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National Evaluation:
Safety Data Test Plan

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ATLANTA
CONGESTION REDUCTION DEMONSTRATION

NATIONAL EVALUATION:
SAFETY DATA TEST PLAN

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Prepared for

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16. Abstract

This report presents the test plan for collecting and analyzing safety data for the Atlanta Congestion Reduction Demonstration (CRD) under the United States Department of Transportation (U.S. DOT) Urban Partnership Agreement (UPA) and CRD Programs. The Atlanta CRD projects include the conversion of lanes for high occupancy vehicles (HOV) on approximately 16-miles of I-85 to high occupancy toll (HOT) lanes along with expansion and enhancement of transit service in that corridor, including new and expanded park-and-ride lots. The Safety Data Test Plan is based on the Atlanta CRD National Evaluation Plan. This test plan describes the safety data sources, data availability, and possible risks associated with the data. The methods for analyzing the safety data are discussed. The schedule and responsibility for collecting, analyzing, and reporting the safety data are presented.

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TABLE OF CONTENTS

List of Appendices

List of Tables

List of Figures

LIST OF ABBREVIATIONS

4Ts	Tolling, Transit, Telecommuting, and Technology
AFV	Alternative fuel vehicles
ALPR	Automatic license plate readers
ARC	Atlanta Regional Commission
CAC	Clean Air Campaign
CBA	Cost benefit analysis
CRD	Congestion Reduction Demonstration
CVO	Commercial vehicle operator
DPS	Department of Public Safety
FHWA	Federal Highway Administration
GDOT	Georgia Department of Transportation
Georgia Tech	Georgia Institute of Technology
GRTA	Georgia Regional Transportation Authority
HOT	High occupancy toll
HOT3+	High occupancy toll lane allowing untolled travel by vehicles with three or more occupants
HOV	High occupancy vehicle
HOV2+	High occupancy vehicle with a minimum of two occupants
MARTA	Metropolitan Atlanta Rapid Transit Authority
MOE	Measure of effectiveness
RFID	Radio frequency identification
SOV	Single-occupant vehicle
SRTA	State Road and Tollway Authority
TDM	Travel demand management
TMC	Traffic Management Center
UPA	Urban Partnership Agreement
U.S. DOT	United States Department of Transportation
VMT	Vehicle miles traveled

1.0 INTRODUCTION

This report presents the test plan for collecting and analyzing safety data for the national evaluation of the Atlanta Congestion Reduction Demonstration (CRD) under the United States Department of Transportation (U.S. DOT) CRD program. The safety data will be used in one or more of the evaluation analyses contained in the Atlanta CRD National Evaluation Plan. This plan is one of ten test plans identified in the Atlanta CRD National Evaluation Plan.

The Atlanta 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 Atlanta CRD national evaluation will address the four primary U.S. DOT Urban Partnership Agreement (UPA) 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 12 "evaluation analyses" described in the Atlanta CRD National Evaluation Plan: congestion, tolling, transit, TDM, technology, safety, equity, environmental, goods movement, business impacts, non-technical success factors, and cost benefit. Each of these 12 analyses relies upon various evaluation measures of effectiveness (MOEs).

"Test plans" are the evaluation planning documents that describe how specific data will be collected and processed to yield the evaluation MOEs 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 Atlanta CRD national evaluation. In addition to this Safety Data Test Plan, there are test plans focusing on the following types of data: traffic, tolling, transit, TDM, surveys and interviews, environmental, content analysis, cost benefit analysis, 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 MOEs needed to support the evaluation will be collected and processed. Most test plans collect data and provide MOEs 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 describes the Atlanta CRD deployments and elaborates on the relationship between test plans and evaluation analyses. The remainder of the report is divided into three sections. Chapter 2 presents the data sources, data availability, and risks associated with the safety data collected through this test plan. Chapter 3 discusses how all of the safety data will be analyzed and used in the national evaluation. Chapter 4.0 presents the schedule and responsibilities for collecting and analyzing the safety data.

1.1 The Atlanta CRD

Atlanta was selected by the U.S. DOT to implement projects aimed at reducing congestion based on a combination of 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 Atlanta 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 Atlanta CRD partnership is led by three public agencies—the Georgia Department of Transportation (GDOT), the Georgia Regional Transportation Authority (GRTA), and the State Road and Tollway Authority (SRTA). Other partners include Atlanta Regional Commission (ARC), Georgia Department of Public Safety, Metropolitan Atlanta Rapid Transit Authority (MARTA), Gwinnett County Government, Clean Air Campaign, and Georgia Institute of Technology (Georgia Tech).

The Atlanta CRD partners have as a long-term regional goal an integrated system of congestion-priced lanes, enhanced transit service, and advanced technology on 49-miles of I-75, I-85, and I-20. The CRD will establish the first phase of that network on approximately 16 miles of I-85 from I-285 to Old Peachtree Road. The Atlanta CRD projects are described briefly below.

High Occupancy Toll (HOT) Lanes on I-85. As the first phase of a regional integrated system of congestion-priced lanes, the existing high occupancy vehicle (HOV) lanes will be converted to dynamically-priced HOT lanes, called Express Lanes, on approximately 16 miles of I-85 from Chamblee Tucker Road, just south of I-285, to just north of Old Peachtree Road in Gwinnett County. The Express Lanes are depicted in Figure 1-1. The occupancy requirement for using the Express Lanes toll-free will change from the two or more people on the current HOV lanes (HOV2+) to three or more people (HOT3+) and registration will also be required. Registered toll-exempt vehicles include vehicles with three or more people, motorcycles, alternative fuel vehicles (AFV) with GA AFV license plates (but not hybrids), transit, and emergency vehicles. Pre-registered vehicles with less than three occupants will be allowed on the Express Lanes by paying a toll. The lanes will operate with seven entry and exit points in the northbound direction and six in the southbound direction. Tolling will occur 24 hours a day and seven days a week in four southbound sections and five northbound sections. GDOT is responsible for the construction in the HOV to HOT conversion. SRTA will operate the tolling portion of the system.

Transit Enhancements. A total of 36 new buses will be added to the commuter bus fleet on the I-85 corridor, with 20 buses added in 2010 and 16 more in 2011. The expanded fleet will enable five new routes to operate on the corridor, the first of which began in August of 2010. GRTA will purchase the buses. GRTA is also responsible for the CRD-funded park-and-ride lot enhancements. These include three new lots—Mall of Georgia, Hamilton Mill, and Hebron Baptist Dacula—and one expanded lot at I-985/GA 20. The Mall of Georgia lot was the first to open in August of 2010 with 750 leased spaces until the permanent lot opens at that location. Opening in June 2011 are 400 new leased spaces at Hebron Baptist Dacula. Scheduled for July 2011 is the expansion of the I-985/GA 20 lot, which will add 384 spaces to the 347 that already exist today. The Hamilton Mill lot is scheduled to open in August 2011 with 918 spaces. In addition to the CRD-funded park and ride lots, the evaluation will include two other lots that are not funded by the CRD but could be impacted. These include the Discover Mills and Indian Trail Park and Ride Lots.

Automated Enforcement Systems. A gantry-controlled access system for the Express Lanes will consist of approximately 35 overhead gantries or existing structures placed in the median. Readers equipped with radio frequency identification (RFID) will read transponders, and cameras will collect images of vehicle license plates. This information will be used to identify toll violators. Mobile automatic license plate readers (ALPR) camera systems installed in enforcement vehicles will aid police officers with visual occupancy verification of vehicles using the Express Lane. Enforcement officials will be provided with an audible or visual alert if a license plate matches the database of registered HOT3+ users to prompt a visual inspection for vehicle occupancy compliance. Officers will upload a list of occupancy violations written during a shift to the Express Lanes back-office system.

Georgia DOT, Presentation at Public Hearing Open House, November 12, 2009.

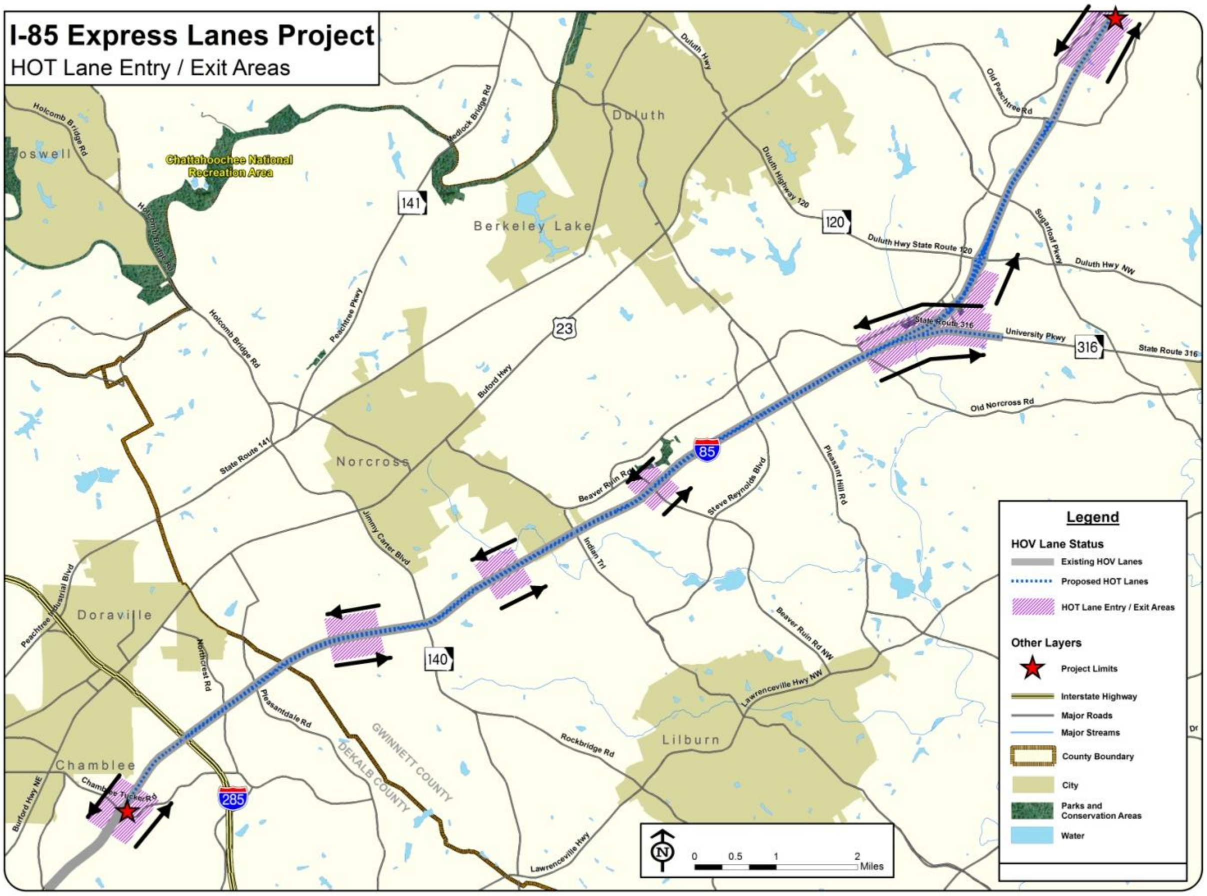

Figure 1-1. I-85 HOV to HOT Conversion Project

Carpooling Outreach. To support the CRD projects, the Clean Air Campaign will undertake public outreach to increase the number of 3 person carpools in the I-85 Express Lanes corridor. Their efforts will focus on converting existing 2-person to 3-person carpools and on creating 3-person carpools from single-occupant vehicle (SOV) drivers. CAC will use existing carpooler databases to identify and contact 2-person carpoolers. In conjunction with SRTA, CAC will identify SOV commuters who travel in the I-85 Express Lanes and encourage carpool formation. SOV drivers will also be targeted through outreach to employers in the I-85 corridor and to employers outside the corridor who may have employees who use the I-85 corridor.

Schedule for the Atlanta CRD Projects. The projects to be evaluated go into operation between August 2010 and July 2012. Table 1-2 presents the dates at which each of the Atlanta CRD projects are expected to be in operation.

Table 1-2. CRD Project Schedules

Projects	Operational Date
Express Lanes on I-85	September 2011
5 New Bus Routes	August 2010 – July 2012
Park-and-Ride Lots	August 2010 – August 2011
Automated Enforcement	September 2011
Carpooling Outreach	Spring 2011 – Winter 2012

1.2 Atlanta National Evaluation Plan and the Use of Safety Data

Table 1-3 shows which of the various Atlanta CRD 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 1-3, the Safety Data Test Plan provides major input to the safety and technology analysis and supporting input to the cost benefit analyses.

Table 1-4 includes a summary of the safety data elements, the MOEs and the hypotheses/questions the safety data will be used to evaluate.

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Table 1-3. Relationships Among Test Plans and Evaluation Analyses

Atlanta CRD Test Plans	Congestion Analysis	Tolling Analysis	Transit Analysis	TDM Analysis	Technology Analysis	Safety Analysis	Equity Analysis	Environmental Analysis	Goods Movement Analysis	Business Impact Analysis	Non-Technical Success Factors Analysis	Cost Benefit Analysis
Traffic System Data Test Plan	●	●		○	○	○		●	●			○
Tolling Data Test Plan		●					○		●			○
Transit System Data Test Plan			●				○	○				○
TDM Data Test Plan		○		●			○	○		○		○
Safety Data Test Plan					●	●						○
Surveys and Interviews Test Plan	○	○	●	●		○	●	○	○	○	●	○
Environmental Data Test Plan							○	●				○
Content Analysis Test Plan											●	
Cost Benefit Analysis Test Plan												●
Exogenous Factors Test Plan	○	○	○	○	○	○	○	○	○	○	○	○

● — Major Input ○ — Supporting Input

Table 1-4. Safety Data Test Plan Data Elements Use in Testing Evaluation Hypotheses/Questions

Atlanta Safety Data Element	Atlanta CRD Measure of Effectiveness	Atlanta CRD Hypotheses/ Questions*
1. Incident Type	• Change in incidents per vehicle miles traveled (VMT) by incident type in treatment corridors compared to that occurring in control corridors • Safety incidents by incident type attributable to double white line crossing	AtlSafety-1 AtlSafety-2 AtlCBA-1
2. Location of Crash	• Change in incidents per VMT by location of crash in treatment corridors compared to that occurring in control corridors • Safety incidents by location of crash attributable to double white line crossing	AtlSafety-1 AtlSafety-2
3. Severity of Crash	• Change in incidents per VMT by crash severity in treatment corridors compared to that occurring in control corridors	AtlSafety-1 CBA-1
4. Crash Type	• Change in incidents per VMT by crash type in treatment corridors compared to that occurring in control corridors • Safety incidents by crash type attributable to double white line crossing	AtlSafety-1 AtlSafety-2 AtlCBA-1
5. Number of Violations and Citations by Type	• Number of citations for double white line crossing • Number of citations issued for unregistered users • Number of citations issued for violating passenger occupancy requirements • Number of toll violations issued for crossing double white line (i.e., entry/exit at non-gantry locations) • Total number of violations • Violation rate (%), by time period (peak and off-peak) • Citations per vehicle miles traveled	AtlSafety-2 AtlTech-1

*Listed are acronyms corresponding to hypotheses/questions to be addressed with data from this test plan. An explanation of these acronyms can be found in Appendix A, which contains a compilation of the hypotheses/questions for all the analysis areas from the Atlanta CRD National Evaluation Plan.

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2.0 DATA SOURCES, AVAILABILITY, AND RISKS

This chapter identifies the sources for the safety data and discusses the availability of the data and any potential risks associated with collecting and processing them for use in the evaluation. Table 2-1 summarizes the data requirements for the Safety Data Test Plan. The details associated with source, timing, and other particulars are discussed in the sections that follow.

2.1 Data Sources

The data acquired under the Safety Data Test Plan will primarily be used for the safety and technology analyses, but it will also be used as an input to the cost-benefit analysis. The primary interest is in whether infrastructural and procedural changes associated with the Express Lanes create safety problems at Express Lane entry points and transition zones, and whether the changes provide safety benefits or result in the emergence of new types of safety events (e.g., incidents involving crossing the double white line to evade tolls). Defined by the start of tolling in September 2011, a year of pre-deployment and a year of post-deployment safety data will be collected. Data back to 2006 will be collected to provide perspective on trends in safety in the corridor. Data collection will also include I-75, so that changes observed in the I-85 corridor can be compared with the safety experience on the I-75, which will serve as a control corridor.

Four types of safety data are required by the evaluation: crash records, incident reports, citations for crossing the double white line, and interviews with enforcement and operations personnel. The interview data requirements are covered under the Surveys and Interviews Test Plan. This current section discusses required safety violation and incident report data, including:

- Locations of safety incidents attributable to crossing the double white line,
- Citations for crossing the double white line,
- Descriptions of the basic facts of safety incidents, and
- Indications of incident type and severity.

The Safety Data Test Plan uses four sources of data, which include the GDOT Crash Reporting Unit, the GDOT Traffic Management Center (TMC), SRTA Toll System, and the Department of Public Safety (DPS) Motor Compliance Motor Carrier Compliance Division. The data from these sources is described next, along with the advantages and limitations of each database. Table 2-1 details the data needs for the Atlanta CRD project and lists location, granularity, frequency, time period, and responsible agency for each data element.

GDOT Crash Reporting Unit. Crash data can be obtained from the GDOT Crash Reporting Unit, which has images of all available crash reports back to 2000. The Georgia FARS (Fatality Analysis Reporting System) Office is also located within the GDOT Crash Reporting Unit. All law enforcement agencies are required to submit their Georgia Uniform Motor Vehicle Accident Reports to the GDOT Crash Reporting Unit. Motor vehicle accident reports include information such as severity, type of crash, crash diagram, crash location, lighting conditions, and surface conditions. GDOT has also stated that "property damage only" crashes are included in the database along with reports on fatalities and injuries.

Table 2-1. Summary of Data Needs for Atlanta CRD Project

Data Element	Location	Data Granularity	Data Collection Frequency	Data Collection Timing		Data Reporting Frequency	Responsible Agency (Data Source)
			Continuous Sampling (Automatic)	Baseline	Post-Deployment		
1. Incident Type	• I-85 Express Lanes Corridor in DeKalb and Gwinnett Counties • I-75 from I-285 to I-575 in Cobb County	Individual incident or crash record	X	Sept. 2006 – August 2011	Sept. 2011 – August 2012	Monthly	• GDOT TMC • GDOT Crash Reporting Unit
2. Location of Crash	• I-85 Express Lanes Corridor in DeKalb and Gwinnett Counties • I-75 from I-285 to I-575 in Cobb County	Individual incident or crash record	X	Sept. 2006 – August 2011	Sept. 2011 – August 2012	Monthly	• GDOT TMC • GDOT Crash Reporting Unit
3. Severity of Crash	• I-85 Express Lanes Corridor in DeKalb and Gwinnett Counties • I-75 from I-285 to I-575 in Cobb County	Individual incident or crash record	X	Sept. 2006 – August 2011	Sept. 2011 – August 2012	Monthly	• GDOT TMC • GDOT Crash Reporting Unit
4. Crash Type	• I-85 Express Lanes Corridor in DeKalb and Gwinnett Counties • I-75 from I-285 to I-575 in Cobb County	Individual incident or crash record	X	Sept. 2006 – August 2011	Sept. 2011 – August 2012	Monthly	• GDOT TMC • GDOT Crash Reporting Unit
5. Number of Violations and Citations by Type	• I-85 Express Lanes Corridor in DeKalb and Gwinnett Counties	• Individual DPS citation records • Individual toll violation records	X	• Sept. 2007 – Aug. 2011 • NA	Sept. 2011 – August 2012	Monthly	• SRTA (DPS Database) • SRTA

GDOT Traffic Management Center (TMC). Archived incident data are available through the TMC with recordings over a 24-hour period at 20-second intervals. The apparent advantage of the GDOT TMC as an incident data source is the ability to provide information to better assess the impact of any change in crashes that may occur as a result of the CRD project. That is, while the crash data can show changes in the number of crashes, the incident data can help show the impact of those changes. Specifically, the data from the TMC system includes:

- Type of incident – accident, stall, debris, road kill, crash, construction, congestion, other closure;
- Type of lane affected – left, right, center, shoulder (no specific designation for HOV/HOT);
- Impact type: no impact, low, medium, high;
- Property damage: indication of damage to guard rails, pavement, light poles, or other structures;
- Number of vehicles involved;
- Number of fatalities and injuries;
- Geospatial coordinates of the incident.

Location data, given as x and y coordinates using the Georgia State Plane Coordinate (West) system, are known for most records and can be used to determine whether a safety incident occurred in the 16-mile corridor. However, the accuracy of the coordinates has not been closely examined. Severity of crash is indicated as impact type of no impact, low, medium, or high. Property damage is indicated as whether any damage had occurred to the pavement, guard rail, light fixtures, or other structures.

SRTA Toll System. Motorists will be required to register to use the Express Lanes and to pay the toll through establishing a transponder-based account. SRTA will identify violators through an electronic detection system that will monitor vehicle presence on the Express Lanes to determine whether vehicles have active transponders or license plates listed in the database. Motorists who have not pre-registered by one of these two methods and who use the Express Lanes will be considered in violation, receiving a violation notice that includes the toll amount and other fees. In addition, SRTA will be issuing violations to vehicles crossing the double white line detected through the gantry-controlled access system.

Georgia Department of Public Safety (DPS) Motor Carrier Compliance Division. Data on HOV lane and double white line crossing violations are collected by the DPS Motor Carrier Compliance Division. DPS is the primary agency responsible for enforcing motor vehicle laws and regulations on the express lane corridor. SRTA has indicated it will be responsible for obtaining the data from DPS before and after project implementation and providing it to the national evaluation team. Other public safety agencies such as the Georgia State Patrol and other local police (e.g., Gwinnett Count, DeKalb County) may also have citation data.

2.2 Data Availability

All crash reports in the GDOT Crash Reporting Unit are processed within 45-60 days of the crash. An additional step of geo-locating each crash can add 45-60 days to availability, but GDOT is in the process of implementing a system for electronic transmission of crash reports, so that additional time may be significantly reduced over the next year. No major obstacles to gaining access to the required data are foreseen, although there may be up to a 120-day delay between the occurrence of safety events and the availability of data describing these events in the GDOT Crash Reporting Unit. GDOT is capable of providing archived incident data from the TMC with a lag time of 1-2 weeks.

2.3 Potential Risks

There are inherent limitations and risks associated with the use of traffic crash and incident databases and safety-related analyses. Table 2-2 identifies the risks and limitations and potential mitigations for each.

Table 2-2. Potential Risks and Limitations of Safety Data

Risk or Limitation	Mitigation
Crash and incident data are recorded by personnel at the scene. As a result, the accuracy of the data depends on individuals providing accurate and complete information.	None identified.
Even when accurate and complete information is recorded, the exact cause(s) of a crash or incident may not be apparent or known. For example, a crash in the HOT lane may be the result of driver actions in the general-purpose freeway lanes or visa-versa.	None identified.
There is a lag time with the availability of data from some of the databases. Less than a year of post-deployment safety data may be available.	The evaluation team will work with available data, to make seasonal or other adjustments if appropriate, and in the final report note cautions to be taken in interpretation of the findings.
It is possible that the geospatial data in these repositories may not be as precise as desired for the evaluation and the causal information recorded for low severity events is likely to be minimal. The national evaluation team recognizes these data limitations.	The information obtained from interviews with law enforcement, service patrol personnel, and from professional drivers who travel in the I-85 corridor may help to fill gaps left by the data in the incident databases.
Fully examining the safety improvements of projects takes longer than the one-year post-deployment period available for analyzing the Atlanta CRD project.	Compare I-85 and I-75 data and historical trends. In the final report note cautions to be taken in interpretation of the findings.
A limitation to using the GDOT TMC system data for an analysis between express and general purpose lanes is that no explicit variable is present to delineate between the two lane types. The closest association may be to link left-lane and left-shoulder incidents to occurrences on express lanes, but that connection may not be exact.	None identified.
GDOT is currently changing the software for the TMC, and the data format for future years may be different from the layout of the historical data.	GDOT has assured the evaluation team that all of data elements presented from the old system will be shown under the new software program.

Given budget and time considerations, there are no cost effective approaches for addressing most of these risks. The use of the multiple databases in this test plan, along with examining crash data from the I-75 control corridor will help address some of the risks. The national evaluation team will analyze the available safety data, but fully exploring the safety impacts of the CRD projects may require a long-term analysis beyond the scope of the national evaluation. Thus, the potential impact of the data risks and associated limitations is that the safety analysis may not provide conclusive findings regarding the CRD projects. Nevertheless, GDOT and other participation agencies will be able to use the evaluation protocol to continue to monitor and analyze crash and incident data in the future, which will provide a longer-term perspective on the safety impacts of the CRD projects.

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3.0 DATA ANALYSIS

The analysis of safety data will focus on before/after comparison of crash and incident data. The data will be used to assess the MOEs in the safety and technology analyses and to estimate the safety cost savings from the CRD projects for the cost benefit analysis.

Members of the Battelle team will conduct a visual inspection of the data and will use automated range checks to identify any outliers or suspect data. Any data concerns identified will be checked with GDOT and SRTA and the appropriate action will be taken.

The evaluation will compare pre- and post-deployment crash, incident and citation data for the I-85 corridor to assess the effects of the CRD project on corridor safety. MOEs described under the safety analysis will be computed. These are concerned with the frequency, type, cause, time, and location of safety incidents in the treatment corridors with special regard to the features of the CRD project infrastructure (Express Lane transition zones and double white lines, etc.) which might be a factor in crashes.

The quantitative information derived from the preceding analyses will be augmented with the information gathered through interviews as outlined in the Surveys and Interviews Test Plan. The interview data will help to illuminate technical and perceptive details which may be difficult or impossible to obtain from the quantitative accident data alone. The data acquired under this Safety Data Test Plan are also expected to be used as an input to the cost-benefit and technology analyses. The technology analysis will use DPS citation data from the safety analysis to assess whether a change in the number and rate of citations (by type) is indicative of implementing an advanced gantry enforcement system. Safety incident data will be used in the cost-benefit analysis to assess the benefits in potential safety cost savings. Examples of the measures and analysis to be used in examining the safety data are highlighted below. Appropriate statistical measures, such as testing for significance, will be applied.

- Total numbers of crashes. The total number of crashes on I-85 and I-75 will be compared before and after deployment.
- Spatial configuration of crashes. The location or spatial configuration of crashes on the various facilities will also be analyzed pre- and post-deployment. This analysis will assist in determining if the I-85 corridor has reduced crashes compared to the I-75 control corridor.
- Types and severity of crashes. The types and the severity of crashes will be examined pre- and post-deployment based on available data. This analysis will assess potential changes in the nature of crashes, and the resulting severity, based on the CRD project.
- Crashes per 1,000 VMT. This analysis will compare pre- and post-deployment crashes per 1,000 VMT, based on available data from the Traffic Data Test Plan. This measure normalizes crash rates to account for either increases or decreases in VMT. Data will be examined for I-85 and I-75.
- Frequency of double white line violations. The number of safety incidents and citations for crossing a double white line will be assessed before and after deployment. This

analysis will assist in reviewing whether the gantry system was effective in reducing the frequency of lane violations.

Judgments about the causal relationship between crashes and incidents will be made based on a detailed understanding of the CRD deployments and operational strategies coupled with all available data on crash and incident cause or contributing factors. Although the specific number of crashes will be considered, most conclusions related to CRD causality will be based on crash rates so that the impact of varying traffic volumes are controlled.

Other factors besides the CRD projects may influence reductions or increases in crashes. Examples of these factors include traffic safety campaigns, other non-CRD improvements, seasonal weather patterns, and reduction in VMT due to the economic slowdown. GDOT and SRTA will inform the evaluation team if any new major traffic safety campaign commences during the observation period. Consideration for non-CRD improvements will be given by comparing the number, type, and duration of construction projects between the I-85 and I-75 corridors using reports from GDOT. Local economic conditions, as measured by the gas prices and employment statistics noted in the Exogenous Factors Test Plan, are expected to be the same throughout Cobb, Gwinnett, and DeKalb counties in the Atlanta region. Given the similar relationship, a comparison between I-75 and I-85 will help to reliably identify the impacts of CRD-related improvements.

Specifically, a variety of multivariate techniques will be used to incorporate exogenous factors into the safety analysis. Descriptive analytic tools, such as histograms and scatter plots, will be produced to identify patterns in the data. Standard statistical measures, such as t-tests, F-tests, and Chi-Square tests, will help identify statistically significant variations in the data. Multivariate regression analysis, Poisson transformations, and correlations will also be used where warranted.

One of the major challenges related to safety data is that given the year-over-year variability in collisions and incidents, one year is a very short period of time upon which to base judgments about post-deployment safety impacts. Collection and analysis of historic collision and incident data in order to determine long-term trends is one method that will be used to control for short-term variability on the pre-deployment side of the before-after safety impacts assessment. Also, if, as expected, less than a full year of post-deployment data is available due to the lag in the availability of data from GDOT Crash Reporting Unit, that data will be extrapolated to create a full one-year comparison with the baseline data, while accounting for seasonal changes.

4.0 SCHEDULE AND RESPONSIBILITY

The collection schedule for safety analysis data are summarized in Table 4-1. These data are routinely collected and archived by GDOT and SRTA. One year of pre- and post-deployment data related to the operation of the Express Lanes will be collected. In addition, the national evaluation will also use 3-5 years of historical data to assess long-term trends. The Atlanta partners will be responsible for providing the safety data, and no special data collection effort will be required to support the evaluation. The national evaluation team will be responsible for analysis of the data and reporting of the findings.

Table 4-1. Tolling System Deployment Data Collection Schedule

Project Element	Date
Historical Data	7/2006 – 6/2010
Baseline Data	7/2010 – 7/2011
Test Period for HOT System	8/2011
One-Year Post-Deployment Data Collection	9/2011 – 8/2012

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APPENDIX A – COMPILATION OF HYPOTHESIS/QUESTIONS FROM ATLANTA CRD NATIONAL EVALUATION PLAN

Evaluation Analysis	Hypothesis/ Question Number	Hypothesis/Question
Congestion	AtlCong-1	Converting the I-85 HOV lanes to HOT operations will improve travel time and average travel speeds on both the general purpose and high occupancy lanes on I-85
	AtlCong-2	Converting the I-85 HOV lanes to HOT operations will improve travel time reliability and reduce variability on both the general purpose and high occupancy lanes on I-85
	AtlCong-3	Deploying the CRD improvements will result in more vehicles and persons being served on I-85
	AtlCong-4	Implementing the CRD improvements in the I-85 corridor will reduce the spatial and temporal extent of congestion
	AtlCong-5	As a result of the CRD improvements, the perception of travelers is that congestion has been reduced in the I-85 corridor
Pricing	AtlTolling-1	Tolling will increase vehicular throughput on I-85 Express Lanes and improve travel reliability
	AtlTolling-2	What changes in usage will occur as a result of the conversion of the HOV2+ lanes to HOT3+ lanes?
	AtlTolling-3	How much will travelers utilize the I-85 Express Lanes system?
	AtlTolling-4	Variable pricing on the I-85 Express Lanes will regulate vehicular access so as to improve the operation of the lanes
Transit	AtlTransit-1	Atlanta CRD project will enhance transit performance in the I-85 corridor
	AtlTransit-2	Atlanta CRD project will increase ridership and facilitate a mode shift to transit within the I-85 corridor
	AtlTransit-3	Increased ridership / mode shift to transit will contribute to congestion mitigation within the I-85 corridor
	AtlTransit-4	What was the relative contribution of each Atlanta CRD project element to increased ridership and/or mode shift to transit within the I-85 corridor?

Evaluation Analysis	Hypothesis/ Question Number	Hypothesis/Question
TDM	AtlTDM-1	Promotion of commute alternatives removes trips and vehicle miles traveled (VMT) from I-85
	AtlTDM-2	CAC incentives support formation of 3+ carpools and vanpools on I-85
	AtlTDM-3	What was the relative contribution of the Atlanta CRD TDM initiatives on reducing I-85 vehicle trips/VMT?
Technology	AtlTech-1	Using advanced technology to enhance enforcement will reduce the rate and type of violators in the corridor
Safety	AtlSafety-1	The collective impacts of CRD improvements will be safety neutral or safety positive
	AtlSafety-2	Gantry-controlled access technology will reduce incidents related to violations for crossing the double white line
	AtlSafety-3	Tolling strategies that entail unfamiliar signage will not adversely affect highway safety
Equity	AtlEquity-1	What are the direct social effects (travel times, tolls, and adaptation costs) for various transportation system user groups from tolling and other CRD strategies?
	AtlEquity-2	What is the spatial distribution of aggregate out-of-pocket and inconvenience costs, and travel-time and mobility benefits?
	AtlEquity-3	Are there any differential environmental impacts on certain socio-economic groups?
	AtlEquity-4	How does reinvestment of toll revenues impact various transportation system users?
Environmental	AtlEnv-1	What are the impacts of the Express Lanes project in the I-85 corridor on air quality?
	AtlEnv-2	What are the impacts on energy consumption?
Goods Movement	AtlGoods-1	Commercial vehicle operators (CVOs) will experience reduced travel time by reduced congestion on general purpose lanes
	AtlGoods-2	Operators with light-duty trucks will prefer to use Express Lanes to general purpose lanes for faster travel times
	AtlGoods-3	Operators delivering goods will perceive the net benefit of tolling strategies (e.g., benefits such as faster service and greater customer satisfaction outweigh higher operating costs due to tolls)
	AtlGoods-4	Operators report changing operational decisions due to use of Express Lanes (e.g., changing delivery times)

Evaluation Analysis	Hypothesis/ Question Number	Hypothesis/Question
Business	AtlBusiness-1	What is the impact of the strategies on employers? e.g., employee satisfaction with commute and increased employment-shed to downtown/mid-town Atlanta
	AtlBusiness-2	What is the impact of the strategies on businesses that rely on customers accessing their stores, such as retail and similar establishments?
	AtlBusiness-3	How are businesses that are particularly impacted by transportation costs affected (e.g., taxis, couriers, distributors, tradesmen)?
Non-Technical	AtlNonTech-1	What role did factors related to “people” play in the success of the deployment? People (sponsors, champions, policy entrepreneurs, neutral conveners)
	AtlNonTech-2	What role did factors related to “process” play in the success of the deployment? Process (forums including stakeholder outreach, meetings, alignment of policy ideas with favorable politics, and agreement on nature of the problem)
	AtlNonTech-3	What role did factors related to “structures” play in the success of the deployment? Structures (networks, connections and partnerships, concentration of power and decision-making authority, conflict-management mechanisms, communications strategies, supportive rules and procedures)
	AtlNonTech-4	What role did factors related to “media” play in the success of the deployment? Media (media coverage, public education)
	AtlNonTech-5	What role did factors related to “competencies” play in the success of the deployment? Competencies (cutting across the preceding areas: persuasion, getting grants, doing research, technical/technological competencies; ability to be policy entrepreneurs; knowing how to use markets)
	AtlNonTech-6	Does the public support the UPA/CRD strategies as effective and appropriate ways to reduce congestion?
Cost Benefit	AtlCBA-1	What is the net benefit (benefits minus costs) of the Atlanta CRD projects?

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