, supportive rules and procedures 4. Media: Media coverage, public education 5. Competencies: Cutting across the preceding areas: persuasion, getting grants, doing research, technical/technological competencies; ability to be policy entrepreneurs; knowing how to use markets
	LANon-Tech-2	Does the public support the CRD strategies as effective and appropriate ways to reduce congestion?
Cost Benefit	LACostBenefit-1	Will the LA CRD (Metro ExpressLanes) Program projects have a net societal benefit?

[7] Relevant CRD changes include narrower lanes on portions of the I-10 freeway, new signage, new HOT procedures, new enforcement procedures, and reduced congestion (i.e., faster flowing traffic).

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