HANDBOOK OF SELECTED CONGESTION MITIGATION TECHNIQUES IN THE UNITED STATES

Prepared by

Texas Transportation Institute

for

Texas Department of Transportation

October 1998

Handbook of Selected Congestion Mitigation Techniques in the United States
Research Report 1798-1

Authors
Jason A. Crawford, P.E.
William E. Frawley, AICP
A. Scott Cothron

Research Study No. 0-1798
Evaluate Congestion Management Measures in Texas and the United States

Sponsored by
Texas Department of Transportation

in cooperation with
U.S. Department of Transportation
Federal Highway Administration

Research conducted by
Texas Transportation Institute
The Texas A&M University System
College Station, TX 77843-3135

October 1998

To order this report, contact
Information and Technology Exchange Center (ITEC)
Texas Transportation Institute
(409) 845-1734

Research & Technology Transfer Office (CST-R)
Texas Department of Transportation
(512) 465-7684

DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the Federal Highway Administration (FHWA) or the Texas Department of Transportation (TxDOT). The handbook does not constitute a standard, specification, or regulation. It is not intended for construction, bidding, or permit purposes. Mr. Jason A. Crawford, PE (TX 83241) and Mr. William E. Frawley, AICP were the Research Supervisors for this project.

ACKNOWLEDGMENTS

This handbook would not have been possible without the funding and guidance of the Texas Department of Transportation. The handbook represents the culmination of work performed for Project 0-1798, *Evaluate Congestion Management Measures in Texas and the United States*. The project was led by Mr. Tim Juarez (TPP) and Mr. Roger Beall (formerly with TPP). Additional guidance was provided by several other advisory members:

Karen Dunlap (TPP)
Elizabeth Hilton (DES)
Randy Keir (TRF)
Bill Reichert (TRF)
Manny Sehgal (TRF)

The focus group, which helped to provide content and format suggestions, is also thanked for their valued suggestions, recommendations, and time. These individuals are:

<u>Texas Department of Transportation</u>
Raymond Sanchez (Pharr)
Ken Zigrang (San Antonio)
Richard Brown (Waco)

<u>Metropolitan Planning Organizations</u>
Bob Dickinson (Beaumont/Port Arthur)
J. D. Reyes (San Angelo)

Thanks are given to the following individuals who collected information and prepared initial drafts of the case studies contained in this handbook:

Mr. Roland Castaneda II
Ms. LaShawn Nunn
Ms. Jolene Piel

Thanks are also given to the many individuals who were contacted and interviewed and who participated in our data gathering efforts. It is the information supplied by these many contacts that provided the needed technical information and personal insight into the success of the projects.

TABLE OF CONTENTS

INTRODUCTION

HANDBOOK PREPARATION AND FORMAT

Preparation of the Handbook

A great amount of information about congestion mitigation techniques exists in countless resources, yet there are few publications that have concentrated case study information. Therefore, the research team faced a potential information overload when gathering case study materials. While publications provide very good basic information and some details about the case studies, it was necessary to contact representatives of agencies to verify that the information was correct and determine if there were any recent changes related to the case studies. In order to complete this work in an efficient manner, the research team developed a methodology to identify potential case studies, collect relevant information, and prepare documentation.

Two simultaneous activities began the first step of data collection. Research team members performed a literature review by exploring publications for articles that described any potential case studies that fit the proposed handbook topics. As researchers identified prospective case studies, they called representatives of the responsible transportation agencies to obtain additional detailed information.

Concurrently with the literature review, research team members also "cold-called" some transportation agencies inquiring about the status of projects related to the chapter topics. These calls were made based on the knowledge of team members about projects in various metropolitan areas. The ensuing discussions resulted in researchers being able to either document valid case studies or rule out examples that did not belong in the handbook.

One of the most important steps in selecting the handbook format, as well as the topics to include, was forming an input panel. Developing the handbook as a loose-leaf binder was an idea that originated with the research project Input Panel, based on their experiences of using and updating similar resources. The Input Panel consisted of five representatives from TxDOT districts and Texas metropolitan planning organizations (MPOs) representing large, medium, and small size urban areas. This mixture was sought to provide a distinctive balance to the techniques included in this handbook.

The research team met with the Input Panel twice during the course of the project to gain insight from prospective users of the handbook. This process was quite valuable in that the Input Panel members gave serious consideration to the structure of the handbook and the proposed topics. The research team was able to incorporate many of the Panel's ideas into the final draft of the handbook.

Format

The goal of this research project was to provide transportation planners and engineers with a reference document that is user-friendly and that can be readily updated. One of the key elements to achieving this goal is preparing the handbook in a physical format that fits these needs. The research team, through discussions with the Input Panel, decided that the most appropriate format was a loose-leaf binder. The Input Panel stated many times that this document would be most useful if it is updated on a regular basis. The binder format allows for inserting updates and removing outdated materials without having to publish an entirely new document. The handbook is grouped by section and divided by chapter. There are six sections and 24 chapters.

The organizational format of the handbook is another consideration that the research team carefully considered. Many brainstorming sessions resulted in a decision to divide the document into sections of related chapters. This format was developed according to a logical organization of subjects that the handbook covers. The chapters each contain up to five case studies of how various transportation agencies use congestion mitigation techniques in their geographic areas of responsibility. These chapters are all formatted in a similar manner, with variations used depending on the specific topics. When the research team began to review the topics to be included in the handbook, they organized the corresponding chapters into related sections.

Each chapter begins with a brief introduction of the subject congestion mitigation technique. This introduction includes some highlights of the case studies that indicate trends, outstanding techniques, and other items of interest. In addition to text, the introductions each contain a table that summarizes some of the basic information for all of the case study areas, such as the 1990 census population and population density. Populations are reported at the metropolitan statistical area (MSA) or primary metropolitan statistical area (PMSA) levels unless otherwise noted. The MSA and the PMSA are equivalent tiers for population comparison. When multiple adjacent MSAs exist, they are re-designated as PMSAs, which are components of a larger consolidated metropolitan statistical area (CMSA). These tables provide helpful comparison information in one location for the user.

Case study selection included several elements. One of the selection considerations was the population of the metropolitan area where the case study is located. The research team attempted to represent a broad cross section of metropolitan area populations with the case studies. In some instances, such as HOV lanes, there are certain congestion mitigation techniques that are financially feasible only in areas with very large populations. In addition, case studies were selected from geographically diverse areas. The primary exception to the geographic consideration is the Rail Transit System chapter. In that chapter, researchers sought case studies from metropolitan areas that have population densities similar to those in Texas in order to provide the most applicable examples. When possible, chapters include one or two case studies from metropolitan areas in Texas.

When developing the chapters, the research team considered more potential case studies than are included in the handbook. Since complete information was not always available for case studies and only a few case studies were detailed, numerous potential surplus case studies were identified. The research team documented projects they did not include as full case studies at the end of each chapter in order to provide the user with as much information as possible. Finally, each chapter contains references that were used to develop the case studies, including publications and staff at the respective agencies. These additional pieces of information will help the user obtain more detailed information as necessary.

INTENDED AUDIENCES AND USE

Audiences

According to the Project Director, the desire for this document is to be a reference material for transportation planners and engineers working for TxDOT districts and Texas MPOs. Specifically, the desire is for these practitioners to be able to use the handbook in developing ideas with which they can address congestion problems in their corresponding metropolitan areas. Therefore, the research team designed and wrote the handbook in a manner that would be most useful as a technical resource. It is recognized, however, that other potential handbook users exist and that they may not be as technically oriented as the primary audience. Such users include policy makers, stakeholders, and professionals not specifically trained in the field of transportation. With this thought in mind, the research team developed the handbook so that these potential users would not be overwhelmed with technical language and information.

Use of the Handbook

This handbook was created for multiple potential uses. First, it will serve as a reference guide for practitioners or other professionals who need a resource that can help them identify congestion mitigation techniques and their potential applications. By reading the case studies in any given chapter, the users will be able to begin the process of identifying assorted techniques that may be appropriate for metropolitan areas.

As metropolitan and state transportation agencies continue to develop congestion management systems (CMS), they will be able to use the handbook to identify prospective CMS elements. After a user has identified techniques of interest, the user will be able to contact the appropriate agency to obtain additional specific details. The case study descriptions give the user some general information about each technique's development, costs and implementation, as well as basic information about the metropolitan area where the techniques are being deployed.

Each MPO, working in cooperation with its corresponding TxDOT district, develops a long range plan known as the Metropolitan Transportation Plan (MTP). Information in this handbook will prove very useful as MPOs and districts work together to develop projects that need to be included in the MTPs in order to address congestion problems. Having the ability to investigate congestion mitigation techniques that have already been used in other locations will help planners select MTP projects with greater discretion.

DEFINING CONGESTION

Traffic congestion has different meanings to different people. To the motoring public, congestion is a problem that they must live through constantly or once in a while, depending on the nature of their travel routes and patterns. To planners and engineers, congestion is a problem that must be solved in order to keep the transportation system functioning at a level deemed acceptable by various constituents. Definitions of congestion vary, depending on the perspective from which a person is looking, such as small versus large urban areas. There are definitions that describe how often congestion occurs, as well as definitions of when congestion occurs.

Recurring vs. Non-Recurring

Traffic congestion can be divided into two basic types — recurring and non-recurring. Recurring congestion is that which can be anticipated to occur on a regular basis due to consistent conditions in the transportation system. An example of recurring congestion is the normal queues that occur routinely in the same locations during peak hours due to the volume of traffic exceeding the capacity of the road. An example of non-recurring congestion is a queue that is caused by a traffic accident or similar isolated incident. Although the accident may occur on a road that is already congested, the additional queue caused by the accident is a non-recurring event since it could not be predicted to occur in a specific location.

Relative to Size

Motorists perceive congestion depending on the circumstances in which they routinely drive. In most large metropolitan areas, it is quite common for drivers to experience delays of 30 minutes or more on freeways during the morning and afternoon peak travel hours. Drivers in those situations often become accustomed to such delays and their concept of congestion develops accordingly. In contrast, drivers in smaller metropolitan areas may only experience measurable delays while waiting through one or two extra cycles of a traffic signal. These drivers also perceive that they are experiencing congestion.

Roadway Congestion Index

Beyond defining at what amount of delay congestion exists, motorists determine what levels of congestion are acceptable and adjust their driving patterns and/or work or home locations accordingly. Correspondingly, transportation planners and engineers use measures to determine what levels of congestion are acceptable and at what point improvements to the transportation system must be made.

Several measures of congestion exist, including volume-to-capacity ratios and travel time delays. One specific congestion measurement tool is the Roadway Congestion Index (RCI) that was developed by researchers at the Texas Transportation Institute (*1*).

The RCI is calculated using ratios of freeway and arterial lane-miles and daily vehicle miles traveled (DVMT). An RCI greater than 1.00 represents an undesirable congestion level in the metropolitan area. The RCI allows one to compare the congestion levels of dozens of major metropolitan areas across the United States. Areas that experience congestion greater than the average level receive ratings above 1.00, and those with less congestion receive ratings below 1.00. This tool allows practitioners and motorists to compare the congestion in their areas with congestion in other areas.

CONGESTION MITIGATION PROGRAMS

Congestion mitigation is vital to ensuring acceptable levels of mobility and accessibility in a metropolitan area. Congestion may be mitigated with a specific technique or a collection of techniques which either influence the operation of the transportation system or influence the demand placed on the transportation system.

The selection of congestion mitigation techniques varies with the size of the metropolitan area. A smaller area may select lower cost options to mitigate congestion, whereas a larger area will use both low-cost options, as well as capital intensive projects to manage regional, corridor, and spot congestion. A metropolitan area will benefit from congestion mitigation in three ways: mobility will be improved which will improve fuel efficiency and improve air quality.

Techniques

Transportation control measures (TCMs) are common congestion mitigation techniques. TCMs include a broad range of transportation strategies which seek to improve traffic flow or influence transportation demand. Techniques which seek to improve traffic flow are commonly known as transportation system management (TSM) strategies. Techniques seeking to modify travel demand and behavior are known as transportation demand management (TDM) strategies. TCMs provide a wide range of benefits. Some of these benefits are reduced congestion, improved safety, reduced travel time, increased fuel efficiency, and improved air quality.

Because of the air quality benefits, the 1990 Clean Air Act Amendments (CAAA) supported the use of TCMs to improve regional air quality in areas designated "nonattainment" for meeting National Ambient Air Quality Standards (NAAQS). TCMs were also touted to complement or be included in congestion management systems (CMS) defined under the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA). Congestion Management Systems (CASS) are still used in nonattainment metropolitan areas.

TDM implementation often requires a cooperative process. State, regional, and local agencies must cooperate with one another, and with the private sector, to select and successfully implement a TDM. Furthermore, elected officials must be committed to the implementation of congestion mitigation techniques if they are to ever be effective (*2*). As noted in the *Transportation Control Measure Information Documents* (*3*), employers have shown to serve a critical role in the increasing effectiveness of an overall TDM program. By working together in a committed environment, congestion mitigation has a better chance at success.

Supply v. Demand

Managing congestion requires a delicate balance between improving the transportation supply and reducing transportation demand. Depending on the size of the metropolitan area, a transportation agency may place the emphasis on improving supply, reducing demand, or a combination of both.

TSM strategies are "..designed to increase effective capacity, specifically to optimize the traffic operations of the existing roadway infrastructure without the addition of general purpose lanes" and "tend to be low cost, requiring minimal right-of-way, and frequently to be rapidly implementable compared to new capital construction" (*4*). Depending on the nature of the congestion problem, TSM strategies can be used to impact all travelers along a corridor, or at a specific intersection or problem site. As noted previously, coordination among local agencies is required to implement these strategies.

It is easier to quantify the effects of TSM strategies than it is to predict the effects of TDM strategies. This is due in part to two reasons. First, transportation engineers and planners have had many years of experience modifying and enhancing the supply side of the transportation system, thus gaining valuable experience as to the effects of system improvements. Second, TSM strategies are based on engineering principles by which impacts on the traffic stream can be quantified. As a result, there is more evidence in the available literature regarding the impacts of TSM strategies.

TDM strategies, however, are more variable in nature in both the amount and duration of participation. Typically, these strategies are more difficult to implement than TSM strategies because they require both employers and employees to willingly participate in them (e.g., compressed work weeks or telecommuting). As defined in *Congestion Management for Technical Staff: Participant's Notebook* (*4*), three common TDM elements are:

1) activity or emphasis at the origin or destination of a trip;
2) frequent need for public/private sector coordination; and
3) emphasis primarily on commute trips because other trip types are more difficult to affect.

For TDM strategies to succeed, several factors must be addressed. First, incentives have to be used to attract participation rather than forcing people to change their behavior. Second, the participant has to realize a financial advantage to make a behavioral change attractive. Third, some convenience or time advantage must be present to encourage changes in travel behavior. Fourth, the TDM strategy must provide security for the participant so that they do not feel that they are at risk of being harmed. Finally, extensive efforts to distribute information about the strategy are needed to educate potential participants and garner support for strategies which attempt to change human behavior.

The Institute of Transportation Engineer's (ITE) *A Toolbox for Alleviating Traffic Congestion and Enhancing Mobility* (*2*) notes that "..well-conceived and aggressively promoted demand reduction programs can decrease peak period traffic at many sites by as much as 10 to 15 percent." It is important to note that these reductions occur at many locations or employment centers. Region-wide benefits are much smaller and more difficult to ascertain. ITE (*2*) also states that TDM will only have a local impact unless efforts are undertaken on a truly massive scale.

Techniques Vary with Size

The use of TCMs vary by the size of the metropolitan area. The Texas Transportation Institute (*5*) created a TDM database which documented TDM projects found in the available literature up to 1991. This study found that certain techniques, such as high occupancy vehicle (HOV) lanes, are more applicable as the urban population and travel activities increase. Other techniques, such as traffic flow improvements, are common among all urban areas managing their traffic congestion. The variety and extent of the transportation system with its differing modes is also a consideration. Larger cities are more likely to have a more developed public transit system which takes advantage of transit centers, signal preemption, transitways, as well as supporting park-and-ride facilities and HOV lanes. Many of these components are capital-intensive and require financing through public bonds.

Larger cities are also more likely to employ transportation demand management as a tool in mitigating traffic congestion. With the presence of large employers at downtown locations or campus-style developments in the suburban areas, greater benefits of transportation demand management may occur. One adverse characteristic that large cities have on TDM is that the employment base becomes so large and diverse that it can discourage certain forms of TDM. For example, ridesharing may suffer as people's schedules fill with errands, and they experience an overwhelming need to exercise personal freedom expressed through their automobile.

Smaller urban areas commonly use less expensive measures to manage traffic congestion. Signal improvements, intersection improvements, construction of additional travel lanes and the like are typically used to improve the flow of traffic. The use of lower cost strategies is driven by the competition for transportation funding and the need to mitigate congestion in larger cities. Little emphasis is placed on managing the demand on the transportation system of smaller areas. Small cities are not likely to pursue demand management projects because congestion has not reached an intolerable level, and greater benefit-cost ratios are obtained through traditional TSM projects.

Implementation as a Program

Congestion mitigation should not be approached in a piecemeal manner rather, it should be approached with a well planned array of complementary measures implemented as a coordinated program. A well planned program to reduce congestion will ensure that strategies are chosen and implemented based on a supportive and/or synergistic basis rather than a counterproductive basis. A well planned program of 15 to 20 separate measures which consist of inter-related measures can be three to four times more effective than any of those measures individually (*3*). By avoiding negative interactions among TCMs, projects can be better supported by the public and users of the system. A supportive program also makes efficient use of scarce public tax dollars.

Benefits

There are three distinct benefits of congestion management. These benefits are increased urban mobility, improved fuel efficiency, and improved air quality.

Urban mobility is increased through congestion mitigation by reducing roadway demand through travel mode shifts or travel time shifts, and by improving traffic flow on roadways through capital improvements. Although mobility is measurable, it is one transportation characteristic which can also be perceived by all users of the transportation system. The general public will most likely gauge the transportation network's performance as a success or failure by this measure. A direct impact of improved mobility is improved fuel efficiency.

Congestion mitigation improves the fuel efficiency of a region's transportation network as traffic flow smooths. When regional speeds on highways and arterials increase and stop-and-go traffic is decreased, the fuel efficiency of personal and transit vehicles increases. By better managing the transportation network's supply, vehicle speeds can be maintained and reduce excess fuel consumption caused by excess idling and numerous accelerations and decelerations. Fuel consumption is related, although not directly, to vehicle emissions which impact regional air quality.

A region's air quality can be improved through congestion mitigation due to decreased delays and improved travel speeds. Increasing evidence also shows that by smoothing traffic flow, great decreases in vehicular emissions can result. As nonattainment metropolitan areas strive to seek improvements from the mobile source inventory, greater emphasis may be placed on traffic smoothing to maintain moderate travel speeds.

Continuing Effort to Monitor and Implement

Choosing and using one or a combination of congestion mitigation techniques to relieve spot, corridor, or regional congestion is not enough. A region must make a committed effort to monitor congestion and the effects of congestion mitigation techniques, and implement additional or new congestion mitigation techniques based on the results of the monitoring. The purpose of monitoring is best described in *Transportation Control Measure: State Implementation Plan Guidance* (*6*) which says that it is "..to provide transportation managers and oversight agencies with the information they need to assess the performance of transportation programs, and to make any adjustments or improvements that are needed to achieve program goals" (*6*). Because a majority of the metropolitan areas' transportation infrastructure is in place, that infrastructure must be managed with care to ensure a complimentary balance between service flow and system demand within fiscally constrained budgets.

REFERENCES

1. Texas Transportation Institute. "Roadway Congestion in Major Urbanized Areas: 1982 to 1987." TTI Research Report 1131-2. Texas Transportation Institute: College Station, TX. (1989).

2. Institute of Transportation Engineers. "A Toolbox for Alleviating Traffic Congestion and Enhancing Mobility." Prepared by Michael D. Meyer, Ph.D., P.E. Institute of Transportation Engineers: Washington, D.C. (1997).

3. U.S. Environmental Protection Agency. "Transportation Control Measure Information Documents." U.S. Environmental Protection Agency, Office of Air and Radiation: Ann Arbor, MI. (March 1992).

4. Federal Highway Administration. "Congestion Management for Technical Staff: Participant's Notebook." NHI Course No. 15259. (April 1994).

5. Knapp, K.K., K.S. Rao, J.A. Crawford, and R.A. Krammes. "The Use and Evaluation of Transportation Control Measures." TTI Research Report 1279-6. Texas Transportation Institute: College Station, TX. (September 1994).

6. U.S. Environmental Protection Agency. "Transportation Control Measure: State Implementation Plan Guidance." U.S. Environmental Protection Agency, Office of Air and Radiation: Ann Arbor, MI. (September 1990).

SECTION 1

INTELLIGENT TRANSPORTATION SYSTEMS

CHAPTER 1
FREEWAY SERVICE PATROL

	San Diego, CA	Denver, CO	Minneapolis, MN	Charlotte, NC	Houston, TX
Implementation Date	1992	1991	1985	1992	1986
Implementation Costs (thousands of dollars)	$2,400	$632 (Annually)	$610 (Annually)	$191 (Annually)	$1,500 (Annually)
Freeway Miles (km)	314 (502)	249 (398)	330 (528)	318 (509)	529 (509)
Population (1990)	2,498,016	1,622,980	2,538,776	1,162,140	3,321,926
Sq. Miles (Sq. km)	4,204 (10,890)	3,761(9,741)	5,051 (13,083)	3,379 (8,750)	5,921 (15,336)
Population Density (pop. per sq. mi.) (pop. per sq. km)	594 (229)	432 (167)	503 (194)	344 (133)	561 (217)

Freeway service patrol programs (FSP) vary in terms of size and services. They generally consist of staffed vehicles that patrol freeways to provide assistance to stranded motorists. FSPs may change a tire, dispense gasoline, or simply help protect the vehicle and occupant(s) from being struck by other vehicles until necessary assistance arrives. Sponsors and participants include state departments of transportation, cities, transit agencies, and private companies.

The freeway service patrol programs in various regions have greatly reduced peak hour congestion caused by traffic incidents. For instance, in Colorado the program is estimated to have saved motorists between 78 and 98 minutes per incident during morning peak hour traffic and between 71 and 75 minutes per incident during afternoon peak hour traffic. As illustrated above, San Diego, Minneapolis, Charlotte, and Houston have reported similar results from their programs. This type of program is not limited to the aforementioned locations. San Francisco, Dallas, Los Angeles, New York, and Washington, D.C. also have freeway service patrol programs, and have reported comparable successes.

San Diego, CA
FREEWAY SERVICE PATROL

Highlights
- Sponsor: San Diego Association of Governments (SANDAG)
- Cost: $2,358,720
- Funding: ISTEA Surface Transportation Program and 25% local matching (sales tax) in accordance with the Freeway Service Patrol Act from Assembly Bill 3346
- Primary services: 20 tow trucks patrol 148.8 freeway miles (238 km); 51,000 vehicles assisted annually
- FSP freeway miles: 212 (339 km)
- Non-attainment region for ozone and CO

Background

On December 18, 1992, the San Diego Association of Governments Board of Directors approved allocating ISTEA Surface Transportation Program Local Funds to provide the 25% matching funds required for implementation of the Freeway Service Patrol (FSP) in the San Diego Area in accordance with Assembly Bill 3346, the Freeway Service Patrol Act. The first route covered 15 miles (24 km); 8.7 miles (14 km) on I-8; and 6.3 miles (10 km) on I-5; and was patrolled by two tow trucks. The program was extended to include 35.3 miles (56 km) by the end of 1993 and grew to 73.3 miles (117 km) in 1994 with six patrols. In 1997, the program covered 148.8 miles (238 km) with 20 patrols at a cost of about $40 per truck/hour. The patrols assisted an estimated 215 motorists per day. The program now covers 212 miles (339 km) and has 21 patrols. One key component of this program is the coordination of all California FSPs which were formed in accordance with Assembly Bill 3346, the Freeway Service Patrol Act. This coordination not only allows for the sharing of ideas and information, but also provides public access to similar services throughout the state.

Effects

The University of California at Berkeley conducted a benefit-cost analysis of the statewide FSP program for California Department of Transportation (Caltrans) in 1993. They reported to the state legislature a minimum benefit-cost ratio of 10:1. A specific benefit-cost analysis was not repeated for San Diego.

Public Perception

None available

Contact Information: John Duve
SANDAG
401 B Street, Suite 800
San Diego, CA 92101-4231
(619) 595-5368
e-mail: jdu@Sandag.cog.ca.us

Reference

Morris, Michelle, and Wilson Lee. "Survey of Efforts to Evaluate Freeway Service Patrols." *Transportation Research Record 1446.* National Academy Press: Washington D.C. (October 1994): 77-85.

Denver, CO
MILE HIGH COURTESY PATROL

Highlights

- Sponsor: Colorado Department of Transportation (CDOT)
- Cost: \$632,250 annually
- Funding: (20%) State, (80%) Federal (highway research funding and highway construction funding)
- Primary services: 10 tow trucks patrol 43 centerline miles (69 km); 20,000 vehicles assisted annually
- FSP freeway miles: 43 (69 km)
- Non-attainment region CO and PM10

Background

In Colorado, the idea for a freeway service patrol program came from the Colorado Incident Management Coalition (CIMC), a task force formed by CDOT to help detect freeway incidents. Mile High Courtesy Patrol (MHCP) was implemented by CDOT upon CIMC recommendation. CDOT entered into contracts with the Colorado State Patrol and the American Automobile Association, and formed cooperative relationships with various media sources, sky-based traffic observers, and local businesses (who played a role by allowing disabled vehicles towed by the MHCP to use specific parking lots as safe havens). CDOT is now the sole sponsor of the program. Program expansion eliminated the need to use the Colorado State Patrol as a service patrol. This reduced costs because officers were being paid time and a half to act as service patrols. The cooperative relationships remain intact, and the current MHCP consists of 10 tow trucks which patrol 43 centerline miles (69 km) on I-70 and I-25 in Denver.

Effects

The delay savings per incident varied from 78-98 minutes during morning peak hour traffic and from 71-75 minutes during afternoon peak hour traffic. A six-month travel time savings was estimated at \$1,800,000 to \$2,000,000. Meanwhile, costs of the project for the same period were estimated to be between \$110,000 and \$130,000. A benefit-cost ratio of between 13.5:1 to 18.4:1 and a valued travel time savings of \$10/vehicle-hour was calculated based on the above estimates. The costs saved by assisted motorists for free services performed by the courtesy patrols were also included in the total savings estimates. The current benefit-cost ratio is estimated at 20:1, reflecting the increase in the number of assists from 12,000 in 1993 to 20,000 in 1997.

Public Perception

During the first six months of the pilot program, 550 comment cards were received, 99% of which expressed the opinion that the program was a good use of their tax dollars.

Contact Information: James Blake, Projects Manager
Projects Management Division
Region 6
Colorado Department of Transportation
(303) 757-9629

References

Cuciti, Peggy, and Bruce Janson. Courtesy Patrol Pilot Program. Report No. CDOT-DTD-R-93-18. Prepared by the Colorado Department of Transportation. (August 1993).

Cuciti, Peggy, and Bruce Janson. "Incident Management via Courtesy Patrol: Evaluation of a Pilot Program in Colorado." *Transportation Research Record 1494.* National Academy Press: Washington D.C. (July 1995): 84-90.

Minneapolis, MN

HIGHWAY HELPER

Highlights

- Sponsor: Minnesota Department of Transportation (MnDOT)
- Cost: $610,000 annually
- Funding: State traffic management budget
- Primary services: Seven trucks; 11,000 vehicles assisted annually
- FSP freeway miles: 71 (114 km)
- Non-attainment region for CO and PM10

Background

MnDOT created the Highway Helper program in 1987 and included it as a part of its traffic management system for the Minneapolis-St. Paul metropolitan area in 1990. The traffic management center (TMC) uses an automated vehicle location (AVL) system which identifies the location of each of the Highway Helper trucks. This AVL system employs global positioning system (GPS) technology and mobile data terminals which allow drivers to relay real-time incident data to the TMC at the Minnesota State Patrol dispatch office. The current program operates Monday-Friday from 5:00 am to 7:30 pm, while one patrol is available on Saturday and Sunday from 9:00 am to 9:00 pm. Another characteristic of this program is that all of the trucks are in-house, not contracted out. The costs include vehicles, staff, operating expenses, and maintenance and repair. Vehicle life is estimated at three years.

Effects

For fiscal year 1995, 11,000 assists were made at a cost of $610,000. This resulted in a benefit-cost ratio of 5:1.

Public Perception

Like similar programs, Highway Helper met with high levels of public and political support. In fact, the Highway Helper program received the highest public approval rating of any MnDOT traffic management initiative, based on a perception tracking market research survey conducted in March of 1996.

Contact Information: Glen Carlson
Traffic Management Center
1101 4th Avenue South
Minneapolis, MN 55404
(612) 341-7500

References

Minnesota Department of Transportation Traffic Management Center. "Mn/DOT TMC - HighwayHelpers." Accessed: 9 November 1998. <http://www.dot.state.mn.us/tmc/program/helpers.fhtml>

Morris, Michelle, and Wilson Lee. "Survey of Efforts to Evaluate Freeway Service Patrols." *Transportation Research Record 1446*. National Academy Press: Washington D.C. (October 1994): 77-85.

Charlotte/Mecklenburg, NC
MOTORIST ASSISTANCE PROGRAM (MAP)

Highlights

- Sponsor: North Carolina Department of Transportation (NCDOT)
- Cost: $191,068 annually
- Funding: State maintenance budget, Federal construction funds, and gasoline tax
- Primary services: Three pick-ups; 9,400 vehicles assisted annually
- FSP freeway miles: 17 miles (27 km)
- Attainment region

Background

The Motorist Assistance Program (MAP) was created by the NCDOT and began operating in the Charlotte/Mecklenburg area in December of 1991. The MAP program first consisted of two vehicles patrolling 1-77 and I-85, Monday-Friday from 6:00 am to 8:00 pm, and on Saturday and Sunday from 11:00 am to 7:00 pm The program now has three patrols covering 17 miles (27 km).

Effects

During the first six months of operation, MAP assisted 2,451 vehicles. For valued travel time per vehicle hour, $10 was used which gave a dollar value of $1,455,930 in delay savings. The benefit-cost ratio based on these figures is 7.62:1.

Public Perception

Since the program began, several letters of gratitude have been received by MAP from thankful motorists. This response is in addition to the positive benefit-cost ratio. Because of its success, this program has been extended to other regions within North Carolina with similar results.

Excerpts from Letters

"...This is a wonderful service and you are to be commended..."
"...We congratulate you for the type of service you provide on your highways..."
"...It is especially refreshing to see such service..."
"...I am proud to be a North Carolina resident hearing that we provide this very valuable service..."
"...I think other states should take example..."
"...Can't say enough about this program. Thanks a million!!!"
"...Thank you for providing this invaluable service through our tax dollars."

Contact Information: Cheryl Evans, Incident Management Engineer
North Carolina Department of Transportation
(919) 733-2210

References

Mooney, Susan S., Edward L. Bruce, and Michael L. Kirk. Motorist Assistance Patrol Benefit/Cost Evaluation. Prepared by the North Carolina Department of Transportation. (March 1993).

Morris, Michelle, and Wilson Lee. "Survey of Efforts to Evaluate Freeway Service Patrols." *Transportation Research Record 1446.* National Academy Press: Washington D.C. (October 1994): 77-85.

Houston, TX
MOTORIST ASSISTANCE PROGRAM

Highlights

- Sponsors: Texas Department of Transportation (TxDOT), Sheriff's Department, Metropolitan Transit Authority of Harris County (METRO), area car dealers, and cellular phone companies
- Cost: $1,500,000 annually
- Funding: TxDOT, Sheriff's Department, METRO, area car dealers, and cellular phone companies
- Primary services: Nine vans patrol 141 miles (226 km); 22,800 vehicles are assisted annually
- Harris County freeway miles: 529 (529 km)
- Non-attainment region for ozone

Background

The first freeway service patrol program in Texas began operating in 1973 and was discontinued after a brief period, despite a benefit-cost ratio of 2:1. After further studies, the Motorist Assistance Program (MAP) was developed and began operating in Houston in 1986. The first patrol service was sponsored and funded solely by the Texas Highway Department, (now TxDOT), whereas the Harris County Sheriff's Department and the Houston Automobile Dealer's Association joined forces to create MAP in 1986. Currently, TxDOT, METRO, and Houston Cellular Phone have joined to sponsor and fund MAP.

Effects

Between August 1989 and July 1991, the Texas Transportation Institute assessed the benefits of MAP. That study documented more than 24,000 assists during this period resulting in time savings of 5 to 20 minutes. Assuming a $12 per vehicle hour amount for value of time, the dollar savings of the high end average of 20 minutes equaled $38,000,000. Using the low end average of 5 minutes, MAP saved citizens $74,000,000. The benefit-cost ratio based on these figures was estimated to be between 7:1 and 36:1 in 1991. A study performed in 1993 yielded a 19:1 benefit-cost ratio.

Public Perception

The MAP program has received several letters of gratitude from motorists assisted by the program.

Contact Information: Carlton Alan, Freeway Operations Supervisor
Texas Department of Transportation
(713) 881-3285

Reference

Morris, Michelle, and Wilson Lee. "Survey of Efforts to Evaluate Freeway Service Patrols." *Transportation Research Record 1446.* National Academy Press: Washington D.C. (October 1994): 77-85.

OTHER EXAMPLES/CITIES WITH FREEWAY SERVICE PATROLS

Reference for all the following cities
Morris, Michelle, and Wilson Lee. "Survey of Efforts to Evaluate Freeway Service Patrols." *Transportation Research Record 1446.* National Academy Press: Washington D.C. (October 1994): 77-85.

San Francisco, CA
- Golden Gate Bridge Freeway Service Patrol
- Four heavy tow trucks

Tampa/St. Petersburg, FL
- Howard Franklin Bridge Courtesy Patrol
- Two heavy tow trucks

Indiana (Northeast)
- Hoosier Help
- Two pickup trucks and two vans

St. Louis, MO
- Motorist Assistance
- Five pickup trucks

Kansas City, MO
- Motorist Assistance
- Four pickup trucks

New Jersey
- New Jersey Turnpike
- Three patrolling vans

Pittsburgh, PA
- Three tow trucks

Fort Worth, TX
- Courtesy Patrol (1973)
- Three extended cab pickup truck

Seattle, WA

- Highway Helper
- One van

Chicago, IL

- Emergency traffic patrol known as "Minutemen"
- 39 heavy and light tow trucks and 11 pickup trucks

Los Angeles, CA

- 88 private patrol trucks patrolling 215 miles (344 km) of freeway
- 130,000 motorists assisted through May 1992

CHAPTER 2
RAMP METERS

	Oakland, CA	Denver, CO	Portland, OR	Salt Lake City, UT
Implementation Date	October 1994	1981	1981	September 1996
Implementation Cost (thousands of dollars)	$4,900	$40	$250	$75
Freeway Miles (km)	18 (29)	249 (398)	81 (130)	70 (112)
Population (1990)	2,080,434	1,622,980	1,515,452	1,072,227
Sq. Miles (Sq. km)	1,458 (3,776)	3,761 (9,741)	3,743 (9,694)	1,618 (4,189)
Population Density (pop. per sq. mi.) (pop. per sq. km)	1,427 (551)	432 (167)	405 (156)	663 (256)

The installation of ramp meters is a proven, cost-effective technique for improving traffic flow. A ramp meter is similar in appearance to a conventional traffic signal at an intersection. Ramp meters, however, do not have yellow lights and they are placed on freeway entrance ramps rather than at intersections. The meters allow one vehicle to proceed onto the highway each time the light turns green. Ramp meter programs have had tremendous impact on freeway congestion in cities across the country. There are significant benefits to using ramp metering for increasing traffic movement by improving merging rates and reducing accidents.

Ramp meters are providing incentives for bus riding and carpooling (utilizing HOV lanes). Since the ramps meters increase delay on freeway entrance ramps, motorists are looking to the HOV lanes to decrease the travel time lost due to waiting longer on the ramps. Although delays are often incurred by ramp traffic, the mainline capacities are generally protected, and the overall operational efficiency of the freeway is improved.

There are two types of ramp metering devices — fixed time devices and traffic response devices. A fixed-time meter is established by presetting the metering rates in accordance with time of day and traffic volume, speed, and density data. The traffic response meter uses real-time volume, speed, and density data. The real-time systems can immediately deal with unusual and unanticipated changes in traffic.

Oakland, CA
RAMP METERS

Highlights

- Sponsors: Federal, State, and Santa Clara Traffic Authority
- Cost: $4,900,000 overall, including $25,000 per ramp meter
- Funding: State gas and sales tax
- Primary Services: 14 meters northbound, Six meters southbound, three freeway-to-freeway meters
- Program freeway miles: 18 (29 km)
- Non-attainment region for CO

Background

On October 19, 1994, Route 85 opened in Santa Clara County, which extends from Route 280 to Route 101, intersecting two other freeways in the interim. Northbound Route 85 has 14 on-ramp meters and two freeway-to-freeway connector ramp meters in operation. Southbound Route 85 has six on-ramp meters and one freeway-to-freeway connector ramp meter. The meters are set at a fixed rate of 900 vehicles per hour during peak periods. Northbound meters are operational during the morning peak hours, while the southbound meters are operational during the evening peak hours.

Effects

Commute times from some locations have dropped as much as 10 minutes, more than making up for the delay the meters cause at entrance ramps. Despite this fact, on November 17, 1994, the California Department of Transportation (Caltrans) was forced to succumb to public pressure and discontinue operation of ramp meters between Highways 101 and 85. However, on April 3, 1995, city officials reversed that decision, since the Santa Clara County Traffic Authority threatened to hold back $4,000,000 dollars per month which comprised the funding for the remaining construction of Route 85.

Public Perception

A public information pamphlet provides quotes from local commuters who have been pleased with the ramp meter program. "Three cheers for metering lights," exclaimed one commuter, who waited five minutes at the Winchester on-ramp but saw his overall commute time drop nearly 10 minutes. Another commuter, who had at one time given up driving Highway 85 due to the traffic congestion, proclaimed that, "these metering lights really make a difference."

Contact Information: Alan S. Chow, District Branch Chief
California Department of Transportation
(510) 286-4577

References

Richards, Gary. "Freeway Lights Pass Test: Highway 85 Now Faster For Most." *San Jose Mercury News.* (8 April 1995): 1-2.

California Department of Transportation. Revised Ramp Metering Plan 85. (February 1995).

This page intentionally left blank.

Denver, CO
RAMP METERS

Highlights
- Sponsor: State of Colorado
- Cost: $40,000 per ramp meter
- Funding: Not available
- Primary Services: Southbound I-225 (seven ramp meters), northbound I-225 (five meters), northbound I-25 (seven meters), eastbound I-270 (one meter)
- Freeway Miles: 249 (398 km)
- Non-attainment region for CO and PM10

Background

Growth that began in the 1970s has increased the demand on Colorado's transportation network, causing the urban freeway system to become increasingly congested. In 1981, ramp meters were demonstrated at five locations on the inbound portion of I-225. The success of the project led to the installation of a central computer system to monitor and coordinate each of the ramp meter locations. This system, called "Coordination Plan," allows each ramp meter to implement a more restricted rate than the first upstream ramp closest to the congestion location. If a critical condition remains, the first upstream ramp uses an even slower metering rate. Then, the second upstream ramp is put under the plan and begins a timing countdown to implement a more restrictive metering rate.

Effects

Positive traffic flow effects have been noticed as a result of the implementation of the ramp meters. However, no formal study has been conducted by any agency concerning the effectiveness of these devices.

Public Perception

Initial public reaction to the ramp meters was dislike. However, after the ramp meters were installed, the media and public agreed that traffic congestion was being reduced. Shortly after implementing the meters, many calls from the public were taken requesting the installation of more ramp meters.

Contact Information: Gordon Hickman, Senior Scientific Programmer
Information Systems Unit
Region 6
Colorado Department of Transportation
(303) 757-9939

Reference

Corcoran, Lawrence J., and Gordon A. Hickman. "Freeway Ramp Metering Effects in Denver." *ITE Compendium of Technical Papers.* (1998).

Portland, OR

RAMP METERS

Highlights

- Sponsor: The State of Oregon
- Cost: $250,000 per ramp meter; $50,000 in annual operating costs
- Funding: State gas tax
- Primary Services: 61 ramp meters are currently in operation; 27 are to be added in 1998
- Freeway miles: 81 (130 km)
- Attainment region

Background

The Oregon Department of Transportation (ODOT) installed its first ramp meter in 1981 on Interstate 84, which accommodates at least 150,000 vehicles a day. Interstate 5 and US-26, where additional meters are planned, each have daily traffic volumes of approximately 120,000. The large traffic volumes are why, by the year 2002, at least 100 ramp meters will be operational in the region. The fixed-time meters are programmed to operate based on historical data concerning traffic in that area. Operation of the area's meters is during the morning and evening peak periods.

Effects

The meters have aided in providing a safer merge for vehicles entering the highway. The meters have also helped keep traffic moving at higher speeds. Eventually, an additional 89 ramps will be metered. Phase 1 of installation is due to be completed in March 1999 and will allow individual ramp meters to be automatically adjusted based upon traffic volumes on the freeway. When traffic volumes are low, the meters will shut themselves off. Phase II will be completed later that year and will allow all ramp meters to be controlled at a central location. Future connections to the traffic management center will allow the programming of the ramp meters to be based upon real-time data from video cameras and pavement detectors.

Public Perception

Some drivers have expressed the opinion that ramp meters are a nuisance, while others have indicated that the meters help smooth the flow of vehicles entering the freeway.

Contact Information: Dennis Mitchell, Program Manager
Advanced Traffic Management Systems
Region 1
Oregon Department of Transportation
123 Northwest Flanders Street
Portland, Oregon 97209
(503) 731-8218

Reference

Rippe, Trudy. "A New Way of Thinking." *TRANSPORT-Transportation Portland.* Produced by the Oregon Department of Transportation, Region 1, Traffic Section. (December 1997).

Salt Lake City, UT

RAMP METERS

Highlights

- Sponsors: Federal and State
- Cost: $75,000 per ramp meter ($1,000,000 with geometric improvements)
- Funding: Federal and State
- Primary Services: Three southbound meters, two Northbound meters - December 1998
- Freeway miles: 70 (112 km)
- Non-attainment region for SO2 and PM10

Background

In 1996, three ramp meters were installed as part of a ramp widening project. The meters are currently used during the morning peak traffic hours. They operate independently, are monitored from a temporary traffic management center location, and are capable of being integrated into the intelligent transportation system. Currently, video detection equipment is used to determine existing freeway occupancy and to set the meter timing rates. This system also can be activated remotely by transmitting compressed digital images through telephone lines. This technique helps prevent slowdowns and "stop-and-go" traffic on the highway.

Effects

Traffic is moving more quickly and smoothly through areas that previously experienced significant congestion problems, and accident rates have decreased. A study of the benefits of ramp meters is currently being conducted by tabulating accident data from before and after installation. A total of 18 additional ramp meters is planned for installation.

Public Perception

The general response has been favorable and, with geometrical improvement to the ramps, citizens readily accept the ramp meter installations.

Contact Information: David Kinnecom, Traffic Management Engineer
Traffic Safety Office
Utah Department of Transportation
(801) 965-4910

Reference

Utah Department of Transportation. "So What's This Ramp Metering All About Anyway?" (August 1996).

OTHER EXAMPLES/CITIES WITH RAMP METERING

Reference for the following cities

Jacobson , E. L., and Jackie Landsman. "Case Studies of U.S. Freeway-to-Freeway Ramp and Mainlane Metering and Suggested Policies for Washington State." *Transportation Research Record 1446.* National Academy Press: Washington D.C. (October 1994): 48-55.

Los Angeles, CA

- Larger number of typical ramp metering with few freeway-to-freeway meters
- No high occupancy vehicle bypass lane on ramps
- Without ramp metering, extensive queuing of traffic occurs

Minneapolis, MN

- Largest freeway-to-freeway ramp metering operation in the United States
- Metering initiated by Minneapolis DOT, in conjunction with other roadway improvements

Seattle, WA

- Metered HOV lane

CHAPTER 3
VARIABLE MESSAGE SIGN

	Cleveland, OH	Houston, TX	Laredo, TX	Madison, WI	Cheyenne, WY
Implementation Date	1994	1983	Not Available	1989	1973
Implementation Cost (thousands of dollars)	$34	$75-$100	$150-$200	$32	$30
Freeway Miles (km)	113 (181)	529 (846)	5 (8)	25 (40)	37 (59)
Population (1990)	2,202,069	3,321,926	133,239	367,085	50,008 [1]
Sq. Miles (Sq. km)	2,708 (7,013)	5,921 (15,336)	3,357 (8,695)	1,201 (3,114)	19 (49)
Population Density (pop. per sq. mi.) (pop. per sq. km)	813 (314)	561 (217)	40 (15)	306 (118)	2,632 (1,021)

[1] Population of city proper

A variable message sign (VMS) offers the ability to effectively communicate traffic information to motorists. Technological advances allow the information provided on VMS to be changed quickly to match the immediate traffic conditions. The types of information that can be shown on these signs can include anything from minor slow downs due to spot maintenance of the roadway to a complete roadway closure caused by a major incident. VMS equipment is often an element of a region's Intelligent Transportation System (ITS). In some cases, a VMS is a simple portable sign to display information on a section of roadway. Permanent VMSs have the capability of displaying information that has been input from a central traffic information center.

Cleveland, OH

PORTABLE AND PERMANENT SIGN PROGRAM

Highlights

- Sponsors: Federal and State
- Cost: $34,000 per sign
- Funding: Federal and State
- Primary Services: one permanent and two portable variable message signs
- Non-attainment region for PM10 and lead

Background

The Cleveland area has been using variable message signs for four years. The signs were purchased through a federal and state project. The idea behind the purchase of the signs was that they might be used on small projects, such as spot maintenance and small construction projects. In the future, the VMS will become a part of a citywide ITS system and provide information of roadway incidents.

Effects

The VMS was found to be more effective at informing the public of traffic tie-ups. VMS is supplemented with highway advisory radio (HAR) as well to provide drivers with possible route detours. The combination of systems has provided many oversized vehicles with crucial information about downstream hazards that these large vehicles find hard to negotiate. They also receive information on possible route detours.

Public Perception

None available

Contact Information: Dennis O'Neil, Transportation Engineer
District 12
Ohio Department of Transportation
(216) 581-2333

Houston, TX

VARIABLE MESSAGE SIGN (VMS)

Highlights

- Sponsors: State as part of Congestion Mitigation and Air Quality program
- Cost: $75,000 to $100,000
- Funding: State of Texas
- Primary Services: 75 Permanent signs in six-county district
- Non-attainment region for ozone

Background

The first Variable Message Sign (VMS) in the Houston area was installed 1983. The signs were used by the Metropolitan Transit Authority of Harris County (METRO) to coordinate and communicate traffic information experienced in the HOV lanes. This information included advance notice of accidents, incidents, special events, traffic levels, and road construction. Half of the VMS equipment is now used on the freeway general purpose lanes, while the other half is used specifically to communicate information to HOV motorists. By simply typing in a new message, the signs have the capability to display the time of day or flash a message. The warnings may be in the form of a direct message to the motorist notifying them of a problem ahead and possible alternative routes. Signs are synchronized by a master controller (computer) which commands and also alerts the department of any malfunctions in the equipment. The district has three or four different brands of signs, with each sign having its own associated controller.

Effects

The signs have provided motorists with advance warning of traffic problems, giving them opportunities to plan alternative routes.

Public Perception

None available

Contact Information: Ken Paradowski
CTMS
Texas Department of Transportation
(713) 802-5845

Laredo, TX

VARIABLE MESSAGE SIGN (VMS) PROGRAM

Highlights

- Sponsor: State
- Cost: $150,000-$200,000
- Funding: State
- Primary Services: Two permanent and two portable flap variable message signs
- Attainment region

Background

The variable message sign (VMS) system in Laredo is an instrumental tool in communicating to motorists crossing the international border into Mexico, as well as to commercial truck traffic. VMS provides information on road conditions, road closures, and alternate routes.

Effects

Due to its key location on the busy US/Mexico border, it is important that Laredo provide assistance for motorists, especially during holiday or seasonal travel times. Traffic information on the bridges of southbound I-35 has proven very important to those traveling in Laredo. The activation and programming of VMS signs has provided a great deal of flexibility in the reporting of this traffic information.

Public Perception

Officials in Laredo have reported receiving daily calls supporting the use of variable message signs.

Contact Information: Fitzgerald Sanchez, Director of Operations
Laredo District
Texas Department of Transportation
(956) 712-7443

Madison, WI

VARIABLE MESSAGE SIGN (VMS)

Highlights

- Sponsor: State
- Cost: $32,000
- Funding: State
- Primary Services: Signs with 12 flap/flip disk, Solid matrix light emitting diode (LED)
- Attainment region

Background

In 1989, a federal grant allowed the City of Madison to acquire equipment machinery to help respond to the existing public demand for better information regarding roadway traffic conditions. VMS offered a way to communicate traffic information quickly and reliably. The VMS in use in Madison allows the signs to be changed with a simple phone call.

Effects

VMSs have provided important traffic information, especially near construction zones. Research results indicate that 74% of the public read VMS signs.

Public Perception

None available

Contact Information: Jeff Gustafson, Traffic Electrician
Traffic and Electrical Office
Wisconsin Department of Transportation
(608) 246-3275

Cheyenne, WY

VARIABLE MESSAGE SIGN (VMS)

Highlights

- Sponsor: State
- Cost: $30,000 per sign
- Funding: State
- Primary Services: Six permanent overhead and one roadside variable message sign
- Attainment region

Background

The Wyoming Department of Transportation (WDOT) uses VMSs mainly to advise motorists of adverse weather conditions, road construction, and supplemental traffic information. Information regarding road conditions is provided to the District's radio operator from law enforcement agencies and WDOT road maintenance crews. The information is then radioed to the VMS for display. Alternate route information is not currently provided on VMS.

Effects

In a study performed by the University of Wyoming, research was conducted concerning the effectiveness of variable message signs in warning motorists of accidents or the possibility of encountering adverse weather conditions. Dynamic message signs proved to be instrumental in providing timely and specific roadway information to motorists. The VMSs in Cheyenne have significantly sped up the provision of accurate information to motorists.

Public Perception

The public has indicated a liking for the information provided by variable message signs. Some motorists, however, indicated that the messages are not changed as quickly as they should be.

Contact Information: Randy Griesbeck, District Traffic Engineer
District 1
Traffic Division
Wyoming Department of Transportation
(307) 777-4495

Dr. Eugene Wilson
University of Wyoming
(307) 766-3202

CHAPTER 4
INCIDENT MANAGEMENT

	Phoenix, AZ	Indianapolis, IN	Charlotte, NC	Portland, OR	Seattle, WA
Implementation Date	October 1998	1991	1998	March 1997	Not Available
Implementation Cost (thousands of dollars)	$35,000	Not Available	$500	$750	$7,900
Freeway Miles (km)	127 (203)	35 (56)	28 (45)	81 (130)	240 (384)
Population (1990)	2,238,498	1,380,491	1,162,140	1,515,452	2,033,128
Sq. Miles (Sq. km)	14,574 (37,908)	3,523 (9,125)	3,379 (8,750)	3,743 (9,694)	4,216 (10,920)
Population Density (pop. per sq. mi.) (pop. per sq. km)	154 (59)	392 (151)	344 (133)	405 (156)	482 (186)

Incident management is one form of implementing an Intelligent Transportation System (ITS). The ultimate goal of ITS is to reduce congestion through surveillance and management of incidents. Freeway incident management involves the pre-planned coordination of personnel, equipment, and materials, with the goal of reducing the time it takes for incident detection, response, and clearance. Traffic incidents include traffic accidents, abandoned or stalled vehicles, debris on the roadway, and other disturbances to the traffic flow. All of these events can cause delays to occur on the roadway. Incident management programs utilize various combinations of strategies and technologies in achieving the goal of clearing the roadway. Some of these strategies include roving service vehicles, motorist aid call boxes, dedicated cellular phone lines, incident management teams, motorist information systems, traffic diversion techniques, and alternate route identification. Incident management technologies include traffic surveillance systems which incorporate mainline detectors, variable message signs, closed-circuit television, advanced communications systems, and highway advisory radios.

Phoenix, AZ

INCIDENT MANAGEMENT

Highlights

- Sponsors: Federal and State
- Cost: $35,000,000 in implementation cost, $150,000 in annual operating cost
- Funding: Federal and State
- Primary services: Road sensors, electronic signs, cameras, Internet
- IM freeway miles: 50 (80 km)
- Non-attainment region for ozone, CO, and PM10

Background

During the rapid growth of the Phoenix area, residential and industrial expansion has increased demand for the transportation system. An Intelligent Technology System (ITS) was introduced to improve traffic and quality of life in Phoenix, while reducing travel time. Currently, there are 50 miles (80 km) of freeway within the Independent Incident Management System. As of October 1998, the system was totally integrated and information was available to the entire municipal system. An additional 14 miles (22 km) of freeway is to be added to the coverage area of the system. The service was implemented by including the following elements:

> <u>Detection/verification</u>: AZTECH uses a network of equipment detectors, including closed circuit television every 1/3 mile (1/2 km) to detect congestion and identify incidents. Once incidents are identified, response teams are notified of accidents.
>
> <u>Response/clearance</u>: Emergency response personnel and partnering agencies are notified, and the freeway changeable message signs provide information on alternate routes. The system is monitored 24 hours per day and seven days per week.
>
> <u>Recovery/Information</u>: The changeable electronic signs alert drivers to delays, suggest alternate routes, and divert traffic between freeways and smart corridors.

Effects

Advanced communication technology links operation centers for the state, county, cities, transit, and emergency services. In-vehicle devices receive broadcast information that has been relayed over the system. These devices include digital telephones, alphanumeric pagers, and FM radio bands. The goal is to develop an infrastructure of private entities that will establish devices to inform the public. At present, this goal is being achieved. That is, travelers can purchase computerized devices and service to receive personalized traffic reports. These devices contribute to a reduction in travel time compared to what would be experienced if the traffic information was not available.

Public Perception

None available

Contact Information: Jim Decker, Project Administrator
Arizona Department of Transportation
(602) 340-8250

Reference

ITS EDL. "Technology Based Transportation Solutions: The Model Deployment Initiative." FHWA Technical Reports and Papers. (August 1997): 1-8.

Indianapolis, IN

HOOSIER HELPERS

Highlights

- Sponsors: Federal and State
- Cost: Not available
- Funding: Federal and State
- Primary services: Vehicles equipped with hand tools, radio, phone, and touch screen computers
- IM freeway miles: 35 (56 km)
- Non-attainment region for lead

Background

The Indianapolis incident management program does not operate like the typical programs originating from a Traffic Management Center (TMC). "Hoosier Helpers" operates with driving patrol vehicles along the freeway system and keeping alert for trouble on the roadway. "Hoosier Helpers" began as a part-time operation in 1991; however, in 1996, it was expanded to a 24 hour a day service. The service was implemented by including the following elements:

> Detection/verification: "Hoosier Helpers" patrol the highway looking for disabled or abandoned vehicles, crashes, debris, and pedestrians needing assistance.
>
> Response/Clearance: Each "Hoosier Helper" patrols 15 to 20 miles (24 to 32 km) of interstate from 4:00 am to 7:00 pm. The freeways are patrolled less frequently during the evening and early morning hours. Traffic accidents are the major focus for the "Hoosier Helpers."
>
> Recovery/Information: Highway Advisory Radio, Variable Message Signs, and Automated Traffic Information Systems are used to report traffic problems and information. Also used is the call-in system of the state police.

Effects

More than 3,000 people have benefitted from the service. The Hoosier Helper program has experienced tremendous benefits by keeping the roadways clear of incidents compared to the operational cost of the program. The motoring public contributes the truest and timeliest information. This program offers the advantages of information regarding incident location, type, cause, anticipated duration, direction of affected roadway, expected consequences, and possible alternative routes.

Public Perception

None available

Contact Information: Dan Shamo, Program Engineer
Intelligent Transportation System (ITS),
Indiana Department of Transportation
(317) 232-5523

Charlotte, NC

NCDOT INCIDENT MANAGEMENT PROGRAM

Highlights

- Sponsors: Federal and State
- Cost: $500,000 (annually)
- Funding: Federal and State
- Primary services: Over 14,000 people have benefitted from the service
- IM freeway miles: 28 (45 km)
- Attainment region

Background

Until recently, there were no provisions or guidelines in the Charlotte area for detouring traffic around accidents or to inform motorists of an incident on the roadway. This situation, and the problems created as a result of increased traffic congestion, freeway rehabilitations, and road widening projects, prompted the development of an incident management program. The service was implemented by including the following elements:

> <u>Detection/verification</u>: Electronic incident detection and verification systems. Operators are alerted of traffic slow downs by detectors along the freeway. Verification of conditions occur through closed circuit television.
>
> <u>Response/clearance</u>: Motorist assistance patrols are called to verify and assess incidents, and to provide traffic control at the incident sites.
>
> <u>Recovery/Information</u>: The traffic flow is kept moving by rerouting traffic. In addition, if traffic is required to detour to access roads, the signal timing is adjusted in order to keep the traffic flowing through the intersection. After the emergency is resolved, the signal timing is allowed to return to normal settings.

Effects

The NCDOT Incident Management Program has evolved from a resolution to reduce incident related delays in Mecklenburg County to a statewide initiative to manage freeway traffic. Other benefits include reduced accident duration, reduced disabled vehicle duration, reduced parked vehicle accidents, and reduced accident rates.

Public Perception

There has been an improved perception of the department and its goals and operations.

Contact Information: Chris Spencer, Freeway Management Engineer
Traffic Engineering
North Carolina Department of Transportation
(919) 250-4151

Portland, OR

COMET

Highlights

- Sponsors: Federal and State
- Cost: $750 ,000 in start-up cost and $1,500,000 (annually)
- Funding: State gas tax
- Primary Services: traffic monitoring with surveillance equipment, variable message signs, radio, traffic signal and ramp meter changes
- IM freeway miles: 81(130 km)
- Attainment region

Background

In March 1997, an effort was launched to reduce congestion and protect the quality of life and economy in Portland. The Oregon Department of Transportation opted to change the operation and use of the transportation system by implementing the following elements:

> Detection/verification: The TRANSPORT system provides traffic monitoring and surveillance equipment to identify incidents and accidents.
>
> Response/clearance: Once an incident is confirmed, predetermined responses are activated. Actions are taken to notify police, fire and rescue, Corridor Management Team (COMET), towing, and news media.
>
> Recovery/Information: Advising motorists through variable message signs, radio, signal and ramp meter changes.
>
> The COMET incident response program is one element of a major transportation system. COMET response crews are dispatched to incidents and help direct traffic and clear the scene.

Effects

TRANSPORT compliments future improvements to light rail, commuter rail, transit, and highway systems. The added information that this system provides forewarns travelers of areas with heavy congestion. It is also reported that the public transit service is enhanced, metropolitan livability is increased, and economic viability has been maintained.

Public Perception

Typical public responses are quite favorable. The city reports such quotes as: "This [COMET Incident Management] is the best thing the Highway Department has ever come up with. It's a good service for everyone."; "this is the best idea since popcorn"; and ". . .add more vehicles. This is a wonderful service."

Contact Information: Dennis Mitchell, Region Traffic Engineer
Traffic Division
Oregon Department of Transportation
(503) 731-8218

Reference

Rippe, Trudy. "A New Way of Thinking." *TRANSPORT-Transportation Portland.* Produced by the Oregon Department of Transportation, Region 1, Traffic Section. (December 1997).

Seattle, WA
INCIDENT MANAGEMENT

Highlights

- Sponsor: State
- Cost: $17,900,000 (start-up)
- Funding: State
- Primary services: Cable television, variable message sign, highway advisory radio, Internet
- Freeway miles: 240 (384 km)
- Attainment region

Background

The mission of the Seattle incident management program is to help travelers make informed choices as they plan and make their trips. The overall goal is to improve traffic and transit management systems to operate as safely and efficiently as possible. Incident management was created to help the growing transportation demands of the population while contributing to the development of a transportation infrastructure that will accommodate future capacity needs. The service was implemented by including the following elements:

Detection/verification: SMART TREK

Response/clearance: The introduction of an enhanced 9-1-1 system provides the ability to send the location of an incident quickly to a response center, thereby helping to speed emergency response personnel to a location where lives may be at stake. Incident response vehicles equipped with global positioning system equipment can monitor incident locations and assist with dispatching.

Recovery/Information: The availability of highway advisory radio (HAR) and variable message signs (VMS) helps to communicate to motorists the current traffic situations and possible alternative routes to travel.

Effects

Smart-Trek, with the help of Microsoft, has introduced on-line, real-time, customized traffic information that includes travel times for alternate routes.

Public Perception

None available

Contact Information: Pete Briglia
Washington State Department of Transportation
(206) 543-3331

References

ITS EDL. "Technology Based Transportation Solutions: The Model Deployment Initiative." FHWA Technical Reports and Papers. (August 1997): 1-8.

Smart Trek. "Smart Trek - Real-Time Traffic Information for the Puget Sound Region." Accessed: 6 November 1998. <http://www.SmartTrek.org>

OTHER EXAMPLES/CITIES WITH INCIDENT MANAGEMENT PROGRAMS

Houston, TX (TranStar)

- Ramp metering, motorist assistance, variable message signs, and traveler information
- Internet Web site
- No research studies or travel surveys conducted to date to estimate the benefits

Reference

Goolsby, Gene, and Michael Ogden. "Estimation of Benefits of Houston TranStar-1997." Texas Transportation Institute: Houston, TX. (1 July 1998).

Detroit, MI

- Advanced traffic control system at 200 intersection
- Installation of traffic sensors, closed circuit televison cameras, ramp meters, and variable message signs

Reference

Beaubien, R.F., and Kunwar Rajendra. "Metro Detroit's Incident Management Program-Applying ITS Technology." *ITE Journal.* Vol.65, No.4. (April 1995): 19-24.

Philadelphia, PA

- Evaluation of applications of advanced information processing, sensors, displays, and communication technology for traffic and incident management
- Education of motorists to acquaint them with facilities equipped with advanced traffic management systems

Reference

Gangisetty, R., and D.W. May. "Traffic and Incident Management System for I-95 in the Philadelphia Area." *ITE Journal.* Vol.65, No.2. (February 1995): 37-44.

CHAPTER 5
TRANSPORTATION MANAGEMENT CENTERS

	Atlanta, GA	Minneapolis, MN	Providence, RI[1]	San Antonio, TX	Milwaukee, WI
Implementation Date	1996	1991	1999	1995	1992
Implementation Cost (millions of dollars)	$11	$40	Not Available	$32	$8.5
Freeway Miles (km)	49 (78)	330 (528)	52 (83)	109 (174)	80 (128)
Population (1990)	2,959,500	2,538,776	1,134,350	1,324,749	1,432,149
Sq. Miles (Sq. km)	6,126 (15,867)	5,051 (13,083)	612 (1,584)	3,327 (8,617)	1,460 (3,781)
Population Density (pop. per sq. mi.) (pop. per sq. km)	483 (187)	503 (194)	1,854 (716)	398 (154)	981 (379)

[1] System under development

Where, when, and how people travel can impact, or significantly lessen, congestion on an area's roadways, highways, or city streets. These are issues that many cities around the country are addressing through management of the transportation system. Transportation Management Center (TMC), Traffic Management Operation (TMO), or Traffic Operation Center (TOC) are terms used interchangeably to denote systems developed to address growing congestion experienced on roadways. Operated under the umbrella of intelligent transportation systems (ITS), transportation management is the foundation of recent innovations in transportation. In TMC facilities, one can find technological advances and improved operations in metropolitan areas across the country.

Real-time information is available within a TMC, allowing operators, planners, and engineers to interact and make immediate, informed decisions regarding transportation. Information about incidents, accidents, road and bridge closures, and emergency situations are gathered through equipment, such as loop detectors and closed circuit television (CCTV), and then disseminated to the public with the push of a button.

The equipment types and technological advances are multi-faceted, and the array of equipment makes communication simpler. Automated congestion detection, automated response plans, freeway ramp meters, traffic signals, and video cameras can all be used to support and control traffic and incidents from within the TMC. This equipment helps reduce the time required to detect and respond to congestion-causing incidents by allowing immediate identification of a problem and determining the proper response.

TMC personnel, along with agencies such as state DOTs, local agencies, and emergency response teams, coordinate and develop plans to use this technology in order to quickly provide important information to motorists. Variable message signs and highway radio advisories release incident information, alternative routes, or possible detours to aid motorists in their daily commute.

This page intentionally left blank.

Atlanta, GA
NAVIGATOR

Highlights
- Sponsors: Federal, State, and Atlanta Regional Commission
- Cost: $11,000,000 start-up
- Funding: Federal and State
- Primary Services: Automated incident detection; 317 fixed black/white TV units, 56 radar units, 400 video monitors, 25 variable message signs, highway advisory radio, five ramp meters, helicopter-mounted gyroscope camera
- TMC freeway Miles: 49 (78 km)
- Non-attainment region for ozone

Background

Atlanta and its 20-county metropolitan area are greatly dependent on the transportation management system due to the rising construction costs, increasing land prices, and decreasing transportation funds associated with the construction of new roadway facilities. This has led to the development of the Transportation Management Center known as "NAVIGATOR." The center is linked with the TCC (a combination of cities and counties that surround Atlanta) and the City of Atlanta in order to monitor over 220 miles (352 km) of roadways. Each of the cities and counties in the TCC are able to easily share traffic information due to the "NAVIGATOR" system. A new campaign to promote public awareness and educate the public about the system will soon be underway. A new web site is also available to give the traveling public easy access to traffic information gathered by the "NAVIGATOR." The on-screen information updates every five minutes to provide the most recent changes to traffic on the highway. Motorists can view this current travel information, including camera images and VHS messages, in list or graphic form displayed on a metropolitan area map. The map allows for a complete overview of the traffic situation across the area or a close-up view of a specific point on the map.

Effects

As of yet, no studies have been completed which would display the effectiveness of this particular system.

Public Perception

One user responded by saying, "[Changeable Message Signs] may help relax some of the people, . . ."

Contact Information: Kim Law, Public Information Specialist
Media Office
Georgia Department of Transportation
(404) 635-8017

Reference

Georgia ITS and Transportation Center. NAVIGATOR. Produced by the Georgia Department of Transportation. (1998).

Minneapolis, MN
TRANSPORTATION MANAGEMENT CENTER

Highlights
- Sponsor: Not available
- Cost: $40,000,000 (from 1970-1995)
- Funding: Federal (90%) and (10%) from Interstate fund
- Primary Services: 380 ramp meters, 156 closed circuit television cameras, communication system with 135 miles (216 km) of fiber optic cable, 400 field microprocessors, 54 variable message signs (VMS), 3,000 traffic detectors, and information via radio programming and cable TV, telephone call-in capability, and Web-site
- TMC freeway miles: 203 (325 km)
- Non-attainment region for CO and PM10

Background

In 1972, the Minnesota DOT Traffic Management Section saw the need to create a central control facility to house staff and equipment to operate two new transportation systems in the area. The system on I-94 used loop detectors to identify incident occurrences. Drivers were warned of flow restrictions, and ramp meters were used to control vehicles entering the system. The central control system grew into the Urban Corridor Demonstration Project, which combined the advantages of freeway traffic management and the area's first "Freeway Flyer" express bus. In 1989, a 10-point plan was developed to reduce congestion in the metropolitan area. From this, Guidestar was implemented by the DOT in 1991 as an ITS program to further expand and enhance the traffic management program.

The goal of Guidestar is to optimize traffic flow and highway safety in metropolitan area freeway corridors with the specific objectives of minimizing accident rates, as well as the magnitude and duration of congestion. Traffic volumes that can be accommodated at freeway bottleneck locations provide support for special events, road construction, and highway maintenance activities.

Effects

The reduction in congestion has resulted in an increase in average peak hour speeds from approximately 35 mph (56 kph) to 50 mph (80 kph), or more. It is estimated that the reduction in congestion also results in the prevention of about 1,200 automobile accidents per year on metropolitan area freeways.

Public Perception

None available

Contact Information: Glen Carlson
Transportation Management Center
Minnesota Department of Transportation
(612) 341-7500

Reference

Minnesota Department of Transportation. "Mn/DOT TMC - Program Information." Accessed: 6 November 1998. <http://www.dot.state.mn.us//tmc/program/index.html>

This page intentionally left blank.

Providence, RI
TRANSPORTATION MANAGEMENT CENTER

Highlights
- Sponsor: Federal and State
- Cost: $1,950,000 start-up
- Funding: Federal and State
- Primary Services: Automated incident detection, variable message signs, closed circuit television, highway advisory radio (under construction)
- TMC freeway Miles: 52 (83 km)
- Non-attainment region for ozone

Background

The Rhode Island Department of Transportation (RIDOT) expects to make its highway system more efficient than present through the use of an intelligent transportation system (ITS). The RIDOT ITS will be developed to provide real-time transportation information which will make the roadway safer and more efficient. The system will also expedite interagency and intra-agency cooperation and improve energy efficiency. This project is part of a goal to manage traffic within the entire Northeast Corridor, which extends from Virginia to Maine. This will be achieved by the integration of the Information Exchange Network Corridor Coalition members (this corridor is one of the three corridors defined as a top priority in relation to transportation issues in the United States). If the system works properly, motorists traveling through Rhode Island will be able to learn of traffic problems in Massachusetts and Connecticut, and plan alternate routes or alter the timing of their trip.

Effects

These cannot be ascertained as of yet, due to the fact that the system has not been fully completed.

Public Perception

None available

Contact Information: Cynthia Levette
Traffic Information Center
Rhode Island Department of Transportation
(401) 222-2481

Reference

Farynk, Linda. "Rhode to the Future." *Traffic Technology International: Moving Ahead with Safety-Advanced Vehicle Control Comes of Age.* (July 1998): 38.

San Antonio, TX

TRANSGUIDE

Highlights

- Sponsors: Federal and State
- Cost: $32,000,000 (Phase I)
- Funding: Federal and State
- Primary Services: Inductive loops, 59 cameras, 359 lane control signals, 51 variable message signs
- TMC freeway Miles: 109 (174 km)
- Attainment region

Background

San Antonio is the ninth largest city in the nation and the third largest in Texas. ITS was introduced as a way to control and manage traffic in this ever-growing metropolis. On July 26, 1995, San Antonio initiated an effort to effectively identify traffic delays due to congestion, accidents, or incidents by using a system that would correctly detect and promptly identify problems. The system, known as TRANSGUIDE, uses road sensors and remote control cameras to detect an incident within two minutes of its occurrence. An incident is verified, and police personnel are dispatched to provide the required assistance. The system can determine which one of 32,000 pre-programmed traffic solutions must be implemented to keep traffic flowing. All affected traffic control devices can be changed within 15 seconds from the time that an incident is verified. The traffic solution chosen by the system will suggest where to reroute the traffic and reprogram VMS to make the appropriate changes to the lane signals to prevent a traffic back-up. In addition, if traffic has to detour to the access roads, the system connection to the traffic signal allows for a longer "green" time to keep the traffic moving. After the emergency is resolved, the system automatically returns devices to their normal settings.

Effects

Driver understanding and utilization of the system has enhanced performance of the transportation system, especially in the area of safety. The system has demonstrated a 15% decrease in the number of overall traffic accidents. The average response times have improved 19% for minor accidents and 21% for major incidents, while staffing levels have remained unchanged. The results of a test simulation revealed an average travel-time delay savings of 700 vehicle-hours and a reduction in fuel consumption of 2,660 gallons (10,068 liters) for a major incident. This translates into an estimated annual savings of $1,650,000.

Public Perception

One user indicated that, ". . .[VMS] allows more time to slow down, thus preventing accidents."

Contact Information: David Rodriguez, Operation Manager
Traffic Management
Texas Department of Transportation
(210) 731-5242

References

Henk, Russell H., Mariano Molina, and Patrick L. Irwin. "Before-And-After Analysis of Advanced Transportation Systems." TTI Research Report 1467-3. Texas Transportation Institute: College Station, TX. (September 1997).

Texas Department of Transportation. TRANSGUIDE, Technology in Motion. A technical video. (6 November 1997).

Milwaukee, WI
MONITOR

Highlights
- Sponsor: Not available
- Cost: $8,500,000 start-up
- Funding: Not available
- Primary Services: 90 ramp meters, 14 variable message signs, closed circuit television, highway radio advisories
- TMC freeway Miles: 80 (128 km)
- Non-attainment region for ozone

Background

In 1978, the regional planning committee encompassing Milwaukee recommended an area-wide freeway traffic management system (TMS). The plan called for the design and development of a system to enhance freeway operations, facilitate increased vehicle occupancy rates, improve safety, and address the transportation needs of the future. The TMS was the only alternative due to the fact that there was a diminished ability to build additional freeways. This led to the preliminary design of "MONITOR." The MONITOR system is being implemented in stages and will ultimately cover 130 miles (208 km) of freeway. After MONITOR is fully implemented, it will be required to perform additional traffic management functions in areas such as the Gary-Chicago-Milwaukee Corridor, signal integration, and incident management initiatives. The system will have information on highway construction projects, transportation plans, and corridor studies in a shared database which can be updated weekly. This provides the opportunity for interested agencies to submit information to other agencies that may help the overall flow of traffic.

Effects

This tri-state ITS program allows MONITOR to serve as a regional hub (or clearing house) for traveler information, real-time transit and traffic information, tourist information, and incident management for the tri-state area. Additionally, the MONITOR system will be used in education programs and strategies for informing motorists of how to avoid incidents, what to do in the event of an incident, and how to make use of the available technology in order to avoid an incident.

Public Perception

None available

Contact Information: John Corbin, Freeway Operations Engineer
Traffic Operations Center
Wisconsin Department of Transportation
(414) 227-2150

References

JHK & Associates, Inc. Milwaukee Area Freeway Traffic Management System. Project I.D. #1000-42-02. (December 1995).

WisDOT, Traffic Incident Management Enhancement. T.I.M.E. Executive Summary. (June 1998).

OTHER EXAMPLES/CITIES WITH TRAFFIC MANAGEMENT CENTERS

Reference for the following cities

Meagher, Joan., ed. "Traffic Operations Centers." *The Urban Transportation Monitor.* Vol. 12, No. 2. (30 January 1998): 6-8.

Columbus, OH

- 865 signalized intersections with 16 having preemption capability
- Future use of ramp metering
- Two radar/microwave detectors, 18 environmental sensors, 24 CCTV cameras
- Information distribution via media (radio, TV, press)
- Capital cost: $800,000; operational and maintenance cost: $348,000/year

Portland, OR

- 60 ramps with ramp metering (1998)
- 60 sites with inductive loop detectors, 6 environmental sensors, 40 CCTV cameras
- Information distribution via radio dispatch, VMS, paging
- Capital cost: $750,000; operational and maintenance cost: $1,500,000/year

Orlando, FL

- 400 signalized intersections with 100 having preemption capability
- 800 inductive loop detectors
- Capital cost: $385,000; operational and maintenance cost: $321,000/year

Charlotte, NC

- 35 inductive loop detector stations, 26 radar/microwave detectors, 26 CCTV cameras
- Capital cost: $3,000,000; operational and maintenance cost: $500,000

SECTION 2

HIGH-OCCUPANCY VEHICLE SYSTEMS

CHAPTER 6
HIGH OCCUPANCY VEHICLE LANES

	Phoenix, AZ	Minneapolis, MN	Long Island, NY (Nassau/Suffolk Co.)	Dallas, TX	Seattle, WA
Implementation Date	1995	1993	1994	1991, 1996, 1997	1991
Implementation Costs (millions of dollars)	$52 (Built as part of other construct.)	$17.3	$107 (8-mile (13 km) section, completed in 1998)	$12.2 (I-30) $7 (I-35E) $16.3 (I-635)	$7.6
Freeway Miles (km)	54 (86)	330 (528)	720 (1,152)	579 (926)	240 (384)
Population (1990)	2,238,498	2,538,776	2,609,212	2,676,248	2,033,128
Sq. Miles (Sq. km)	14,574 (37,908)	5,051 (13,083)	1,198 (3,103)	6,186 (16,024)	4,216 (10,920)
Population Density (pop. per sq. mi.) (pop. per sq. km)	154 (59)	503 (194)	2,178 (841)	433 (167)	482 (186)

High-occupancy vehicle lanes, also known as HOV lanes or carpool lanes, are found in larger metropolitan areas throughout the country. HOV lanes are implemented with varying elements, but all work to alleviate congestion by reducing the number of single occupant vehicles (SOV). HOV lane requirements vary, with some requiring two or more passengers (2+ HOV) per vehicle, while others require three or more passengers (3+ HOV). It is also common to allow motorcycles with only 1 person to drive in HOV lanes. Some jurisdictions prohibit trucks over certain threshold weights from driving in HOV lanes. One such example is the I-35 HOV facility in the Dallas area. Transit agencies, some of which actually operate HOV facilities, include HOV lanes as elements of bus routes. The physical separation of HOV lanes from general purpose lanes varies among facilities, even within jurisdictions. Wide, painted stripes, with no physical barriers are the buffer separation that is provided for some facilities. Other HOV lanes are separated by physical barriers that range from flexible pylons to concrete barriers. Some concrete barriers are actually moveable by "zipper" machines, allowing the HOV lane to be moved from one side of the freeway to another. Benefits of using HOV lanes include travel time savings, increases in transit use, and the overall increased capacity of the highway facilities for both HOV lanes and general purpose lanes. Some HOV lane person per vehicle requirements are enforced only during the peak periods, while others are enforced 24 hours per day.

Phoenix, AZ

<u>I-10</u>

Highlights

- Sponsors: FHWA and state
- Cost: $42,000,000 (built in segments as part of other construction on I-10)
- Funding: FHWA
- Primary Services: 27.1 miles (43 km), barrier-separated
- Freeway Miles: 54 (86 km)
- Non-attainment region for ozone, CO, and PM10

Background

HOV lanes are available in Phoenix on Interstate-10. The HOV system includes 27 miles (43 km) of freeway. New freeway construction and freeway reconstruction is now planned with the inclusion of HOV lanes. By the year 2000, Phoenix plans to have a total of 40 miles (64 km) of freeways with HOV facilities. The initial implementation of HOV lanes was only for use by vehicles with 3+ persons. This restriction was later reduced to 2+ persons in order to increase the HOV lane utilization.

Effects

The HOV lanes are most effective during periods of high congestion on the adjacent general purpose lanes. These priority lanes operate at uncongested speeds, even during peak times. The HOV facilities were evaluated based on the priority-lane effectiveness for the variables of automobile occupancy and vehicle occupancy. The occupancies on priority lanes are considerably higher than those of the adjacent nonpriority lanes. "Before and After" studies were not available for this facility since the HOV lanes were constructed with new freeway segments. HOV freeway automobile occupancy rates are greater than facilities without HOV lanes due to a possible shift in driving habits. Information from the Arizona Department of Public Safety indicates that the HOV lanes are experiencing only 25% to 45% of the vehicles that it is capable of handling. The Arizona Department of Transportation is in the process of developing methods for educating the public about the existence and benefits of HOV lanes.

Public Perception

None available

Contact Information: Bill Haden, Special Assistant to the Director
Office of Privatization
Arizona Department of Transportation
(602) 255-7524

Reference

Poppe, Mark, David Hook, and Ken Howell. "Evaluation of High-Occupancy-Vehicle Lanes in Phoenix, Arizona." *Transportation Research Record 1446.* National Academy Press: Washington D.C. (October 1994): 1-7.

Minneapolis, MN

I-394

Highlights

- Sponsor: MnDOT, FHWA, Metropolitan Council, Metropolitan Transit Commission, Hennepin County, and the City of Minneapolis
- Cost: $17,300,000
- Funding: Federal and State
- Primary Services: 11 mile (17.6 km) facility with 3 miles (5 km) of reversible HOV lanes and 8 miles (12 km) of concurrent-flow HOV lanes
- Freeway miles: 330 (528 km)
- Non-attainment region for CO and PM10

Background

The construction of the I-394 HOV facilities was completed in 1992. This was a project to combine the funding for construction of freeways with construction of HOV lanes. This project was intended to maximize the freeway by encouraging car pooling and bus ridership in heavily congested highway corridors. The initial objectives of the project were to increase peak-hour transit modal split; improve level of service for carpools and vanpools; improve or maintain the existing level of service for mixed traffic; decrease the accident rate; achieve and maintain high-occupancy compliance, and construct a cost-effective HOV facility.

The facility was designed to integrate transit and highway facilities in order to maximize the use of HOV lanes by buses, carpools, and vanpools. The Minneapolis HOV lanes require 2+ persons per vehicle. The original HOV lane was a physically separated, single reversible lane in the median of Truck Highway 12 and eventually became the permanent HOV lanes being used today. An interim HOV lane was initially used to introduce the public to the HOV concept. This was done in hopes of an increased level of public support for car pooling and bus ridership. This also offered additional people-carrying capacity of the facility during the construction phase. The facility required an evaluation at four distinct times during construction to review the public's acceptance of the facility.

Effects

The actual performance of the HOV lane and level-of-service was higher than had been projected. A higher average speed on the facility was also noted. HOV use continues to increase during peak hours, whereas the mixed lane use appears to have peaked related to available capacity. Sharp increase in HOV lane usage accompanied the completion of major portions of the HOV lanes.

The vehicle occupancy rates for this facility increased from 1.15 persons per vehicle to 1.29 persons per vehicle over a 10 year period. There has been a 126% increase in transit ridership. The vehicle trips increased by 57%, and person trips increased by 72%. This increase in person trips occurred predominantly on the HOV lane.

Public Perception

Residents of Minneapolis and surrounding areas have indicated that the HOV lane availability has made their commute simpler. It has encouraged them to use public transportation more frequently. They have also indicated seeking out carpool and vanpools so that they can take advantage of the travel time savings that are possible in the HOV lane.

Contact Information: Robin Belemy, Communications and Marketing Specialist
Traffic Management Center
Minnesota Department of Transportation
1101 4th Ave. South
Minneapolis, MN 55404
(612) 341-7505

Reference

Pint, Allan, Charleen Zimmer, Joseph Kern, and Leonard Palek. "Evaluation of Minnesota I-394 High-Occupancy-Vehicle Transportation System." *Transportation Research Record 1494.* National Academy Press: Washington D.C. (July 1995): 59-66.

Long Island, NY

I-495

- Sponsor: NYSDOT
- Cost: $107,000,000 (2nd 8-mile (13 km) section, completed in 1998)
- Funding: NYSDOT
- Primary Services: 12 miles (19 km), painted buffer zone, concurrent
- Freeway Miles: 720 (1152 km)
- Non-attainment region for ozone, CO, and PM10

Background

The Long Island Expressway (I-495) had the first high occupancy vehicle (HOV) lanes in New York State for 2+ person vehicles. A 12 mile (19 km) section was opened in 1994, and the second 8 mile (13 km) section was opened in 1998. Upon completion of the facility in 2003, it will extend 41 miles (66 km) from the border of New York City to Suffolk County. The Long Island Expressway has been a major highway link in the New York City area since the 1940s. With the average daily traffic exceeding twice the design standard, the idea of adding lane capacity was proposed in the late 1980s. State transportation officials identified HOV lanes as an alternative to constructing additional lanes. Implementation of HOV lanes on the Long Island Expressway was preceded by a careful planning and marketing effort. The Long Island Expressway/HOV Task Force was formed in 1991 to facilitate cooperation between government agencies and the private sector in implementing and operation of the HOV facilities.

Effects

Traffic volumes, vehicle occupancy, and speeds were monitored using continuous count data and field observations in late 1994. The HOV lane volumes showed a noticeable increase during the peak periods at the facility. The person-carrying efficiency of the entire highway is measured by the average vehicle occupancy (AVO). Six months after the facility opened, there was a significant increase in volumes for the AVO, HOV and general purpose lanes combined. Vehicle speeds were significantly and consistently higher during the peak periods. The single largest speed difference recorded on one section of the facility saw vehicles in the HOV lanes traveling 41% faster than the adjacent general purpose lanes during the afternoon peak period. A 1997 survey indicated that the HOV lanes have encouraged more than 10,000 people on Long Island to begin ridesharing. Research of the first 12 mile (19 km) section was conducted to compare the third year of operation to its first year. The AVO and traffic volumes had a noticeable increase in just three years.

Public Perception

A survey of users and non-users was conducted in early 1995. The results indicated that both groups agree that the HOV lanes improved the traffic flow. Eight-seven percent of the users and 69 % of the non-users agreed with extending the HOV facilities to 41 miles (66 km) in length. Users of the HOV lanes reported that the HOV facilities saved them between six and 15 minutes in travel time. Over half of the users believed that the HOV lanes motivated people to join carpools. Over two-thirds of those surveyed in 1997 supported extending the HOV lanes.

Contact Information: Jack Donahue, Assistant to Regional Director
New York State Department of Transportation
Region 10
New York State Office Bldg.
Hauppauge, NY 11788
(516) 952-6632

References

Ugolik, Wayne, Nancy O'Connell, Jerome S. Gluck, and Atma Sookram. "Evaluation of High-Occupancy-Vehicle Lanes on Long Island Expressway." *Transportation Research Record 1554.* National Academy Press: Washington D.C. (1995). 110-120.

Bloch, Arnold, Margaret C. Jackson, Wayne Ugolik, and Mel Cooperman. "Marketing a High-Occupancy-Vehicle Lane in a Suburban Setting: Long Island Expressway Experience." *Transportation Research Record 1446.* National Academy Press: Washington D.C. (October 1994): 38-43.

Dallas, TX

I-30, I-35E NORTH, AND I-635

Highlights

- Sponsors: Texas Department of Transportation (TxDOT), Dallas Area Rapid Transit (DART)
- Cost: $12,200,000 (I-30), $7,000,000 (I-35E), and $16,300,000 (I-635)
- Funding: Federal (66.6%), TxDOT (16.7%), DART (16.7%)
- Primary Services: 35.4 total miles (57 km) of HOV lanes, barrier-separated, contraflow and buffer-separated concurrent flow
- Freeway miles: 579 (926 km)
- Non-attainment region for ozone and lead

Background

The first HOV facility in the Dallas area was the East R. L. Thorton Freeway (I-30), which opened in 1991. It uses movable barrier-separation for operation of the contraflow HOV lane. The Stemmons(I-35E) and Lyndon B. Johnson (I-635, or LBJ) Freeways' HOV lanes began operation in 1996 and 1997, respectively. These offered concurrent flow with buffer-separation from adjacent general purpose lanes. These facilities were implemented as short-term interim HOV projects by the Texas Department of Transportation (TxDOT) and Dallas Area Rapid Transit (DART) until permanent treatments could be funded. The Dallas HOV system is used to promote carpooling, vanpooling, and the use of mass transit. While there are no physical barriers on the Stemmons and LBJ facilities, ingress and egress to these HOV lanes is only permitted at specified locations. Transit police enforce this law.

Effects

Research indicates that the Stemmons and LBJ HOV lanes have more daily use than any other HOV facility in Texas. Use of the Stemmons HOV lanes is increasing at a rate of 5% per month. LBJ, Stemmons, and East R. L. Thorton Freeways have increased their person movement percentages by 12%, 26%, and 52%, respectively, with average vehicle occupancy rates increasing by at least 4% at each facility. Travel time savings in the HOV lanes is between 15 to 20 minutes per day. This may explain why carpools have doubled on each facility. The Stemmons Freeway has seen a carpool increase of 260%.

Public Perception

Public opinion concerning the HOV lanes has been favorable by both users and non-users. A survey conducted in 1994 showed that 66% of the freeway motorists thought that the East R. L. Thornton HOV lane was a good transportation improvement. Sixty-five percent of bus riders feel that the HOV lane is very important in their decision to ride the bus. The actual travel time is cut in half by using this facility.

Contact Information: Jacqueline Bell, Administrative Assistant II
Transportation Department
North Central Texas Council of Governments
(817) 608-2329

References

Skowronek, Douglas A. "Development of Interim HOV Lanes in Dallas." *1996 Compendium of Technical Papers for 66th Institute of Transportation on Engineers Annual Meeting.* (1996): 81-85.

Skowronek, Douglas A., Angela M. Stoddard, and Olyai Koorosh. "Operational Evaluation of Dallas Area Concurrent Flow HOV Lanes." *Proceedings of the Texas Section American Society of Civil Engineers Meeting.* (Spring 1998).

Regional Transportation Council, North Central Texas Council of Governments. Regional Transportation Council: Dallas Leads the Way in HOV for Texas. (1998).

Seattle, WA
I-5

Highlights

- Sponsor: Federal and State
- Cost: $7,600,000
- Funding: FHWA, Washington State Legislature
- Primary Services: I-5 mileage: (Southbound HOV: 7.7 miles (12 km), northbound HOV: 6.2 miles (10km)
- Freeway miles: 240 (384 km)
- Non-attainment region for PM10

Background

The development of HOV facilities in the State of Washington was focused on providing mobility choices to users of the transportation system. Specifically, the state wanted to decrease the number of vehicles on congested freeways by increasing the number of persons per vehicle. It was anticipated that this improvement would help provide travel time savings and safe travel options for high-occupancy vehicles.

The HOV lanes were first opened in Seattle in 1983. Initially, users were required to have a ridership of 3+ persons per vehicle. This ridership requirement was later decreased in 1992 to 2+ persons per vehicle. The 2+ persons per vehicle requirement for using HOV lanes is enforced 24 hours per day.

Effects

The success of the I-5 HOV facilities was measured by determining numbers for person throughput and vehicle occupancy. The success is also measured by making comparisons between HOV and general-purpose lanes, travel times, travel time reliability, and accident rates. The change from HOV lanes requiring 3+ persons per vehicle to users with 2+ persons per vehicle more than doubled the vehicle volumes in the HOV lanes. This also increased the number of persons using the HOV lanes by 35%.

Public Perception

The I-5 HOV lanes in the Seattle area have had a positive response by both users and non-users. Surveys of bus riders, carpoolers, and motorists indicated support of HOV lanes. A recent switch from 3+ to 2+ HOV lanes brought a mixed response from users. Although there continued to be a positive response for HOV lanes, there was an indication that users felt the switch caused an increase in travel times. A survey conducted by the Washington State Transportation Research Center (TRAC) at the University of Washington indicated that 64% of solo drivers and 87% of HOV lane users agree that HOV lane construction should continue.

Contact Information: Jerry Ayres, Coordinator, High Occupancy Vehicle Policy and High Capacity Transportation Demand Management Program
Transportation/ Public Transportation and Rail Division
Washington State Department of Transportation
(360) 705-7910

References

Turnbull, Katherine, Cyrus Ulberg, and Leslie Jacobson. "Evaluation of the Seattle I-5 North High-Occupancy Vehicle Lane 2+ Occupancy Requirement Demonstration." *Transportation Research Record 1394.* National Academy Press: Washington D.C. (1993): 32-41.

Washington Department of Transportation. "WSDOT Homepage." Last revised 5 November 1998. <http://www.wsdot.wa.gov/>

OTHER EXAMPLES/CITIES WITH HOV FACILITIES

Orlando, FL (Interstate-4)
- Concurrent flow/buffer-separated freeway right-of-way
- 30 miles (48 km) long

Reference
Fuhs, Charles A. "Preferential Lane Treatments for High-Occupancy Vehicles." Transportation Research Board. *NCHRP Synthesis of Highway Practice #185.* (1993): 86.

Seattle, WA (Interstate-5, State Route 520, and I-405)
- Buffer-separated freeway right-of-way
- 6 (9.6 km), 2.8 (5 km), and 6 miles (10 km) long, respectively

Reference
Meagher, Joan., ed. "Operational Characteristics of Selected Freeway/Expressway HOV Facilities (Part I)." *The Urban Transportation Monitor.* Vol. 12, No. 4. (27 February 1998): 7-8.

Seattle, WA (Interstate-90)
- Barrier separated: two-way
- 1.5 miles (2 km) long
- 24 hour HOV operation

Reference
Meagher, Joan., ed. "Operational Characteristics of Selected Freeway/Expressway HOV Facilities (Part I)." *The Urban Transportation Monitor.* Vol. 12, No. 4. (27 February 1998): 7-8.

Northern Virginia (Interstate-395, Shirley Highway)
- Barrier-separated: reversible-flow
- 15 miles (24 km) long
- 24 hour HOV operation
- 3+ person per vehicle operation

Reference
Meagher, Joan., ed. "Operational Characteristics of Selected Freeway/Expressway HOV Facilities (Part I)." *The Urban Transportation Monitor.* Vol. 12, No. 4. (27 February 1998): 7-8.

Boston, MA (Interstate-93 Southeast Expressway)

- 4 miles (6 km) long
- Morning and evening peak hour operation
- Zipper truck
- 3+ person per vehicle
- 2+ person per vehicle with stickers on alternating days

Reference

Paiewonsky, Luisa. "Massachusetts Highway Department I-93 Southeast Expressway HOV Lane." *ITE Journal.* Vol. 67, No. 6. (June 1997): 38.

CHAPTER 7
HIGH OCCUPANCY TOLL LANES AND CONGESTION PRICING

	Orange County, CA	San Diego, CA	Lee County, FL	Houston, TX
Implementation Date	December 1995	December 1996	June 1998	1996
Implementation Costs (millions of dollars)	$126	$10	Not Available	$0.87
Freeway Miles (km)	75 (120)	314 (502)	34 (54)	529 (846)
Population (1990)	2,410,668	2,498,016	335,113	3,321,926
Sq. Miles (Sq. km)	790 (2,045)	4,204 (10,890)	804 (2,081)	5,921 (15,336)
Population Density (pop. per sq. mi.) (pop. per sq. km)	3,051 (1,179)	594 (229)	417 (161)	561 (217)

While HOV lanes are becoming ubiquitous, only a few have a special toll associated with them. The practice of tolling HOV lanes is a relatively new concept that developed when certain HOV facilities were not being used efficiently for congestion management. In such instances, commuters may, for a fee, use HOV lanes even if their vehicle has less than the minimum number of persons that is required on the facility. Windshield decals and electronic on-board vehicle transponders have simplified that task of collecting tolls. Since 1995, a few states have moved forward in conducting high occupancy toll (HOT) lane demonstration projects to determine whether long term implementation is feasible. The demonstrations have looked at concepts such as "Time of Day Pricing," private-for-profit facilities, and the benefits of having HOT lanes that require 2+ persons per vehicle versus 3+ persons per vehicle.

Orange County, CA

CALIFORNIA STATE ROUTE 91 (SR 91) VARIABLE-TOLL EXPRESS LANES

Highlights

- Sponsor: California Private Transportation Company
- Cost: $126,000,000
- Funding: California Private Transportation Company
- Primary Services: 10 miles (16 km), two toll lanes each direction, buffer with channelizers, electronic transponders, carpool usage is up 18% since its opening
- Freeway Miles: 75 (120 km)
- Non-attainment region for ozone, CO, and PM10

Background

The California State Route 91 (SR 91) express lanes were opened in 1995. The privately built and operated toll lanes have tolls that vary with time-of-day. This "Value Pricing" concept works by having all tolls collected by automatic vehicle identification (AVI). Vehicles with three or more persons can use the facility toll free. The facility was built as a private-for-profit investment as one of four such private-public partnership experiments authorized by the California Legislature. The lanes were built by the California Private Transportation Company on land leased by the state.

Effects

At the end of the first year in operation, the peak period traffic had increased to a level that warranted a toll increase to protect the toll lanes from becoming congested. During the first 15 months of the facility's operation, traffic on the facility increased at a steady rate. This increase was unaffected by a January 1, 1997, toll change. The capacity of the facility has increased with the addition of two new toll lanes in each direction on SR 91. This increased capacity has substantially reduced peak period congestion causing some of the traffic to shift back to the freeway from parallel arterials. The estimated use during peak hours on weekdays is 450-500 3+ high occupancy vehicles and 2,650-2,700 tolled users.

Public Perception

Surveys in late 1995 and throughout the year in 1996 were conducted to determine the degree of approval of congestion-based tolls. The idea of providing additional toll-financed lanes to bypass congestion had a public approval rating of 60-80%. The idea of varying tolls based on the severity of the congestion bypassed was not as popular, with only a 45% approval rating. This rating increased in subsequent surveys.

Contact Information: Mike Gray, High Occupancy Vehicle Facility Coordinator
High Occupancy Vehicle Systems Branch
California Department of Transportation
Sacramento, CA
(916) 654-6133

Reference

Sullivan, Edward C. "Impacts of Implementing the California Route 91 Variable-Toll Express Lanes." *1997 Compendium of Technical Papers of the 67th Annual Meeting of the Institute of Transportation Engineers.* (1997).

San Diego, CA

INTERSTATE 15 (1-15) CONGESTION PRICING PROJECT EXPRESS PASS PROGRAM

Highlights

- Sponsor: San Diego Association of Governments (SANDAG), California Department of Transportation (Caltrans), Federal Highway Administration (FHWA), and Federal Transit Administration (FTA)
- Cost: $9,950,000 for project implementation
- Funding: The Congestion Pricing Pilot Program which is managed and implemented by FHWA, the primary funding agency ($7,960,000), local matching funds totaling $1,990,000 includes State Transportation Development Act funding provided for express bus service in the I-15 corridor and local funding for freeway service patrols. Federal Transit Authority (FTA) also provided an additional $230,000 for the project
- Primary Services: 8 miles (13 km), Two toll lanes, (reversible), barriers, windshield decals and transponders after June 1997
- Freeway miles: 314 (502 km)
- Non-attainment region for ozone and CO

Background

The Interstate 15 (I-15) Congestion Pricing Project uses the concept of allowing non-high occupancy vehicle traffic to use HOV lanes for some type of toll or user fee. The I-15 HOV facility, which opened in October 1988, resulted in excess capacity due to the HOV lanes not being used. The adjacent mixed-flow lanes still experienced severe congestion during the peak periods. The San Diego Association of Governments implemented a roadway pricing project known as the "Express Pass Program" in order to improve transit and HOV services, relieve congestion, and use the existing roadway facilities more efficiently.

A monthly subscription process is used by solo motorists who pay a flat monthly rate for unlimited authorized use of the HOV lanes during hours of normal operation. During early implementation, a windshield decal system was used to identify authorized single occupant vehicles. Later, an electronic system would be introduced. During later phases of the project, the method of pricing changed to a variable per-trip fee. Full implementation of the toll lanes will have either varying tolls on a fixed daily schedule, or use fully dynamic pricing based on actual, real-time levels of traffic within the HOV lanes.

Effects

Traffic counts taken before the "Express Pass Program" was implemented showed a daily traffic volume of 3,888 vehicles in the HOV lanes. Counts conducted in January 1997 showed that 326 of the 500 participants in the "Express Pass Program" were using the HOV lanes during the morning peak period. The HOV lane traffic increased by 553 vehicles per day in the month of January, and 315 more vehicles per day were seen in February over the volumes seen in January.

Public Perception

The project has had considerable public acceptance and success. During the first month of operation, 500 customer accounts were established.

Contact Information: Mike Gray, High Occupancy Vehicle Facility Coordinator
High Occupancy Vehicle Systems Branch
California Department of Transportation
Sacramento, CA
(916) 654-6133

Reference

Regan, Edward J., Kim J. Kawada, and Robert A. Davis. "I-15 Congestion Pricing Demonstration Project." *1997 Compendium of Technical Papers of the 67th Annual Meeting of the Institute of Transportation Engineers.* (1997).

Lee County, FL
TIME OF DAY PRICING PROGRAM

Highlights

- Sponsor: Department of Transportation in Lee County (Leeway Services)
- Cost: Not available
- Funding: FHWA
- Primary Services: 25% of motorists indicated using the facility during non-peak hours due to the reduced tolls
- Freeway miles: 34 (54 km)
- Attainment region

Background

The purpose of using variable pricing is to financially force travel demand patterns. The objective is to move trips from the peak hours into off-peak hours. Typical congestion pricing programs have a higher "premium price" during the peak hours. The Lee County system uses lower tolls during off-peak hours as an incentive to move traffic out of the peak hours. Rush hour motorists will be offered a 50% discount if they traverse the facility, which in this case study are bridges, during periods just before or just after the typical weekday peak periods. The three bridges included in the program are the Cape Coral Bridge, Sanibel Bridge, and Midpoint Memorial Bridge. Lee County has implemented the project with the aid of the revenue reserve fund of the Congestion Pricing Pilot Program, which was established to ensure that existing revenue sources would not be harmed by the adoption of peak/off-peak pricing differentials. Variable tolling is being implemented in conjunction with radio frequency electronic tolling with transponders.

Effects

The option of reduced tolls would cause around 25% of the current users to travel at times other than rush hour.

Public Perception

Surveys indicated that participants responded favorably to a 50% reduction in tolls and the discounted hours. The use of transponders also met with positive responses. Over 66% of the survey participants indicated that they would likely obtain a transponder when it becomes available. Commercial users of the facilities have supported the use of electronic toll collection (ETC) and the variable pricing concept.

Contact Information: Chris R. Swenson, Transportation Engineer
Leeway Services
Department of Transportation of Lee County
Lee County, FL 33902-0398
(941) 573-1170

John T. Berg
Highway Revenue and Pricing Team
Federal Highway Administration, HPP-10
Washington, DC 20590
(202) 366-0570

Reference

Swenson, Chris R., and George L. Crawford. "Development of a Time of Day Pricing Program for Lee County, Florida." *1997 Compendium of Technical Papers of the 67th Annual Meeting of the Institute of Transportation Engineers.* (1997).

Houston, TX

I-10 HIGH OCCUPANCY TOLLS (PRIORITY LANE PRICING)

2+ Vehicles versus 3+ Vehicles

Highlights

- Sponsor: Metropolitan Transit Authority of Harris County (Metro), Texas Department of Transportation (TxDOT), with support from Federal Highway Administration (FHWA), and Federal Transit Administration (FTA)
- Cost: $870,000
- Funding: FHWA (80%), TxDOT and Metro (20%)
- Primary Services: 13.1 miles (21 km), one lane (reversible), barriers, electronic transponders
- Freeway miles: 529 (846 km)
- Non-attainment region for ozone

Background

The HOV lanes were opened in 1984 with a minimum occupancy for vehicles of 2+ persons. The minimum occupancy for vehicles was raised to 3+ persons in 1988 to preserve the minimum operating speed desired within an HOV lane for the peak hour of the peak period. This improved the operating speed and the transportation service of the facility, but there was an increased amount of excess capacity. The use of "pricing" was initiated in order to increase use of HOV lane without adversely affecting the operation of the entire facility. The concept of "pricing" allowed a controlled number of two-person vehicles, for a fee, to use the HOV lane during the time restricted for 3+ person vehicles. This project is known as *Quick Ride.*

Effects

A research study determined that the available capacity could be filled daily by using a per-trip price ranging up to $3.50. In November 1997, two-person vehicles were to be able to pay a $2.00 per-trip fee to travel in the 3+ person lane during the peak-travel periods. The annual revenues from "pricing" should cover the operation costs of the facility. In order to participate in the program, travelers would have to purchase a visual identification "hang-tag" and an electronic transponder, which debits the per trip fee from a pre-established account.

The number of users after six weeks of operation were only increased from 94 to 148 per day. Currently, there exists room for 600 two-person, buy-in users per hour. Preliminary results indicated that the trial period for using the "pricing"concept was a modest success. The goal of increasing peak-hour HOV lane utilization was being realized.

Public Perception

Three groups of users of the Katy Freeway were approached on the subject of "pricing." These were SOV drivers, regular carpoolers, and transit riders. Most of the participants indicated using HOV facilities before the usage was restricted to 3+ persons per vehicle for the peak periods. There was agreement that the 3+ restrictions during the peak hour was useful and that the HOV lane appears to be underutilized during the 3+ periods. All the participants indicated that they would use the HOV lane during the peak hours, even if a toll was assessed when their vehicle has less that three persons. The EZ tag was considered by most to be the best method to collect the revenue.

Contact Information: Bill Stockton, Research Engineer
Texas Transportation Institute
7715 Chevy Chase Dr.
Austin, TX 78752
(512) 467-0946

Reference

Stockton, W. R., C.L. Grant, C.J. Hill, F. McFarland, N.R. Edmonson, and M. Ogden. "Feasibility of Priority Lane Pricing on the Katy HOV Lane: Feasibility Assessment." TTI Research Report 2701-1F. Texas Transportation Institute: College Station, TX. (June 1997).

OTHER EXAMPLES/CITIES WITH HOT FACILITIES

Minneapolis, MN (I-394)

- HOV buy-in
  Phase I: Distributed 500 passes
  Phase II: Electronic tolling and integration with ramp metering
- Project dropped in October of 1997 after public opposition

Reference

The Hubert H. Humphry School of Public Affairs. "Congestion Pricing Homepage." Last revised 18 August 1998. <http://www.hhh.umn.edu/Centers/SLP/Conpric/cpnotes3.htm>

CHAPTER 8
RIDESHARE

	Boulder, CO	Denver, CO	Montgomery County, MD	Austin, TX	Bremerton, WA
Implementation Date	1990	1990	1985	1986	1992
Implementation Costs (thousands of dollars)	Not Available	Not Available	$35	Not Available	Not Available
Freeway Miles (km)	70 (112)	249 (398)	72 (115)	437 (699)	22 (35)
Population (1990)	225,339	1,622,980	4,222,830	846,227	189,731
Sq. Miles (Sq. km)	742 (1,923)	3,761 (9,741)	6,510 (16,682)	4,226 (10,945)	396 (1,026)
Population Density (pop. per sq. mi.) (pop. per sq. km)	304 (117)	432 (167)	649 (253)	200 (77)	479 (185)

The concept of ridesharing refers to two or more people sharing a daily commute to or from work or some other common destination. Local governments and private companies have been actively promoting formal and informal ridesharing programs to combat increasing traffic congestion and air quality problems. Carpools, vanpools, and guaranteed rides home are elements of ridesharing. Carpools usually involve the use of an employee's personal automobile for transport of up to four or five other people. Carpool members either share the expenses of operating a particular vehicle or rotate the use of personal vehicles among the members. Vanpools can accommodate up to 15 passengers with one or more of the employees accepting the responsibility of driving. Costs of vanpool operations are available from the vanpool members' monthly participation fees and by employer subsidies. Guaranteed rides home can be provided by participating taxi companies who have previously developed contracts with employers. The primary benefits received by employees who use ridesharing are a decrease in personal commuting expenses and possible travel time savings that are possible with the ability to utilize high occupancy vehicle lanes on freeways. Some employers also provide preferred parking to carpool and vanpool vehicles. Preferred parking can involve premium spaces and/or subsidized fees where there is a cost involved.

This page intentionally left blank.

Boulder, CO

RIDESHARE, GUARANTEED RIDE HOME

Boulder Community Hospital

Highlights

- Sponsors: Boulder Community Hospital, City of Boulder, and Community Transit Agency
- Cost: Not available
- Funding: Boulder Community Hospital, "Cool Your Wheels" Program
- Participation: Not available
- Primary Services: Financial incentives
- Non-attainment region for CO and PM10

Background

In 1990, the Boulder Community Hospital initiated an alternative transportation program (ATP) for carpooling and bus use. In 1992, the hospital began the "Cool Your Wheels" program. The program provided financial incentives to get employees to use alternative transportation. Over 100 employees participated and pledged that they would leave vehicles at home four out of five weekdays. For each day employees used an alternative commute option, the hospital would give them $4.00. A hospital-wide incentive program was later adopted giving equitable rewards to all who used alternative transportation. For each day employees used an alternative commute option, they would receive a coupon entering them into a monthly drawing for 10 cash awards of $100 each.

Effects

The implementation of these programs saw approximately 18% of the hospital staff using transit, 8% using carpools, and 6% biking or walking to work. An employee survey indicated that 68% of the staff prefer driving alone and did not wish to participate in the program.

Public Perception

The incentives offered by hospital management for using alternative transportation modes have met with a positive response from employees. The hospital management noted that there had been improved relations with the city government, hospital neighbors, and the general public.

Contact Information: Joe McDonald, Vice President
Boulder Community Hospital
(303) 440-2214

Reference

COMSIS Corporation. SMART COMMUTING - Corporate Participation in Employee Commute Option. Produced by the New Jersey Department of Transportation, Division of Transportation Systems Planning. (January 1997).

Denver, CO

THE GUARANTEED RIDE HOME PROGRAM
RIDEARRANGERS/ ECO PASS

Highlights

- Sponsors: Denver Regional Council of Governments, individual employers
- Cost: Not available
- Funding: Denver Regional Council of Governments, individual employers
- Participation: 1,201 employers and 43,500 employees (1997)
- Primary Services: Guaranteed taxi rides home, use of public transportation
- Non-attainment region for CO and PM10

Background

The guaranteed ride home program offered by RideArrangers, the commuter assistance program of the Denver Regional Council of Governments (DRCOG), is offered to employers on a region-wide, eight county basis. The program includes, if needed by the employee, a taxi ride home guaranteed to a distance of up to 100 miles (160 km) one-way. The program is not available to individual employees but must be purchased by an employer for all full-time employees at a company location, whether or not those employees are currently patronizing an alternate mode of transportation. This allows an occasional carpooler or bus rider to use the program as well as those who commute by alternate modes on a regular basis. The RideArrangers' Guaranteed Ride Home program is sold to employers on a stand-alone basis or as part of a unique bus pass program offered by the Regional Transportation District serving metropolitan Denver. The bus pass program, known as the "Eco Pass," is available only through employers and, like the guaranteed ride home, must be purchased for all employees at any company location whether or not they currently ride the bus. With photo identification, which represents participation in the Eco Pass Program, patrons have unlimited rides on RTD for the life of the pass, which is usually a year.

Effects

According to 1993 data, over 360 companies with over 19,000 employees were enrolled in the Eco Pass/Guaranteed Ride Home program. Another five companies with a little over 10,300 employees participated in the Guaranteed Ride Home program on a stand-alone basis. A cost analysis performed after nine months of the program's existence indicated that the average cost of taxi service per enrolled employee was $0.76 per year. When taking only employment size into consideration, the cost per employee per year ranged from a high of $1.54 each for employees of medium-sized companies to a low of $0.49 each for employees of large companies. Data gathered in 1997 saw increased levels of enrollment. Program enrollment included 1,201 employers and over 43,500 employees with 3,200 actual uses of the Guaranteed Ride Home by the employees.

Public Perception

During the test phase of the program, no limit was set on the distance a guaranteed ride home might require. To increase the awareness of this element, a distance limit of 100 miles (160 km) one-way was applied when the program was expanded region-wide. This limit has had the desired affect of bringing attention to the generous benefits of the program. Even with the generous limitations and policing, it appears that inappropriate usage has been held to a minimum.

Contact Information: Greg Krtinich, Van Pool Coordinator
Ride Arrangers
Division of DRCOG
2480 W. 26th Ave. #200B
Denver, CO 80211-5580
(888) 458- POOL

Reference

Denver Regional Council of Governments. "Welcome to DRCOG." Accessed: 6 November 1998. <http://www.drcog.org/>

Montgomery County, MD
GOVERNMENT EMPLOYEE TRANSIT INCENTIVES (GET-IN) PROGRAM

Highlights

- Sponsor: Montgomery County
- Cost: $35,000 for implementation
- Funding: Montgomery County Division of Transit Services, Dept. of Public Works and Transportation (Mass Transit Fund)
- Participation: Over 100 county employees
- Primary Service: Monthly subsidy for not driving alone
- Attainment

Background

In 1985, Montgomery County established a transportation program for Montgomery County government employees as a test program for other employers in the region. The "Get-In" program offered a $15 (increased to $30 in 1997) monthly subsidy for employees switching from driving alone to either public transportation, Maryland Commuter Rail (MARC), or vanpools. Employees had to turn in their parking permits and received a "Get-In" membership card. With this card, employees purchase at a discount: Metrorail farecards and passes, Metrobus flash passes or tokens, Ride On 20-trip tickets, two-week Ride About Passes, or MARC tickets. Participants in a registered vanpool receive a $15 rebate to offset the cost of monthly vanpool fees.

Effects

Over 100 employees participated in the program when the subsidy was $15 per month. The number of participants increased to 135 when the subsidy was increased to $30 per month in 1997. The guaranteed ride home, which is offered within the "Get-In" program, was only used four times during 1997.

Public Perception

Maryland County "Get-In" program participants are required to reapply every two years. Coordinators request feedback on the program during this time to continually evaluate its benefits. Many participants indicated that they depend on the monthly subsidy to keep their commute expenses to a minimum.

Contact Information: Maureen P. O'Hara, Fare Media Program Coordinator
Montgomery County
Division of Transit Services
110 N. Washington St. #200
Rockville, MD 20850
(301)217-2184

Reference

Florida Department of Transportation. "National Transit Library." Accessed: 10 November 1998. <http://www.fta.dot.gov/fta/library/planning/tdmstatus/FTAGUAR2.HT>

Austin, TX
RIDEFINDERS

Highlights

- Sponsor: Capital Metro
- Cost: Not available
- Funding: Transit Fund from a $0.01 sales tax implemented over 500 square mile area (1,280 sq. km)
- Participation: 33,000 (1998 average monthly ridership), 111 vans as of August 1998
- Primary Services: Computerized ride matching, vanpool program, employer assistance, and guaranteed ride home
- Attainment region

Background

Capital Metro, in the Austin area, offers a ridesharing program called Ridefinders, which began operation with five vans in 1986. The program included a computerized ride matching service, vanpool program, employer assistance, and a guaranteed ride home service. The vanpool program has been used as a model for cities nationwide. A record 115 vans were in service during 1996. The cost for riding in a 15 passenger van is $25.00 per month. Included as a part of the van fleet is one wheelchair accessible van and 17 vans equipped with bicycle racks. A guaranteed ride home service is provided by local taxi companies for individuals participating in the vanpool program.

Effects

Ridefinders had a total vanpool ridership in 1997 of over 500,000 people. The total vanpool ridership through June 1998 was around 200,000, indicating an average monthly ridership of approximately 33,000 people. The tremendous on-time performance of the vanpools has contributed to the exceptional ridership participation.

Public Perception

A survey conducted in February 1996 found that a majority of the riders preferred the convenience of the vanpool as opposed to the headache of commuting in rush hour traffic. Many of the vanpool riders stated that they own personal vehicles. Numerous survey respondents said that the vanpool offered them the opportunity to sit back, relax, and let someone else do the driving.

Contact Information: Dolly Watson, Community Transit Specialist
Fare Media Message
Capital Metro
(512) 389-7516

Reference

Lindquist, Nell F., and Katherine F. Turnbull. "National Review of Statewide Rideshare Programs and Surveys of Texas Rideshare Programs." TTI Research Report 1964-1F. Texas Transportation Institute: College Station, TX. (June 1993).

Bremerton, WA
SMART COMMUTER

Highlights

- Sponsor: Washington State
- Cost: Reimbursement of $16,577 to taxi companies who provided guaranteed rides home
- Funding: Washington State's CTR (Commute Trip Reduction) "clean air" account, state
- Primary Services: vanpools, guaranteed rides home, park-and-ride lots
- Participation: 882 guaranteed rides home since 1994
- Attainment region

Background

In 1992, the Washington State Commuter Trip Reduction (CTR) law became effective ordering large employers to have a ridesharing program. Many of the large employers, however, indicated minimal employee interest in ridesharing. Kitsap County Transit agreed to coordinate participation of over 180 employers in a county-wide ridesharing program for their registered employees, known as "Smart Commuters."

The Rideshare operation in the Bremerton area includes vanpools, guaranteed rides home, and park-and-ride lots. Kitsap Transit owns a fleet of vans that can be used by groups of seven or more for their daily commute. Kitsap Transit pays for the fuel, insurance, and vehicle maintenance on the entire fleet. The guaranteed ride home program requires that users be a "Smart Commuter" who either walks, bicycles, carpools, vanpools, or takes the bus to work at least three times per week. The program provides free rides home by an authorized transportation provider for emergency use only. Kitsap Transit also serves and operates a network of free commuter park-and-ride lots and encourages their use for reduction of traffic around ferry terminals and major employment sites in Kitsap County.

Effects

As of July 1998, over 5,000 employees in Kitsap County are participating in the "Smart Commuter" program. Since 1994, 882 guaranteed rides home had been provided to registered employees at a cost of $16, 577 to Kitsap Transit to reimburse the taxi companies providing the rides home.

Public Perception

A survey conducted in 1995 by Kitsap Transit indicated that 37% of the respondents would not have participated in ridesharing if guaranteed rides home were not available. The overall consensus of participants in the ridesharing program was favorable.

Contact Information: Bob Ferguson, Transportation Demand Management Administrator
Kitsap County Transit
(360) 478-5864

Reference

Kitsap Transit. "Welcome to Kitsap Transit." Last revised 15 July 1998.
<http://www.kitsaptransit.org/>

OTHER EXAMPLES/CITIES WITH RIDESHARE PROGRAMS

Dallas, TX (Commuter Services)
- Vanpools, carpools, and guaranteed rides home
- Discounted monthly transit passes

Reference
Lindquist, Nell F., and Katherine F. Turnbull. "National Review of Statewide Rideshare Programs and Surveys of Texas Rideshare Programs." TTI Research Report 1964-1F. Texas Transportation Institute: College Station, TX. (June 1993).

Fort Worth, TX
- Vanpools through a van broker and subscription bus service
- Guaranteed ride home program for vanpoolers and subscription bus passengers
- "School Pool," a service providing carpool matching for 55 area elementary and middle schools

Reference
Lindquist, Nell F., and Katherine F. Turnbull. "National Review of Statewide Rideshare Programs and Surveys of Texas Rideshare Programs." TTI Research Report 1964-1F. Texas Transportation Institute: College Station, TX. (June 1993).

Plymouth, MN (Minneapolis Metropolitan area)
- Carpools and guaranteed rides home

Reference
Plymouth Minnesota. "Plymouth Metrolink Offers Guaranteed Ride Home."
Accessed: 9 November 1998.
<http://www.ci.plymouth.mn.us/city_services/public_transit/ride_home.html>

Charlotte, NC
- Vanpools

Reference
Charlotte - Mecklenburg. "Vanpool Information." Last revised 25 August 1998.
<http://www.charmeck.nc.us/citransportation/transit/vanvan.html>

Tucson, AR (Raytheon Missile Systems Company)

- Vanpool and Guaranteed ride home for emergency situations

Reference

Florida Department of Transportation. "National Transit Library." Accessed: 10 November 1998.
<http://www.fta.dot.gov/fta/library/planning/tdmstatus/FTAGUAR2.HTM>

Bellevue, WA (City of Bellevue)

- Subsidized taxi guaranteed ride home

Reference

Cosette, Polena, and Lawrence Jesse Glazer. "Examination of 11 Guaranteed Ride Home Programs Nationwide." *Transportation Research Record 1321.* National Academy Press: Washington D.C. (1991): 57-65.

Basalt, CO

- Park-and-ride

Reference

Colorado Department of Transportation. "82 park-and-ride." Accessed: 6 November 1998. <http://www.dot.state.co.us/public/constructioninfo/82.htm>

San Francisco, CA (Golden Gate Transportation District)

- Introduces commuters to vanpooling using a small vanpool fleet. After a trial period, commuters are encouraged to purchase or lease vans themselves. At that time, the district vans are then made available to other groups with the potential of developing a successful vanpool program.

Reference

Meyer, Michael D., T.F. Humphrey, C.M. Walton, and K. Cooper. A Toolbox for Alleviating Traffic Congestion. Transportation Research Board. Institute of Transportation Engineers: Washington D.C. (1989).

SECTION 3

CONSTRUCTION

CHAPTER 9
NIGHT CONSTRUCTION

	Los Angeles, CA	St. Louis, MO	Columbus, OH	Harrisburg, PA	Seattle, WA
Implementation Date	Not Available	Not Available	Not Available	1940	Not Available
Implementation Cost (millions of dollars)	Not Available	Not Available	Not Available	Not Available	Not Available
Freeway Miles (km)	155 (248)	94 (150)	128 (205)	505 (808)	240 (384)
Population (1990)	8,863,052	2,492,348	1,345,450	587,986	2,033,128
Sq. Miles (Sq. km)	4,060 (10,515)	6,393 (16,558)	3,142 (8,138)	1,991 (5,156)	4,216 (10,920)
Population Density (pop. per sq. mi.) (pop. per sq. km)	2,183 (843)	390 (151)	428 (165)	295 (114)	482 (186)

Construction projects are often a cause of traffic congestion. Roadway construction is necessary, however, to maintain roadways and to develop new facilities. Some transportation agencies have taken steps to lessen the inconvenience of construction projects to motorists. One option is to conduct road work during the nighttime hours. This practice lessens the impacts of lane closures that are usually associated with roadway construction, since there are fewer vehicles on the road during the nighttime hours. Night construction does produce some adverse effects that may prohibit its use in heavily populated areas or areas where construction funding is limited. For example, night construction can produce significant noise problems and is more costly than daytime construction.

Los Angeles, CA
Night Construction

Highlights

- Sponsor: Federal Government
- Cost: Variable with each individual project
- Funding: General fund and gas tax
- Non-attainment region for ozone, CO, PM10, and NO2

Background

One particular overlay project in 1994 took over seven months to complete at a cost of over $100,000. With the presence of passing vehicles, it became necessary to remove the threat caused by and to passing traffic. This was accomplished by performing much of the work at night.

Effects

Traffic congestion was reported to be much lower during night construction projects, as opposed to those done in the day. The City's Traffic Division designated optimal times for non-urban road construction, but it is policy that construction on major urban roadways be completed at night due to the vast volumes of automotive traffic.

Public Perception

Complaints are highest if work is still in progress when early morning commute hours begin, as motorists are most impatient when trying to be at work on time.

Contact Information: Mark Archaletta
Construction Department
California Department of Transportation
(213) 897-0059

St. Louis, MO

Night Construction

Highlights

- Sponsors: Federal and State
- Cost: Not available
- Funding: Matching funds
- Non-attainment region for ozone, PM10, and lead

Background

The St. Louis area decided five or six years ago that it would perform metropolitan roadway construction projects at night. Nighttime work is done on interstates that require work adjacent to, or on, the actual roadway. Since St. Louis and Kansas City have high traffic volumes and problems with limited capacity, all work must be done at night. Their policy is to have absolutely no peak-hour closings of traffic lanes.

Effects

Work on construction projects performed during the daytime hours caused excessive delays and traffic back-up. Capacity and traffic volume studies supported the transition to night work. As a result, safety has increased around construction projects. Night construction also allows the use of different construction techniques, such as the pouring of paving material for a straight 72 hours. Additionally, construction workers did not have the usual problem of making their way through traffic to deliver construction materials to and from the site.

Public Perception

It is reported that other areas of trouble, for instance, the levels of frustration that motorists had regarding bumper-to-bumper traffic associated with daytime construction projects, has decreased.

Contact Information: Randall Potts, Estimating and Reviewing Engineer
Missouri Department of Transportation
(573) 526-8486

Columbus, OH

Night Construction Policies

Highlights

- Sponsors: Federal, City, and State
- Cost: Not available
- Funding: Federal, State and local
- Attainment region

Background

Much of the construction done in the City of Columbus is now being performed between the hours of 8:00 pm on Friday and 5:00 am on Monday. It is always necessary to maintain two lanes of traffic, and when this is not possible, construction projects are performed at night. The Oregon Department of Transportation (ODOT) requires that paving, repaving, or shaving be done between the hours of 8:00 pm and 6:00 am. During the initial construction phases, options regarding when and how a project will be managed are examined, especially for long-term construction that may require substantial public forewarning.

Effects

Reports indicate that the ever increasing numbers of vehicles has led to increased nighttime construction. Construction during the night has provided the benefit of more hours in which to work. Hence, it is possible to complete the job more quickly. The construction workers are exposed to vehicles less, especially when setting up or tearing down traffic control devices. Additionally, less traffic allows the use of a flat bed trailer, which must travel at speeds less than 20 mph (32 kph), to set-up traffic cones.

Public Perception

Many in the public would like to know why more construction work cannot be performed at night. The public seems to enjoy the fact that projects are completed faster when they are done at night. The public has also indicated that the use of tower lighting and portable lighting is very helpful for them.

Contact Information: Ken Linger, Safety Program Engineer
Office of Traffic Engineering
Ohio Department of Transportation
(614) 466-0139

Harrisburg, PA

Pennsylvania Turnpike

Highlights

- Sponsor: Pennsylvania Turnpike Commission
- Cost: Not available
- Funding: Toll and tax funding
- Non-attainment region for ozone

Background

Every construction project on the Pennsylvania Turnpike is subject to a traffic analysis and a capacity analysis. Typical data that are collected in the analysis are the traffic volumes and vehicle polls along the roadway. Volumes and grades on the roadway are also taken. This analysis helps to determine the most efficient times during which construction should take place. The possible construction hours are provided to the contractor, and only during these hours can work be performed on the roadway. Typically, only when backlogs occur are projects scheduled to be completed during the day. Not creating backlog is the whole goal around scheduling construction.

Effects

The Turnpike Commission reports that worker productivity during night construction projects is not as high as during daytime projects. Additionally, the quality of the work may also suffer as a result of the lighting, fatigue, etc.

Public Perception

The public almost always prefers night construction as compared to those operations which take place during the day. Furthermore, the Turnpike Commission has determined that the less inconvenience there is for motorists, the more there is support for the project. The fact that traffic is not inhibited makes construction work more tolerable in the eyes of the public.

Contact Information: Mike Shaak, Roadway Engineer Manager
Pennsylvania Turnpike Commission
(717) 939-9551

Seattle, WA

Night Construction

Highlights

- Sponsor: Federal
- Cost: Not available
- Funding: Federal
- Non-attainment region for PM10

Background

Most work requiring lane closures justifies the performance of that work during nighttime hours. Due to high traffic volumes in the Seattle urban area, most work is done at night on roadways that cannot accommodate daytime lane closures. One particular project on I-405 necessitated the closure of an entire freeway. The overlay project was 6 miles (10 km) long and completed on two consecutive weekend nighttime closures of the highway. Coordinated partnering efforts with local agencies, the state highway patrol, and the contracting community were started early in the design phase of the project. It was decided that the project could be completed more efficiently over two weekends. This roadway was closed for a total of 57 hours. Closure occurred between 8:00 pm Friday and 5:00 am Monday. This practice has allowed over 50% of the work to be completed at night.

Effects

WSDOT indicated that they believe the keys to success were advance communication, traffic control, proximity of the fabrication material, and partnering. They found the greatest assets to be up-front communication with local jurisdictions, as well as making sure that motorists were well informed. A massive media campaign, which served to inform motorists of the closure, was launched before the project began.

Public Perception

A University of Washington survey reported that the public felt that night construction was a very effective and efficient way to complete roadway projects more quickly.

Contact Information: Kim Henry, Construction Administration Engineer
Washington State Department of Transportation
Northwest Region
1500 Dayton Avenue North
P.O. Box 330310
Seattle, Washington 98133
(206) 440-4674

CHAPTER 10
CONSTRUCTION AND PUBLIC AWARENESS/RELATIONS

	Montgomery, AL	Detroit Lakes, MN	Raleigh, NC	Columbia, SC	Fort Worth, TX
Implementation Date	Monthly Press Release	April or May of each year	Not Available	Not Available	Not Available
Implementation Cost (thousands of dollars)	$90 (Annually)	$45 (Annually)	Not Available	Not Available	Not Available
Freeway Miles (km)	38 (61)	Not Applicable	47 (75)	60 (96)	699 (1,118)
Population (1990)	292,517	7,141 [1]	858,485	453,932	1,361,034
Sq. Miles (Sq. km)	2,008 (5,199)	4 (10)	3,491 (9,041)	1,457 (3,774)	2,918 (7,558)
Population Density (pop. per sq. mi.) (pop. per sq. km)	146 (56)	1,785 (714)	246 (95)	312 (120)	466 (180)

[1] Population of city proper; Program is for the state DOT district.

Highway construction projects frequently affect motorists as they travel the transportation network. Accurate, timely information about affected routes is vital to the motoring public. Furthermore, by providing as much information as possible, including alternate routes, transportation agencies can realize less public resistance to construction projects. Some agencies even make the public an active part of the process, a step that can even gain public support of the project.

Construction project information gives motorists the opportunity to adjust their travel routes and avoid travel delays that often accompany roadway projects. The impact of construction projects on the transportation system can be minimized with an effective public awareness campaign. Public awareness of projects is made possible through informal workshops and public hearings. Many transportation agencies have formed project teams with the specific duty of informing the public of upcoming projects, as well as projects scheduled to begin several years in the future. Other methods of providing construction information include brochures, press releases, media kits, telephone hotlines, television (public access channels), and the Internet. Construction public awareness usually requires cooperation between the Federal Highway Administration (FHWA), DOTs, public safety agencies, and other local agencies.

Montgomery, AL (Alabama DOT)
CONSTRUCTION and PUBLIC RELATIONS/AWARENESS

Highlights

- Sponsor: State
- Cost: $90 thousand (annually)
- Funding: State
- Primary services: Press releases, bulletins, Internet, TV
- Staff: Not available
- Attainment region

Background

Once a month, except November and December, the Alabama Department of Transportation sends press releases, which inform the public of upcoming projects, to both print and electronic media around the state. The press describe construction projects, including location, type, and purpose. A referral to a project contact is made available in case more details are needed. Sent out each month are press releases about specific projects within each county. These releases are sent to the Associated Press (AP) and to local media in the county where the project is to take place. In addition, a construction bulletin is made available via the Internet on a quarterly basis which lists each project, its estimated completion date, and other pertinent information. If the construction projects require a lane closure, the local DOT official may contact the media directly.

Effects

The availability of construction information helps the public know the status of the project and how it affects public agencies that are involved. As a result, the motoring public is able to seek alternate routes in advance of their trips. The Alabama Department of Transportation does report that traffic congestion has been less severe at construction locations since the implementation of this project.

Public Perception

None available

Contact Information: Robert Johnson, Special Projects Engineer
Alabama Department of Transportation
(334) 242-6788

Sandra Nesbitt, Public Affairs Officer
Alabama Department of Transportation
(334) 242-6640

Detroit Lakes, MN (MnDOT)

CONSTRUCTION and PUBLIC RELATIONS/AWARENESS

Highlights

- Sponsors: Federal and State, Minnesota Department of Transportation (MnDOT)
- Cost: $45,000 (annually)
- Funding: Federal and State
- Primary services: Media kits, press releases, radio, Internet, media interviews
- Staff: One public relations employee (Detroit Lakes, District 4)
- Attainment region

Background

Beginning in early April to late May, media kits are sent across the state which provide information to various entities regarding the upcoming construction season. This kit offers valuable information regarding driving through work zones, safety, accident statistics (that are work zone specific), and fatalities. Also included in a media kit are a directory of contacts and a letter from the news director. At the MnDOT district level, this media kit provides an overview of construction for the entire summer. The media kit announcement gives each project's start date, location, and project details. Motorists are made aware of what to expect within a construction zone, especially the possibility of a reduction of travel speed and merging construction vehicles. This information is made available on the Internet as well.

Effects

Public access channels and software are under development that will provide motorists with timely facts and give access to information that is not currently available. Motorists obtaining this information will have a better understanding of the driving conditions around a construction site. As the motorists become more knowledgeable about construction projects, they can better select the appropriate travel route, thereby decreasing the frustration related to construction projects.

Public Perception

The public seems to greatly appreciate when construction information is made available, as well as the fact that it is continually updated.

Contact Information: Patty Vogt, Acting Public Affairs Coordinator
Minnesota Department of Transportation
(218) 846-0722

References

Minnesota Department of Transportation. Public Information Handbook. (May 1996).

Raleigh, NC (NCDOT)
CONSTRUCTION AND PUBLIC RELATIONS/AWARENESS

Highlights
- Sponsor: State
- Cost: Not available
- Funding: State
- Primary services: Newspaper advertisements, public hearings, Internet, radio, mailing list
- Staff: Five public relations employees (statewide)
- Attainment region

Background

The North Carolina DOT has determined that during the development of a project, the public must have an active role. This role is provided in the Raleigh, North Carolina, area through informal project workshops and public hearings. Citizens are concerned about how they will be affected by a project, and these workshops and public hearings provide an avenue by which these concerns can be addressed. The hearing officer explains the project and its details, and then responds to questions. During the hearings, comments are voiced and participants are given the opportunity to fill out comment sheets. Public hearings are usually held in the evenings at a central location. Many times, one-on-one meetings are arranged with property owners to provide them with more specific information and to receive comments from them. In addition, citizen participation units are created and are responsible for the publication of newspaper advertisements concerning upcoming construction projects. The citizen participation units are also responsible for contacting property owners to inform them about possible upcoming changes. More recently, NCDOT has begun providing construction project information on the Internet.

Effects

This public awareness process provides the motoring public with accurate advance information about construction projects. In addition, the public is made a part of the process, giving them a greater stake in it. As North Carolina looks to the future, there will be a greater emphasis on providing the public with proper and timely information about changes in the highway system. According to NCDOT, the project workshops and meetings are the best ways to release information and acquire citizen input.

Public Perception

None available

Contact Information: Carl Goode, Manager
Construction and Public Relations/Awareness
Citizens Participation Unit
North Carolina Department of Transportation
(919) 250-4092

Columbia, SC

CONSTRUCTION and PUBLIC RELATIONS/AWARENESS

Highlights

- Sponsor: Federal and State
- Cost: Not available
- Funding: Federal and State
- Primary services: Highway advisory radio (HAR), Internet, brochures, phone line
- Staff: Six public relations employees (statewide)
- Attainment region

Background

When the Construction and Public Relations/Awareness program was begun, a process was established to set up a project team to deal with any future construction projects. This process addresses projects in the near future or several years away. The project team works to develop formulas for notifying motorists and businesses in the Columbia area about future construction projects. The goal of the team is to complete construction without unduly hindering the motorists. A brochure regarding the possible impacts of a construction project is created and distributed to businesses and employers. The brochure also provides suggestions to minimize travel delays related to construction. An Internet site is also in place, providing the public with real-time information. Also, an information desk is available to assist the motorist in avoiding problem areas. For instance, current policy requires that at least two lanes remain open through construction zones at all times. This type of information is made available at the information desk.

Effects

This project team reports having had great success in keeping people informed of area construction projects, thereby reducing traffic delays.

Public Perception

With the availability of current information regarding travel in construction areas, the public has generally had less resistence to construction projects and the traffic problems that usually accompany them.

Contact Information: Stan Shealy, Director,
Publication and Media Sources,
South Carolina Department of Transportation
(803) 737-1064

Fort Worth, TX (TxDOT)
CONSTRUCTION and PUBLIC RELATIONS/AWARENESS

Highlights
- Sponsors: Federal and State
- Cost: Not available
- Funding: Federal and State
- Primary services: TV, radio, brochures, bulletin, press releases
- Staff: Three public relations employees (Fort Worth District)
- Non-attainment region for ozone and PM10

Background

The Texas Department of Transportation's (TxDOT) Public Information Office serves many audiences. They are: 1) the general public, 2) local news media, 3) local and state legislative officials, 4) business transportation providers, 5) emergency services, and 6) TxDOT employees. Information is provided about TxDOT policies, procedures and who the public can talk to about a particular situation. Information on lane closures is available by calling a hotline that is updated daily, or by accessing one of TxDOT's community relations programs. Additionally, the Fort Worth District provides daily lane closure information by reports that are sent to all media outlets every afternoon, including television, radio, and local newspapers.

Effects

People look to save time and money by planning their routes according to construction and lane closures. To facilitate this need, TxDOT literature is developed to support a construction project by providing additional information. Meetings are held with communities throughout the month to address issues that will affect them. In some cases, detours and alternative routes are developed when transportation professionals are made aware of traffic problems related to a construction project.

Public Perception

None available

Contact Information: Bill Page, Public Information Officer
Texas Department of Transportation
Fort Worth District
(817) 370-6630

OTHER EXAMPLES/CITIES WITH PUBLIC AWARENESS PROGRAMS

Arlington, TX (Department of Engineering Services)

- Community newsletters

Houston, TX

- Public awareness of the Pierce Elevated (I-45) construction project

References

Fenno, David. Analysis of the 1997 Auto Show Public Awareness Survey. Interagency Contract: 406446-0004. Texas Transportation Institute: Houston, TX. (June 1997).

CHAPTER 11
LANE CLOSURES

	Little Rock, AR	Tallahassee, FL	Baltimore, MD	Dallas, TX
Implementation Date	Not Available	Not Available	Not Available	Not Available
Implementation Cost	Not Available	Not Available	Not Available	Not Available
Freeway Miles (km)	69 (110)	12 (19)	69 (110)	579 (926)
Population (1990)	513,117	233,609	2,382,172	2,676,248
Square Miles (Sq. km)	2,909 (7,533)	1,183 (3,064)	2,609 (6,658)	6,186 (16,024)
Population Density (pop. per sq. mi.) (pop. per sq. km)	176 (68)	197 (76)	913 (352)	433 (167)

For a variety of reasons, lanes must be closed to increase the safety and maneuverability of construction crews. However, the improper closure of lanes can result in significant traffic congestion. While they are certainly preferable, alternative routes are not always available. Roadway capacity is one of the first considerations when deciding whether to close a lane. The contractor must ensure that the standards of the city and state are adhered to when performing construction on a public roadway. High capacity roadways with four or more lanes are less sensitive to lane closures. Low capacity roadways with two or three lanes can be severely affected by lane closures which produce significant travel time delays or require roadway detours.

This page intentionally left blank.

Little Rock, AR

LANE CLOSURES

Highlights

- Sponsors: Federal and State
- Limits: Closures are permitted during day, except during peak hours
- Elements: Signs, barricades, lane striping, local newspaper, local traffic reports
- Freeway miles: 69 (110 km)
- Attainment region

Background

The Arkansas Department of Transportation has developed criteria concerning the use of lane closures during highway construction projects in and around the Little Rock area. Roadway lane closures occur only when absolutely necessary. In the past, weekday lane closures were allowed only during non-peak traffic periods, and Saturday lane closures were limited to times other than the peak shopping hours which usually occur during midday. More recently, ADOT has adopted a policy of closing lanes for construction purposes only between the hours of 7:00 pm and 7:00 am. Alternate routes are usually provided when lane closures occur on roadways with large traffic volumes.

Effects

Limited research is available about the impact of lane closures in the Little Rock area. However, lane closures are thought to increase travel times somewhat during the non-peak traffic periods. The impact on the transportation system during the peak travel times due to construction lane closures is minimal since they are not allowed at those times. The recent policy of only having construction lane closures during the evening and early morning hours will considerably lessen their impact on the transportation system in Little Rock.

Public Perception

The policy of conducting lane closures during the evening and early morning hours is a result of the public outcry against their occurrence during the daytime hours. State resident engineers received a significant amount of public feedback from area residents and local merchants that lane closures were decreasing the level of mobility that they require from the transportation system during the daytime. In response, the state DOT now only allows lane closures at night.

Contact Information: Margaret Middleton, Senior Design Technician
Arkansas Department of Transportation
(501) 569-2061

Reference

National Committee on Uniform Traffic Control Devices. Manual on Uniform Traffic Control Devices - For Streets and Highways. Produced by the Federal Highway Administration. (1988).

Tallahassee, FL
LANE CLOSURES

Highlights

- Sponsors: Federal and State
- Limits: Only occur during non-peak periods
- Elements: Signing, radio, television, newspaper
- Freeway miles: 12 (19.2 km)
- Attainment region

Background

FDOT conducts lane closures anytime people, equipment, or materials will be in the vicinity of the travel lane where construction is taking place. Locations that have a high probability of intrusion of passing vehicles into a work zone require a lane closure to insure the safety of the area. Currently, lane closures are only allowed during non-peak travel periods, unless authorized by the state's resident engineer. There are no restrictions on weekend lane closures, except they cannot conflict with any special events in the area. Short term lane closures are conducted using standard traffic barrels or traffic barricades. Long term closures require "New Jersey" barriers and portable changeable message signs to inform motorists of the closure.

Effects

Although limited research is available to determine the impact of lane closures on motorists' travel time delays or their use of alternate routes during construction projects, FDOT assures any inconvenience suffered by motorist is kept to a minimum. Construction contractors are required to monitor the traffic backups that occur as a result of lane closures. On short term construction projects, when traffic backups or queues reach a certain length or the time to go through a construction zone reaches a certain maximum value, the construction contractors are required to halt work and reopen the closed lane. Lane closures are usually addressed in construction projects at the planning stage. FDOT assures that long term lane closures are kept to a minimum within construction contracts by including a penalty fee when construction contractors exceed the maximum time period allowed for a lane closure.

Public Perception

Overall, the general public would rather not experience the traffic delays that usually accompany lane closures at construction projects. FDOT realizes that lane closures can be a substantial inconvenience to motorists. Lane closure information is provided via newspaper, radio, and television, and most construction projects have a public relations official where the public can voice their concerns and any suggestions. The public is reportedly appreciative of the easily obtained lane closure information and that their concerns and suggestions are considered on present and future construction projects.

Contact Information: Archie Montgomery, Chief Area Engineer
Florida Department of Transportation (FDOT)
(850) 414-414

Baltimore, MD
LANE CLOSURES

Highlights
- Sponsors: Federal and State
- Limits: Nighttime lane closures, with few peak-time closures
- Elements: Posted signs, variable message signs, public meetings, toll-free number, radio
- Freeway miles: 69 (110.4 km)
- Non-attainment region for ozone

Background

Standards for lane closures are in place to insure that motorists do not suffer substantial travel time delays. An area's traffic congestion is the first consideration in determining when and where to have a lane closure. The amount of delay is assessed according to traffic counts and past volume statistics. The standards for lane closures require that a lane be closed if it will be obstructed for more than 10 minutes. This standard applies to both primary and secondary roadways. The closure of the first lane at a location requires that a permit be obtained from the district in which the construction work will occur. In heavily traveled areas, it is necessary to reduce the speed limit. Most lane closures take place during nighttime hours, and there are absolutely no peak hour lane closures allowed except in extreme emergencies.

Effects

As a result of the standards created for lane closures and the associated safety considerations, Maryland is using several innovative devices that help motorists stay alert while driving through a construction zone. Experimental barricades were tested which sound an alarm to warn construction workers of the intrusion of a vehicle into a construction zone. Other devices used to warn motorists when they have entered a closed lane are collapsible barriers and low-intensity drums which help the motorist to respond to their driving error.

Public Perception

Motorists have indicated numerous concerns about road construction and closures. At one time, calls were received roughly every 20 minutes concerning the lack of notification of a lane closure. Lane closure information is now made available via newspaper, television, radio, and public meetings.

Contact Information: Robert K. Harrison, Deputy Chief Engineer
Office of Construction.
State Highway Administration
Maryland Department of Transportation
(410) 545-0072

Dallas, TX

LANE CLOSURES-US 75

Highlights

- Sponsor: State and City
- Limits: No peak hour lane closures
- Elements: 12 variable message signs, newspaper, meetings, door hangings
- Non-attainment region for ozone and lead

Background

The City of Dallas has adopted a policy of not having any lane closures during peak traffic hours. A particular roadway project that began in 1990 included the construction of a drainage tunnel. The project is scheduled for completion by the year 2000. Although the project could be completed at an earlier date, construction is limited to being conducted between the hours of 9:00 am and 3:30 pm or during the evening hours after 7:00 pm.

Effects

The limited daily time periods which are available for completing the construction work increase the overall cost of the project. Each extra day that is required to complete the entire project is costing taxpayers an additional $200,000. However, the impact to the transportation system of the construction project during the peak periods is kept to a minimum, thereby keeping travel times and motorists' inconvenience and the associated cost to a minimum. Requiring that lane closures be conducted at non-peak periods actually save the taxpayers substantially more in cost due to travel time savings and inconvenience than the additional daily cost of the construction project itself.

Public Perception

None available

Contact Information: Pat Ellis, Area Engineer
Dallas District
Texas Department of Transportation
(214) 320-6240

SECTION 4

ROAD IMPROVEMENTS

CHAPTER 12
TRAFFIC CALMING

	Boulder, CO	Las Vegas, NV	Portland, OR	Ft. Worth, TX	Seattle, WA
Implementation Date	1994	1995	1984	1998	1978
Implementation Costs (thousands of dollars)	$875 first year	$180 FY 1998	$1,500 (Annually)	$32	$350 for Traffic Circle Prgm.
Primary Services	24 Speed Humps	Road Humps	Traffic Circles	36 Speed Humps	300 Traffic Circles
Population (1990)	85,127 [1]	258,204 [1]	463,634 [1]	447,619 [1]	516,259 [1]
Square Miles (Sq. km)	23 (58)	83 (216)	125 (323)	281 (728)	84 (217)
Population Density (pop. per sq. mi.) (pop. per sq. km)	3,701 (1,468)	3,111 (1,195)	3,709 (1,435)	1,593 (615)	6,146 (2,379)

[1] Population of city proper

As traffic volumes increase on arterials causing increased delays at signalized intersections, some traffic will divert to local streets. Traffic using local streets as a throughway typically have higher speeds than the local residential traffic. As a result, neighborhoods become concerned about the safety of children who may play in or near the street, as well as their own safety when using that street. The emergence of "traffic calming" techniques has provided a solution to concerned neighborhoods.

The construction of "traffic calming" devices is often preferred most by those who live on streets with them, and are often reported to be the most effective and inexpensive techniques to slow traffic speeds and mitigate traffic congestion on local streets. A major area of concern with these devices is the response time of emergency vehicles. Fire departments, in particular, are critical of these devices if they are not built in a manner which allows emergency vehicles to keep their response times low. Some of the cities described in this chapter have, or are trying to, develop "traffic calming" technology that will not affect emergency response times.

Boulder, CO

NEIGHBORHOOD TRAFFIC MITIGATION PROGRAM

Highlights

- Sponsors: Colorado Department of Transportation, Police Department, Transportation Division, Neighborhood Liaison's Office, and the Fire Department
- Cost: First year $875,000
- Funding: Dedicated sales tax and general funds
- Implementation Date: December 1994
- Primary Services: Speed humps (24), traffic circles (8), raised crossings (2), and raised intersection (1)
- Non-attainment region for CO and PM10

Background

In 1994, Boulder developed the Neighborhood Traffic Mitigation Program (NTMP). A group meeting of neighborhood residents, city personnel, and those representing business, pedestrian, and bicycling interests gathered to address traffic safety. Boulder's NTMP, once formed, began to set policies. For example, it was decided that traffic could be calmed on two-lane roads but not on arterials. Additionally, arterials would be the most desirable path for through traffic. Furthermore, any traffic re-routed from a higher classification road to a lower classification one, due to mitigation, would be unacceptable.

Effects

In the first year that the NTMP began service, they received requests from 44 neighborhoods seeking traffic mitigation. Boulder's NTMP relies on the Three "E"s: Education, Enforcement, and Engineering. The first response from the NTMP was to educate the neighborhood. Education for the city's citizens costs less than $1,000 per project. Education is provided via the Neighborhood Speed Watch, the Neighbor-to-Neighbor education kit, and/or the Radar Speed Monitoring Trailer. The data gained by Radar Speed Monitoring Trailers can later be used to help the neighborhood further petition the city for help. Enforcement was the next step and involved increasing the number of police patrols in the area, creating a High Enforcement Zone (HEZ). A neighborhood still troubled by traffic problems could finally receive engineering solutions (e.g., street signs, road humps, traffic circles, etc.). Neighborhoods provide 50% of the funds to build speed humps. The neighborhood also must gather enough signatures in support of the project as well.

While street signs are roughly $200 each, their effectiveness has been minimal. Maintenance costs and "sign/marking pollution," tend to offset the low cost as well. There are currently 24 permanent speed humps, 12 feet (3.6 m) in length, 3 to 4 feet (0.91 - 1.2 m) in width, costing between $1,000 and $10,000. Boulder also has eight permanent traffic circles, 20 to 30 feet (6.1 to 9.1 m) in diameter, costing approximately $10,000 to $40,000. Traffic circles have slowed speeds to between 15 mph and 20 mph (24 kph and 32 kph).

There are two streets with permanent raised crossings, with lengths of 18 to 23 feet (5.4 to 7.6 m), costing between $1,000 and $10,000. These devises raise the roadway approximately 6 inches (15.24 cm), creating a "table-top" effect. Their length allows long vehicles, such as fire engines, to get both wheels on top of the device, lessening the shock to the vehicle and its passengers. These "table-tops" are ramped between 7 and 12 feet (2.1 and 3.6 m) long, according to the desired speed limit. These devices are also known as "Raised Crosswalks" when utilized in conjunction with pedestrian use.

One permanent raised intersection is currently in use in Boulder, costing more than $40,000. It is much like the raised crossing in that a "table-top" is created. However, the "table-top" covers the entire intersection area, raising it to the height of the curb.

Combined, these devices have lowered the speed on one street by 8 mph (13 kph). On another street, average daily traffic was reduced by 4.6%.

Due to complaints from Emergency Medical Services, the City of Boulder stopped NTMP from installing traffic mitigators in 1997. The NTMP is now experimenting with traffic mitigators which would not slow down emergency response times, including staggered speed humps, conical (i.e., "volcano") type traffic circles, and slotted speed humps.

Public Perception

A 1997 Citizen Survey by the City of Boulder reported that 80% of Boulder's residents believed that there was too much traffic. Two-thirds reported that traffic is a major and growing problem. Those residents who live in the neighborhoods in which the traffic calming devices are placed are very happy with them and support them completely.

Emergency response departments, such as fire and emergency medical services, find the current devices very unappealing (due to a delay in response time of 6 - 7 minutes).

Contact Information: Noreen Walsh, Project Manager
Neighborhood Traffic Management Program
Public Works Department
City of Boulder
(303) 441-3266

References

Van Note, Kathryn. Neighborhood Traffic Mitigation Program: Tool Kit. Produced by the City of Boulder, Colorado.

City of Boulder-Public Works, Transportation Division. "Neighborhood Traffic Mitigation Program." Accessed: 9 November 1998.
<http://publicworks.ci.boulder.co.us/DEPTS/TRANS/NTMP/your_ntmp.htm>

Las Vegas, NV
NEIGHBORHOOD TRAFFIC MANAGEMENT PROGRAM

Highlights
- Sponsors: City of Las Vegas, Department of Public Works (DPW)
- Cost: $180,000 for FY 1998
- Funding: All funds are derived from City of Las Vegas' general funds
- Implementation Date: May 3, 1995
- Primary services: Road humps, chokers, roundabouts, delineators
- Non-attainment region for CO and PM10

Background

Responding to the need for increased livability on "local residential streets," the City created the Neighborhood Traffic Management Program (NTMP) in 1995. Objectives set by the NTMP stress attainment of both growth and neighborhood livability. NTMP goals are set by the City and the DPW, and include: "mitigating the impact of vehicular traffic," "encourag[ing] citizen involvement," and "efficiency." Policies of NTMP include re-routing of through traffic to arterial streets and the maintenance of "adequate emergency vehicle access," via traffic circles, speed humps, diverters, medians, curb extensions, chicanes, and cul-de-sacs. NTMP offers two types of projects: "local residential street projects," and "neighborhood area studies;" they involve placing traffic mitigators on only one street and addressing problems such as speeding and excess through traffic, respectively.

The process can begin with a request by one or more citizens. The City gathers preliminary data, delegating "point assignments" according to the seriousness of the problem. Projects ranking highest are addressed first. However, a neighborhood, with the permission of the City, may develop and implement their own NTMP. If a neighborhood is ranked high enough, a "petition-to-study" must be circulated and signed by a majority of all businesses and households potentially affected by the project. A public meeting is then scheduled in which a "citizen traffic committee" is formed. Following the completion of these steps, test installations, project evaluations, balloting, City Council action, design and construction, monitoring, and follow-up evaluations are conducted. After construction, the City is responsible for the maintenance of the devices.

There are a number of devices used by the city, including speed humps, traffic circles, street closures, chokers, and stop signs. The most widely used traffic calming device in Las Vegas is the speed hump. In 1997, 74 speed humps were created on 17 streets. These passive speed mitigators work 24 hours per day with no need for enforcement. The speed humps vary in size from 14 to 22 feet (4.2 to 6.7 m), and are approximately 3 inches (7.6 cm) tall. To minimize the amount of liability subject to the city, certain precautions such as a 25 mph (40 kph) speed limit sign, street lighting, warning signs, recommended crossing speed signs, and distinctive paint markings are utilized.

Mini-roundabouts, or traffic circles, have helped to slow speeds and are most effective when used in a series along a single street. They also aid in the decrease of reported traffic accidents. Closures of streets have reportedly resulted in both a reduction of speed and traffic volume.

Chokers or curb extensions narrow the local neighborhood street by extending the sidewalk, making automobile travel less comfortable and pedestrian crossing easier. Semi-diverters reduce traffic volumes by blocking one side of a neighborhood street's entrance. Chokers have worked especially well in reducing the impediment to emergency vehicles, since they can be mounted by all emergency response vehicles. Diagonal diverters are created by placing barriers at intersections, from one diagonal corner to the other, making it impossible to travel straight through an intersection. Diagonal diverters are effective at reducing traffic volumes and can be designed to allow emergency vehicles to pass unimpeded. Intersection channelization can take many shapes and designs depending on the task. They often route traffic, via curbs or medians, so as to limit access onto a particular street.

Stop signs are not utilized as traffic calming devices. The City of Las Vegas has determined that they actually increase speeds and the number of accidents when used for the purpose of traffic calming. The City uses them solely for the purpose of delegating the right-of-way at intersections.

Las Vegas reports that only 3 of 14 traffic management devices serve to positively reduce speed. They include photo radar, speed humps, and traffic circles. Only one category serves to positively effect traffic diversion, and that is the diverter/semi-diverter/cul-de-sac. The cost effectiveness during construction of a street hump, rumble strip, and one-way street ranks "high." The city notes that improvements to arterial streets are "unlikely" to reduce speeds or divert traffic from neighborhood streets.

Public Opinion

Residents on Neighborhood Traffic Mitigation Program streets applaud its effects. On average, they report that traffic volume and speeds do decrease. Non-residents who once sped through these neighborhoods are vocal in their complaints.

Contact Information: O.C. White, Program Director
Traffic Engineering Department
City of Las Vegas
(702) 229-6327

References

The City of Las Vegas. A Neighborhood Traffic Management Program for the City of Las Vegas: A Report for the City Council of Las Vegas. (3 May 1995).

Whitely, Joan. Las Vegas Review Journal, LIFESTYLES. "Homeowners Applaud Use of Residential Speed Humps." Last revised 29 April 1997.
<http://www.lvrj.com/lvrj_home/1997/Apr-29-Tue-1997/lifestyles/5246605.html>

Portland, OR

THE TRAFFIC CALMING PROGRAM (TCP)

Highlights

- Sponsor: City of Portland, Oregon
- Cost: $1,500,000 per year, utilized mainly for capital and operating expenses
- Funding: General Transportation Revenue, Transportation Intraservice Revenues, Parking Meter Revenues, Traffic Ticket Revenues, and a State Gasoline Tax
- Implementation Date: 1984
- Primary services: Curb extensions, slow points, traffic circles, speed bumps
- Non-attainment region for PM10

Background

The City of Portland, Oregon, has produced an innovative and inclusive plan to promote traffic calming in their City. The program's goal is to increase the livability of neighborhoods by providing safer streets. Portland created (under the Bureau of Traffic Management [BTM]) the Neighborhood Traffic Program in 1984 (later renamed the Traffic Management Program in 1992) to deal with the problem of traffic congestion and speeding on "Local Service Roads," "Neighborhood Collectors," and "Arterials." City of Portland Municipal Code - Title 16 allows the City to use traffic calming devices on neighborhood streets burdened by speeding traffic. Portland involves the public in the City's efforts to educate, enforce, and engineer (the Three "E"s) . Local service street projects are solely initiated by neighborhood associations. Public involvement includes the issuing of radar guns to neighborhood associations who can use them to issue warnings to speeders. Another community solution involves hanging "Slow Down" banners on neighborhood streets. The BTM must rank streets in order to determine whether, and to what degree, a neighborhood needs traffic calming devices. BTM analyzes and ranks the street(s) according to speeds, traffic volume, etc. This is followed by public surveys, plan development, petitions, ballots, city council action, and eventually, a trial solution.

Effects

The City has relied primarily on traffic calming devices such as curb extensions, slow points, traffic circles (70), and speed humps (470). Others include traffic diverters, school safety zones, flashing beacons, stop signs, cul-de-sacs (13), and street signs. The cost for a 22-foot (6.7 m) speed bump ranges from $1,500 to $2,000; curb extensions range from $7,000 to $10,000; traffic circles cost $5,000 - $15,000; slow points range from $8,000 to $15,000.

Portland will also randomly study particular streets which utilize the traffic calming devices to determine their efficacy. In a study which examined particular streets between 36 to 76 months after traffic calming implementation, traffic circles (with a diameter of between 6.1 and 7.6 m) were reported to have decreased reported accidents on local service roads by 30%. Neighborhood collector streets utilizing the 22-foot (6.7 m) speed hump saw a 36% reduction in reported accidents.

Local service roads utilizing the 14-foot (4.2 m) speed hump experienced a 39% decrease in reported accidents.

Recently, the City has begun to use new technology to determine how effective a speed hump will be at a particular location, and this process saves the City thousands of dollars. Additionally, Recycled Technology, Inc. of Tualatin, Oregon, in cooperation with the City of Portland, developed rubber speed humps 14 feet-long (4.2 m). These new humps are easily and inexpensively installed and/or moved.

Public Perception

None available

Contact Information: Ellis McCoy, Program Manager
Traffic Calming Program
City of Portland
(503) 823-5214

References

City of Portland, Office of Transportation. "Studies and Reports." Last revised 15 October 1998. <http://www.trans.ci.portland.or.us/Traffic-Management/Trafficcalming/reports.htm>

Fort Worth, TX
THE TRAFFIC CALMING PROGRAM

Highlights
- Sponsor: City of Ft. Worth
- Cost: $32,000 for implementation
- Funding: City General Funds
- Implementation Date: 1998
- Primary Services: 36 speed humps on five streets
- Non-attainment Region for ozone and lead

Background

The City of Ft. Worth decided to expand its traffic calming program on July 21, 1998, after success with its pilot project which began earlier that year. The pilot program constructed 36 speed humps 3 inches (7.6 cm) high on five streets that were experiencing severe traffic congestion and speeding problems. At the conclusion of the pilot program, the City Council decided to let neighborhoods petition for road humps on their streets. The petitioning neighborhood must receive the approval of at least two-thirds of the residents living on a street to receive the small amount of funding available. Because of the shortage of funds, neighborhoods which apply first receive funding first. However, exceptions will be made if a street is in serious need of "traffic calming." The city said it would spend $60,000 on more road humps for the months of July, August, and September of 1998, and the City Manager proposed spending an additional $60,000 in FY 1998-99.

Effects

On one of the streets, Clayton Road, used in the pilot program, speeds were reaching 60 mph (96 kph) on the 30 mph (48 kph) road. At first, police used a "zero tolerance" approach, spending 11 days on Clayton Road, and issuing 2,520 traffic citations. Second, was the construction of 13 speed humps on the 2.2 mile (3.5 km) long local artery; speeds were reduced from 39 to 31 mph (62 to 50 kph). However, it finally took the installation of several stop signs on the road to lower the average speed from 44 to 39 mph (70 to 62 kph). The traffic volume was reduced 22% from 2,489 vehicles per day to 1,951 vehicles per day.

Public Perception

Some of those who live on the traffic calmed streets claim to find the speed humps as annoying as those who use the roads as throughways. However, the difference is that those who live on "traffic calmed" streets know that these devices are necessary and desire them for the safety of their children and themselves. Those who do not live on these traffic calmed streets are the only ones to actually complain to the city. Opponents mention worries concerning wear and tear on their cars, emergency response times, and the cost of the program. Some believe that those tax dollars would be better spent on more police patrols in the areas. However, the Chief of Police responded after their "zero tolerance" operation that the Department could not afford the manpower it would require to patrol those areas in such a similar manner and result.

Contact Information: Hugo Malanga, Director
Transportation and Public Works
City of Fort Worth
(817) 871-8900

Reference

Smith, Jack. "Fort Worth s-l-o-w-s Traffic." *Fort Worth Star-Telegram.* (22 July 1998): B (6).

Seattle, WA
NEIGHBORHOOD TRAFFIC CONTROL PROGRAM

Highlights

- Sponsor: Seattle Transportation (SEATRAN)
- Cost: $350,000 dedicated to the Traffic Circle Program
- Funding: State Gasoline Tax, State Vehicle Licence Fee, Neighborhood Street Fund, and Neighborhood Matching Funds (money or labor)
- Implementation Date: 1978
- Primary services: Speed watch programs, traffic circles (300), chicanes (12 sets), speed humps (30 on 6 streets),
- Non-attainment region for PM10

Background

Approval of the Forward Thrust Bond Issue in 1968 allowed Seattle to move forward on its plan to revitalize deteriorating neighborhood through streets. In the 1970s, the City began testing temporary traffic calming devices using barriers to simulate traffic circles, partial closures, full closures, and diagonal diverters.

In 1978, the annual Neighborhood Traffic Control Program (NTCP) was established. Neighborhood Transportation Plans (NTP) are put into effect when a neighborhood experiences excessive traffic volumes and speeds. The goal of the NTP is to improve the flow of arterial streets and slow speeds in neighborhoods.

The first step in a NTP is a Neighborhood Speed Watch Program. It is the least expensive option offered by the City. The next most highly preferred options are physical devices which slow traffic (e.g., traffic circles, chicanes, and speed bumps). These devices may result in decreasing traffic volumes as well. However, they are not meant to restrict access to a street. Traffic circles receive annual funds from the City's Transportation Operating Budget which amounts to $350,000 annually, and is derived for the most part by a State Vehicle Licence Fee. Chicanes and speed humps have no dedicated funding, instead receiving their funding via a general Neighborhood Street Fund. The City's least preferred traffic calming options are physical devices which divert traffic (e.g., partial closures, full closures, and diagonal closures). These devices are less favorable due to their impact on emergency, service, and residential access.

NTCP is funded to build 30 traffic circles per year at a cost ranging between $4,000 and $6,000. Others who help to fund these circles are private developers, neighborhoods with matching funds, and neighborhood street funds (which allow the citizens to choose those projects they find most desirable). Any citizen (or even the city) may initiate the process to mitigate traffic volume and speed. Neighborhoods are ranked in order of need and compete for city funds.

Since 1973, more than 600 traffic circles have been constructed. The traffic circles are made to fit within the intersection without the need to alter the sidewalks in any way. The average street in Seattle being 25 feet (7.5 m) wide; the average traffic circle is 12 to 16 feet (3.6 to 4.8 m) in diameter. Traffic circles are also constructed with a mountable curb to allow for quicker response times for emergency vehicles. Indeed, all plans that involve the fitting/retrofitting of intersections to include traffic circles are reviewed by the Fire Department and King County Metro. Residents living in a neighborhood are allowed to maintain landscaping on the circle, making the circle more visible to drivers, and more pleasing to residents.

Effects

All of the devices listed above have considerably lowered the number of traffic accidents and the speed in neighborhoods. SEATRAN gets an average of 700 requests per year for traffic circles alone.

Seattle reports that it has found the traffic circle to be the most preferable traffic calming device at its disposal. It is the most effective device to control both speeding and reduce traffic accidents with very little controversy. Traffic circles do not divert traffic onto other roads substantially. While volumes remained the same, a study showed a 94% drop in accidents over a one year period after traffic circles had been constructed in an area. Injuries, too, fell from 153 to only 1 at those intersections.

Public Perception

Directors of NTCP feel that public sentiment is divided among two extremes. However, the City reports that the majority of citizens feel extremely positive about the traffic calming devices. According to mail surveys conducted by the City, between 80% to 90% of the residents feel that traffic circles are effective and would like them to remain.

Contact Information: James Mundell, Program Manager
Neighborhood Traffic Engineering
Seattle Transportation (SEATRAN)
(206) 684-0814

References

Seattle, Washington. "Seattle Transportation Home Page." Last revised 13 August 1998. <http://www.ci.seattle.wa.us/td/newhome.htm>

U.S. Roads: Road Management & Engineering Journal. "Neighborhood Traffic Calming: Seattle's Traffic Circle Program." Accessed: 9 November 1998. <http://www.usroads.com/journals/rmej/9801/rm980102.htm>

OTHER EXAMPLES/CITIES WITH TRAFFIC CALMING

Washington, D.C. (The International City/County Management Association)

- The Association has produced a report entitled "Traffic Safety: Local Options," concerning strategies for the implementation of such options as traffic calming.

Reference

Meagher, Joan., ed. "Intelligence." *The Urban Transportation Monitor.* Vol. 12, No. 9. (8 May 1998): 5.

Sioux City, Iowa

- A report on the issue of speed humps

Reference

Smith, Duane E., and Karen L. Giese. "A Study on Speed Humps." Last revised September 1997.
<http://www/ctre.iastate.edu/projects/other/roadhump/speedhump.htm>

Maryland County, MD

- Approximately 1,000 speed humps at a cost of $1,645 per hump
- Speeds on traffic calmed streets have decreased, while parallel streets have experienced increased speeds.

Reference

Meagher, Joan., ed. "Speed Humps Create Controversy Among Residents in Maryland: Traffic Engineering Study Shows Net Benefits." *The Urban Transportation Monitor*. Vol. 12, No. 4. (27 February 1998): 1.

Montpelier, Vermont (Keck Circle)

- Modern roundabout almost five blocks from the State Capital
- 111 residents from the area surrounding Keck Circle were polled
- 85.5% of respondents had a favorable or neutral opinion of the device
- "By a 30-7 margin, very favorable responses outnumbered very unfavorable responses."

Reference

Redington, Tony. "Montpelier's Modern Roundabout at Keck Circle Neighborhood Opinion Survey: January 1997." Last revised January 1997.
<http://www-uftrc.ce.ufl.edu/wwwround/montpeli.htm#Facts>

ADDITIONAL REFERENCE

Smith, Duane E., and Karen L. Giese. "A Study on Speed Humps." Last revised 9 November 1998. <http://www.ctre.iastate.edu/projects/other/roadhump/speedhmp.htm>

CHAPTER 13
ACCESS MANAGEMENT

	Irvine, CA	Melbourne Area, FL	Atlanta, GA	Overland Park, KS	Plano, TX
Implementation Date	1998	1997	1990	1986	1998
Implementation Cost (millions of dollars)	Not Available	$4.23	$3.9	Not Available	$6
Primary Improvements	4-lane, median	4-lane divided arterial	6-lanes, raised median	Arterial and raised median	6-lanes, 24' (7.3 m) median
Population (1990)	110,330 [1]	60,034 [1]	393,929 [1]	111,790 [1]	127,885 [1]
Square Miles (Sq. km)	42 (110)	29 (74)	132 (341)	56 (144)	66 (172)
Population Density (pop. per sq. mi.) (pop. per sq. km)	2,627 (1,003)	2,070 (811)	2,984 (1,155)	1,996 (776)	1,938 (744)

[1] Population of city proper

Access management is the control of intersections and driveways that intersect an arterial roadway. It is based on the concept of reducing potential vehicular conflict by reducing conflict points (i.e., reduce their number, separate them, and remove slower traffic). If access is not managed on a busy arterial, traffic flow will decrease on the arterial, leading to increased levels of traffic congestion and/or accidents. Features of access management include the spacing and design of driveways, median use and the number of median openings, shared access improvements, turn lanes, and freeway interchange spacing and design. Various combinations of these and other access management features are included in this chapter.

References

Minnesota Department of Transportation. "Transportation Questions and Answers." Last revised July 1998. <http://www.state.me.us/mdot/planning/rtacnews/current/q&a.htm>

Ohio-Kentucky-Indiana Regional Council of Governments. Access Management: A Policy for Local Communities. National Transportation Library. (March 1988): 1-26.

Bureau of Transportation Statistics. "Access Management: A Policy for Local Communities." Last revised March 1988. <http://www.bts.gov/ntl/DOCS/AMPLC.html>

Irvine, CA

ALTON PARKWAY

Highlights

- Sponsor: City of Irvine
- Cost: Not available
- Funding: City of Irvine
- Implementation Date: 1998
- Primary Services: 8.5-mile (13.6 km), four-lane, raised median roadway
- Non-attainment region

Background

For new communities such as Irvine (incorporated in 1971), use of a master plan is effective in simplifying the issuance of access points for development, due to the fact that access management features are pre-set by existing criteria. Irvine is an example of a city guided by a master plan that integrates land use and transportation. As a result, access management is a major component in land planning and development. Access management is taken into account in three stages of the City's master planning processes. The first stage is the general plan. Within Irvine's general plan is its circulation element, which is unique in that it includes a hierarchy of arterial roads based on their level of access management. The hierarchal rankings range from arterials which have restricted access, serve as a supplement for a highway, with no on-street parking to local streets which typically provide access to residential and business developments. Irvine's general plan calls for a restriction of access for non-retail developments or non-accessible developments that are adjacent to a thruway or parkway. Additionally, only one driveway is allowed for each property unless those within the property can show a need for additional access via a circulation plan. If any non-retail property is adjacent to more than one roadway, access is only made available from the lower classified roadway. The second stage in which access management is addressed is within the Tentative Tract Map, which is used in the planning of each of the twenty "villages" within the city. An access plan accompanies the distinction of each parcel of land included within the Tentative Tract Map. These parcels are quite large, giving the city flexibility in permitting access. In the third phase, the site plan review process, site plans are made in accordance with the tentative tract access map plan, with exceptions made as necessary.

Effects

Since the City of Irvine is so young, current development is based on the three stages listed above. As a result, most arterials in Irvine operate at 45 or above mph (72 kph) or more. In 1993, these arterials provided for the movement of more than 30,000 vehicles per day, and the city's accident rates were much lower than California's average rate. An example of an access management project that has been occurring for more than 10 years is the Alton Parkway project. On this corridor, 8.5 miles (13.6 km) of two-lane roadway have been converted to a four-lane roadway with a raised median. Alton Parkway traverses the entire city, passing through residential and business areas. The raised median ranges in width from 14 to 26 feet (4.2 to 7.9 m). Spacing between median openings is a standard 0.25-mile (0.4 km). Left-turn bays are also present at many locations along the median. The minimum distance between service road access points or driveways ranges from 300 to 500 feet (91 to 152 m) before an intersection. Right-in/right-out adjacent driveways are planned to be no less than 300 feet (91 m) apart. Right-turn acceleration and deceleration lanes are common features of the corridor and are standard in areas of new development. In order to accommodate those drivers who must reverse direction to gain access to the other side of the road, U-turns at intersections are allowed. Right-turn-on-red and other techniques are in place to protect these U-turn maneuvers.

Public Perception

Concern from the owners in residential and business areas has been minimal. In the case of commercial areas, little disapproval has arisen since most business along Alton Parkway has occurred during its improvement. As for the residential area, there were concerns about safety near a high school, so speed limits were reduced to alleviate danger. Speeds in the residential area are presently 45 mph (72 kph), while business area speeds reach 55 mph (88 kph).

The City of Irvine did acknowledge the citizens' and business owners' concerns regarding safety and access. Resistance from the business community was largely nonexistent due to the fact that many of the businesses that now occupy parcels adjacent to Alton Parkway were constructed as the road was being widened. Therefore, the business owners had advance knowledge of the impending roadway changes.

Contact Information: John Toolson
City of Irvine
Traffic Operations
(949)724-7643

Reference

Neustaedter, Craig, and Joann Lombardo. "Arterial Access Management Issues and Opportunities: Three Southern California Case Studies." *1993 Conference on Access Management Compendium of Papers.* (1993): 253-255.

Melbourne Area, FL

NEW HAVEN AVENUE

Highlights

- Sponsor: Florida Department of Transportation
- Cost: $4,230,000
- Funding: Florida Department of Transportation
- Implementation Date: June 1997
- Primary Services: A four-lane divided arterial
- Attainment region

Background

The State of Florida was among one of the first states to establish a comprehensive access management program. Beginning in 1991, the Florida Department of Transportation (FDOT) adopted standards for the provision of restricted medians, interchange spacing, traffic signal spacing, median opening spacing, and driveway spacing. FDOT has mandated that any multi-lane roads with design speeds of 40 mph (64 kph) include restrictive medians. Restrictive medians are a major feature in FDOT's access management strategy. FDOT classifies a road for restrictive medians, even in cases where no restrictive median is in place. That is, a roadway is classified for restrictive medians so that these devices will be put in place when, or if, the roadway is reconstructed. FDOT is concerned with the turning movements at driveways and median openings. Directional median openings physically restrict specific turning movements of vehicles, such as left turns.

Effects

In April of 1996, a 5.1-mile (8.16 km) four-lane section of New Haven Avenue (US 192) was modified. The land uses adjacent to US 192 are mainly commercial and office, with residential development behind them. Speed limits on the roadway are between 40 and 45 mph (64 to 72 kph). Traffic counts at three locations found that the total weekday volume of traffic along this section of roadway was approximately 110,000. Transportation Engineering, Incorporated (TEI) had determined in their study for FDOT that openings along the 40-foot (12 m) wide median were either too close together and/or of substandard quality. Their suggestions were to include the closure of 16 median openings and the modification of 42 full openings into directional median openings. Before construction, there had been a total of 12 signalized median openings and 65 unsignalized full median openings. None of the signalized median openings were eliminated. The TEI study yielded the following data concerning the "before" and "after" effects of the US 192 project:

- rates of collisions decreased 15%,
- injury rates decreased 24%,
- traffic volumes increased dramatically,
- travel speeds increased, and
- left turn collisions decreased by a significant amount.

Public Perception

TEI noted that the public was very concerned about how the access management changes would affect them or their businesses. FDOT addressed the public's fears, and after construction was completed along US 192, public correspondence eventually ceased.

Contact Information: Jim Wood
Regional District Office
Florida Department of Transportation
(904)943-5320

References

Wu, Co-Co. Median Modifications after Study for US 192 from East of I-95 to East of Babcock Street, Brevard County. Transportation Engineering, Inc.: Altamonte Springs, FL. (July 1998).

Sokolow, Gary H. "Practical Considerations for Beginning a Comprehensive Access Management Program." *First National Conference on Access Management Compendium of Papers.* (1993): 69-73.

Atlanta, GA

MEMORIAL DRIVE (STATE ROUTE 10)

Highlights

- Sponsor: Georgia Department of Transportation
- Cost: $3,919,876
- Funding: The Georgia Department of Transportation
- Implementation Date: September 30, 1990
- Primary Services: A six-lane arterial with raised median
- Non-attainment region for ozone

Background

In the early 1980s, Memorial Drive came to the attention of the Georgia Department Of Transportation (GDOT) as a result of the number of injuries and fatalities caused by accidents, particularly at mid-block, and increased traffic volumes. By 1986, GDOT had consulted with county officials and obtained funding for the installation of a raised median separation. In 1987, GDOT met with citizens concerning the planned improvement. Opposition by merchants was great and led to the modification of the project from a median barrier to a raised median, including additional median openings. On July 28, 1989, GDOT began construction on Memorial Drive, replacing a two-way left turn lane (TWLTL) with a raised median along a 4.34-mile (6.9-km) section of Memorial Drive. The modification maintained 14 median openings at major intersections and key driveways and equipped them with traffic signals. All but one intersection allowed drivers the option to make U-turns. Cross traffic at these intersections was, therefore, not allowed to turn right on red lights. A total of seven large intersections on the corridor were not provided with median openings. Since shared access was not part of the Memorial Drive project, there was no construction of joint parking lots, alleys, frontage roads or driveways. The raised median was constructed with a width of 14 feet (4.2 m) and a height of six inches (15 cm). The raised median narrows at intersections to a width of five feet (1.5 m), due to the presence of left-turn lanes. The medians at intersections are constructed to be mountable for the benefit of emergency response vehicles and also so as not to further disrupt an errant driver that may come in contact with the median. The medians are also treated with yellow thermoplastic paint and yellow reflectorized raised pavement markings. The speed limit on this section of Memorial Drive is currently 45 mph (72 kph).

Effects

While the effect on the business community along this stretch of Memorial Drive is somewhat inconclusive, the decrease in the accident rates is remarkable, according to research. A study produced by the Georgia DOT states that roughly 300 accidents and 150 injuries were prevented after the installation of the raised median. This translates to 37% and 48% drops in these occurrences, respectively, in addition to a 64% drop in left-turn accidents. While allowing traffic to make a U-turn can be problematic, this did not raise the accident levels at intersections along Memorial Drive. Furthermore, injury levels are not higher at this type of intersection either, since accidents that occur as a result of a U-turn often occur at much lower speeds. There were a large number of pedestrian deaths and injuries along this section of Memorial Drive before the construction of the raised median. Two and one-half years after the median was constructed, there had been no pedestrian fatalities, in contrast to the 15 lives that were lost on this segment of Memorial Drive between 1979 and 1989. The median now tends to provide a safety island for the many pedestrians who cross this roadway. Data show that daily traffic volumes decreased after construction of the raised median from 50,400 to 43,000. Data show that while traffic volumes on Memorial Drive dropped 12%, traffic volumes on roadways in a two-mile (3.2-km) radius dropped as well, by 5.5%. Researchers believe that many factors could have been involved in the decline of traffic volumes, including a nationwide recession, other construction projects within the two-mile (3.2-km) study zone, or the closing and/or transition of many businesses in the area. Businesses affected by the construction of the raised median were mainly of the convenience store type. These types of business are usually found frequently on both sides of the street, so motorists find it easier to continue forward, rather than make a U-turn.

Public Perception

The public was informed of, and involved in, the construction of the Memorial Drive project. Some merchants expressed displeasure with the construction and its impact of businesses.

Contact Information: George Boulineau, Director
Planning and Programming
Georgia Department of Transportation
(404) 656-0610

Reference

Parsonson, Peter S., Marion G. Waters, and James S. Fincher. "Effect on Safety of Replacing an Arterial Two-Way Left-Turn Lane with a Raised Median." *First National Conference on Access Management Compendium of Papers.* (1993): 265-269.

This page intentionally left blank.

Overland Park, KS

135th STREET (Kansas State Highway 150)

Highlights

- Sponsors: Cities of Overland Park, Leawood, and Olathe
- Cost: Not available
- Funding: Not available
- Implementation Date: Design concept approved in 1986
- Primary Services: Nine-mile (14.4 km) multi-lane arterial with median, and limited right-turn-only access
- Attainment region

Background

In 1984, the Cities of Overland Park, Leawood, and Olathe joined together to produce a study concerning the area one mile north and south of 135th Street, a major arterial also known as Kansas State Highway 150 (K-150). Large traffic volumes on K-150 and anticipated development on adjacent land prompted this study. The objective of the K-150 Corridor Study was to provide data concerning the relationship between land use patterns under full development and transportation, as well as safety and efficiency. In 1986, the three cities approved a design concept that would consist of a multi-lane divided roadway with median openings every half-mile (0.8 km), right-turn-only access, and reverse frontage roads (along the back sides of properties) every quarter-mile (0.4 km) in areas of intensive development. Although the Kansas Department of Transportation (KDOT) owned 135th Street, it limited its participation to endorsement of the concept.

Effects

Since the adoption of the K-150 Corridor Study recommendations, Overland Park has endeavored to apply them as uniformly as possible. As expected, developers have had different ideas concerning the access that their property should be allowed. These development matters are handled on a case-by-case basis.

Public Perception

None available

Contact Information: Mike Ross
Public Works Department
City of Overland Park
(913)895-6038

Reference

Stuecheli, Michael J. "Trials and Tribulations of Enforcing a Locally Established, Corridor-Wide, Restrictive Access Plan - Implementation of the K-150 Study." *The Second National Conference on Access Management.* (1996): 1-7.

Plano, TX

ACCESS MANAGEMENT / CUSTER ROAD

Highlights

- Sponsor: City of Plano
- Cost: $6,326,992
- Funding: Capital Improvements Program
- Implementation Date: Construction began February 1998
- Primary Services: 6-lane roadway with 24-foot (732 cm) median
- Non-attainment region for ozone and lead

Background

The City of Plano's Development Services Department has composed a "Thoroughfare Standards Rules and Regulations manual to inform the public of the City's policies concerning access management. Streets are assigned designations from "A" to "G." Only the streets designated as "D" or higher are equipped with medians which range in width from 20 to 28 feet (6.1 to 8.5 m).

Type	Designation	R-O-W	Pavement Lanes/Lane Width	Median
Expressway	A	144'-244' (44 m - 74 m)	6/12' (3.7 m)	28' (8.5 m)
Major Thoroughfare	B+ B	140' (43 m) 130'-160' (40 m - 49 m)	8/12' (3.7 m) 6/12' (3.7 m)	20' (6 m) 24' (7 m)
Major Thoroughfare	C	110' (34 m)	6/11' (3.4 m)	20' (6 m)
Secondary Thoroughfare	D	92' (28 m)	4/12' (3.7 m)	20' (6 m)

An "A" designation is given to all expressways in the city. Major thoroughfares with rights-of-way between 130 and 160 feet (39 and 48 m) are designated as "B" major thoroughfares. A "C" designated major thoroughfare is a road with a right-of-way of 110 feet (33 m). Type "D" roads have rights-of-way of 92 feet (28 m) and are classified as secondary thoroughfares. Major and secondary thoroughfares are open only to "commercial" and "industrial" driveways, not "residential." Posted speed limits on the roads described above range from 35 to 50 mph (56 to 80 kph). Spacing between median cuts vary according to the speed of the roadway (e.g., 100 feet [30 m] for type "D" and 200 feet [61 m] for type "A's"). Additionally, type "A through D" thoroughfares are not fronted by residential houses. Any median opening and left-turn lane that is constructed for a private drive or new road is paid for by the developer served by that opening. Minimum distances between median openings range from 310 to 220 feet (94 and 67 m). The City has mandated that any roadway with a classification of less than type "D" that connects to a type "A" thoroughfare shall have a deceleration lane. Construction costs for this device shall be paid for by the developer of the land. Additionally, egress from driveways shall use a 40 degree exit radius. Median openings and traffic signals on type "A" thoroughfare roadways are not built within one-quarter mile (0.4 km) of each other, and only at cross streets. These median openings are to be accompanied by left-turn bays in both directions of not less than 150 feet (45 m) each. The Dallas North Tollway Corridor spanned in length from the City's southern border to Spring Creek Parkway in 1997. The City of Plano has mandated that driveways along the Tollway will be spaced at least 160 feet (48 m) away from an intersecting cross street on the service roads that run parallel to the Tollway. There is also a minimum spacing of 325 feet (98 m) between driveways. At no point shall a drive be present less than 400 feet (121 m) from an entrance ramp, or exit ramp. Additionally, no drive will be closer than, or less than, 50 feet (15 m) from an entrance or exit ramp, respectively.

Effects

Custer Road is a project the City of Plano has begun construction on which has widened an existing two-lane roadway to six-lanes, with a 24-foot (7.3 m) wide raised median. The project includes the extension and realignment of the roadway as well. The roadway now travels through undeveloped land for the most part, and hence, there are hardly any median cuts. These will be constructed and paid for by developers according to City rules. Currently, there are five median openings which cost approximately $30,000 to $45,000 each. Three of these median cuts are to public right-of-way roadways.

Public Perception

In the words of those with the City of Plano, the retrofitting of any roadway to include additional access management features in a developed area at this time would be political suicide. A proposal to construct an overpass at one major intersection in the City was quickly and vociferously rebuffed by the business community at this intersection. The City is still young and growing, and concerns of increasing traffic flow or safety to levels any higher than they are now seems unnecessary to those in the business community.

Contact Information: Lee Stimpson, Traffic Engineer
Traffic Engineering
City of Plano
(972) 461-7152

Reference

City of Plano. Thoroughfare Standards: Rules and Regulations. Development Services Department: Plano, TX. (August 1997).

OTHER EXAMPLES/CITIES WITH ACCESS MANAGEMENT

State of Florida

- Attempting to "withstand the demands of roadside development."
- "A new rule promulgated by the state's land use agency . . ." which will standardize land use next to highways.

Reference
Huntington, Del, and Richard McSwain. "Access Management and Facility Planning in Oregon." *1993 Conference on Access Management Compendium of Papers.* (1993): 75-78.

Upland, CA (Foothill Boulevard)

- The Foothill Boulevard Vision Plan

Reference
Neustaedter, Craig, and Joann Lombardo. "Arterial Access Management Issues and Opportunities: Three Southern California Case Studies." *1993 Conference on Access Management Compendium of Papers.* (1993): 253-257.

Anaheim, CA (Commercial Recreation Area)

- Adopted ordinance (11/90) which recommends such features as a "[m]inimum lot frontage of 175 feet for new developments."

Reference
Neustaedter, Craig, and Joann Lombardo. "Arterial Access Management Issues and Opportunities: Three Southern California Case Studies." *1993 Conference on Access Management Compendium of Papers.* (1993): 253 -257.

CHAPTER 14
BICYCLE / PEDESTRIAN PATHS

	Davis, CA	Minneapolis, MN	St. Louis, MO	Austin, TX	Madison, WI
Implementation Date	Not Available	1995	1995	1996	Not Available
Implementation Costs (thousands of dollars)	Not Available	$1,100	Not Available	$750	Not Available
Primary Services	45 mi. (72 km) Bike Lanes, 48 mi. (77 km) Bike Paths	The Cedar Lake Trail	Bicycle Trails	34 mi. (54 km) of Paths/ Lanes	20 mi. (32 km) Bike Paths, 59 mi. (94 km) Mixed
Population (1990)	46,322 [1]	368,383 [1]	396,685 [1]	472,020 [1]	190,766 [1]
Sq. Miles (Sq. km)	8 (22)	55 (142)	62 (160)	218 (564)	58 (150)
Population Density (pop. per sq. mi.) (pop. per sq. km)	5,515 (2,115)	6,698 (2,594)	6,398 (2,479)	2,165 (837)	3,289 (1,272)

[1] Population of city proper

Currently, only 2% of Americans commute to work by bicycle. The Texas Natural Resources Conservation Commission reports that bicycling is most beneficial in terms of individual health and convenience for those living roughly 10 miles (16 km) away from their job or school. In a 1990 poll conducted by Louis Harris & Associates, respondents reported that they would bicycle to work if the facilities that made it fun, safe, and convenient were in place. These facilities include bike paths, bike lanes, bike trails, bike lockers, showers, etc. The most desired facility was the bicycle lane. Eighteen percent of these same people reported that they would commute by bicycle if their employer offered incentives. With the cost of owning and operating a car being approximately $6,723, many have realized the benefits of increased health and monetary savings, not to mention the environmental advantages associated with the use of bicycles.

Davis, CA
BICYCLE PROGRAM

Highlights

- Sponsors: City of Davis, State of California, and local developers
- Cost: Not available
- Funding: State and local tax, developer payments
- Implementation Date: Not applicable
- Primary Services: 45 miles (72 km) of bike lane, 48 miles (77 km) of bike path
- Attainment region

Background

The City of Davis began constructing bicycle paths, lanes, and facilities in the 1960s. Bicycle facility development was in response to increasing bicycle traffic that was attributed to the growing University of California at Davis campus. This campus, with an enrollment over 20,000, is a very dominant feature in the city that has a population approaching 50,000. Today, the City boasts 48 miles (77 km) of bike paths, 45 miles (72 km) of bike lanes, and numerous bicycle parking facilities. Eighty percent of the arterials contain painted, designated bike lanes which were funded by general revenue. This system also contains 12 grade separations which allow for continuous and safe bicycle travel. Most of this system was created by utilizing green belts and easements to create access and connections for bicyclists. Much of this has been made possible through extensive use of planning regulations. One such regulation requires that developers form links to neighboring bicycle facilities. The cost of this extensive bicycle network is not possible to estimate since much of the work performed coincided with either state road projects or private development projects.

Effects

Research indicates that a noticeable increase in bicycle travel has resulted from the installation of these facilities. Survey respondents near the University of California, Davis, indicated that the installation of bicycle facilities allows them to utilize bicycle facilities more than they use motorized traffic facilities. The effects of this extensive system are quite impressive. Of all trips made in Davis, 20% to 25% of them are by bicycle.

Public Perception

Reportedly, the desire for more bicycle facilities is constantly rising.

Contact Information: Tim Bustos, Bicycle and Pedestrian Coordinator
Bicycle and Pedestrian Program
1717 5^{th} Street
Davis, California 95616
(530) 757-5686

References

City of Davis, Public Works Department. " 1993 Bikeway Plan." Last revised 26 May 1993. <http://www.city.davis.ca.us/city/pworks/bike/bkwypn1.htm>

Hunter, William W., and Herman F. Huang. "User Counts on Bicycle Lanes and Multiuse Trails in the United States." *Transportation Research Record 1502.* Washington D.C.: National Academy Press. (1995): 45-57.

Minneapolis, MN

THE CEDAR LAKE TRAIL

Highlights

- Sponsors: Cedar Lake Park Association, Minneapolis Department of Public Works, Minneapolis Park and Recreation Board, and the Hennepin County Regional Railroad Authority
- Cost: $1,100,000
- Funding: Federal ISTEA (34.1%), LCMR State funds (32.5%), the Metropolitan Council (18.9%), private donations (10.7%), and the City of Minneapolis (3.8%)
- Implementation Date: 1995
- Primary Services: The Cedar Lake Bicycle Highway (3.5 miles, or 5.6 km), lanes (approx. 35 miles, or 56 km), paths (56 miles, or 90 km), and parking facilities (46 bike racks, 14 bike lockers)
- Non-attainment region for CO and PM10

Background

Taking into account that bicyclists seek safety and accessibility, the City of Minneapolis opened a bicycle and pedestrian highway. The Cedar Lake Trail is completely separated from the roadway. The divided-lane bicycle and pedestrian highway is the first such facility in the nation. Costs for the 3.5-mile (5.6 km) highway totaled $1,100,000. The Cedar Lake Trail is the first phase of many other highways to be built in and around the city. The trail removes the hazard and inefficiency associated with the conventional method of combining automobile and bicyclist on the same roadway. Cedar Lake's trails are a combination of separate bicycle and pedestrian paths. Bicyclists and skaters can use one of two 10-foot (3.0 m) wide asphalt paths. The two paths are one way, leading to or from the downtown area. Pedestrians can choose between either a six-foot (1.8 m) paved walkway or a crushed stone path, three feet (0.9 m) wide. Crushed stone acts as a cushioning devise for joggers. Once commuters utilizing the Cedar Lake Trail reach the downtown area, bicyclists can utilize roughly 15 miles (24 km) of bicycle lane. There are also 56 miles (89.6 km) of path. Businesses in the downtown area are offered a matching payment from the city to provide secure storage spaces for their employees' bicycles. As well as additional parking, the City's Department of Public Works is also promoting the installation of shower facilities. Currently, six businesses provide this service, as well as several government buildings.

Effects

The City of Minneapolis reports that the number of commuters on its bicycle and pedestrian facilities doubled between 1977 and 1987, and nearly doubled again between 1987 and 1990. Approximately 1,300 people use the trail on the average weekday. As a result, the City hopes to build another 35 to 40 miles (56 - 64 km) of commuter bicycle trails in the near future. Demand was so high for bicycle facilities in 1990 that there was a lack of bicycle parking of roughly 100 secure lock-up spaces.

Public Perception

Some of those who live next to land that is used (or under consideration for later trail development) as a bike and pedestrian facility are often unhappy with its location close to their property. These residents express fears of increased pollution and crime. For instance, the Midtown Greenway connects a high-income community to a low-income neighborhood. Complaints arose as soon as plans were announced about the trail. On the other hand, home buyers who walk or bicycle commute have sought out homes near the City's bicycle and pedestrian facilities.

Contact Information: Rhonda Rae
Public Works
City of Minneapolis
(612) 673-3439

St. Louis, MO
REGIONAL BICYCLE AND PEDESTRIAN ADVISORY COMMITTEE

Highlights

- Sponsor: East-West Gateway Coordinating Council
- Cost: Not available
- Funding: Federal Highway Administration Planning Funds, City Dues
- Implementation Date: July 1995
- Primary Services: advise, coordinate, promote, and implement bicycle and pedestrian service plans
- Non-attainment region for ozone, PM10, and lead

Background

The St. Louis Regional Bicycle and Pedestrian Advisory Committee (BPAC) was created by the East-West Gateway Coordinating Council (EWGCC), which includes 12 counties, and oversees the coordination of various modes of transportation systems within the region. BPAC's membership was formulated based on the recommendations of EWGCC's St. Louis Region Bicycle Facilities Plan, adopted in April of 1995. BPAC's members consist of citizens representing public, private, and non-profit sectors. This includes members of state and local government, university professors, business representatives, interest groups, and local citizens. BPAC advises municipalities and EWGCC in the development, coordination, standardization, promotion, education, and implementation of municipal plans (i.e., they appropriate funds to a bike or pedestrian facility plan that a city submits). A city within the region (e.g., St. Louis) submits bicycle and pedestrian plans that the city creates in conjunction with its own hired consultants. BPAC reviews these plans and may or may not allocate the funds that the City has been granted through ISTEA's Transportation Enhancement Funds. When the City receives the revised plan back from BPAC, the City must comply with BPAC criteria (whatever the changes) to receive funding.

Effects

BPAC reports that in the eight county area which they involve themselves in, only 11 municipalities (including St. Louis) have designated bicycle facilities. BPAC itself has created no on-road bike or pedestrian facilities since its inception, only trails. With the aid of ISTEA funds, BPAC hopes to increase the availability of access to bicycle and pedestrian paths which it perceives as limited, at best. BPAC feels that with improvement in signage, greater shoulder widths, road conditions, and safer intersections, the bicycling and pedestrian commuting community will increase. BPAC's St. Louis Region Bicycle Facilities Plan of April 1995 proposed a number of facilities that would link and extend bicycle and pedestrian facilities to shopping, employment, educational, transit, and park facilities. Within the plan are eight proposals, four of which include the City of St. Louis directly. Two proposals involving the St. Louis Bikeway will serve 10 communities and parallel both roads and highways. A proposed MetroEast Bikeway will connect both existing and proposed routes, connecting seven communities in three counties. Finally, the Broadway Bikeway would generally parallel St. Louis' Broadway Boulevard. Funds could potentially be made available by local, state, and federal (ISTEA) sources.

Public Perception

Based on the number of riders that are using the bicycle and pedestrian facilities, BPAC reports that popularity is soaring. According to surveys conducted by BPAC, almost two-thirds of respondents who replied said "they never used their bicycles for errands" but said they would "if roads were more bicycle friendly and safety was increased." Half of the respondents also reported that they would commute to work if the route were safe and accessible.

Contact Information: Ivan Miller, Transportation Planner
Bicycle and Pedestrian Advisory Committee
(314) 421-4220

Reference

St. Louis Regional Bicycle and Pedestrian Advisory Committee. "BPAC - Regional Bicycle Facilities Plan." Last revised 14 September 1998.
<http://www.ewgateway.org/html/regbikeplan.htm>

Austin, TX
BICYCLE AND PEDESTRIAN PROGRAM

Highlights

- Sponsors: Austin Transportation Study, Texas Department of Transportation, City of Austin Department of Public Works and Transportation
- Cost: approximately $750,000 in grants
- Funding: City Capital Metro Transit, U.S. DOT Federal Grants, and Texas Department of Transportation (TxDOT) grants
- Implementation Date: 1996
- Primary Services: Bicycle lanes, wide curb lanes, trails, sidewalks, crosswalks
- Attainment region

Background

In the mid-1970s primarily, the City of Austin constructed 34 miles (54 km) of bike paths and bike lanes around the campuses of the University of Texas and other schools. In 1994, the City of Austin formed the Bicycle Program consisting of a coordinator and two employees, and which called for the acquisition of $2,500,000 in federal grants to be used to produce the bicycle plan and various bicycle projects. Two years later, the Sidewalk Task Force was included in the Bicycle Program, thus creating the Bicycle and Pedestrian Program. On May 7, 1998, the Bicycle Plan, Part II, passed the City Council unanimously as an ordinance which would implement recommended routes and facilities, connections to outlying areas, maps of pedestrian and bicycle lanes and paths, and seek to upgrade a temporary bike lane to a permanent, single, one-way bike lane on Woodward Road. The City of Austin provided the bicycle riding community with guidelines in the City of Austin Code - Chapter 16-8: Bicycles. For instance, the code defines a Bicycle Lane as "an area within the roadway specifically designated for the use of bicycles." A Bicycle Path is defined as "an area adjacent to a roadway specifically designated for the use of bicycles." Parts of the Code include sections which forbid the use of sidewalks within a business district for bicycle traffic, requiring bicyclists to use the roadways and follow basic traffic laws, as if they were motorists. The Bicycle and Pedestrian Program has also used promotion as a tool to educate and excite the community about these new bicycle and pedestrian programs. For example, the Bicycle and Pedestrian Program held "Bicycle! Austin" week, featuring "Bike to Work Day."

Effects

Since 1994, 15 miles (24 km) of bike lanes and one-half mile (0.8 km) of bike path have been installed. There have been no additions of sidewalks or crosswalks as planned. The new Program Coordinator, however, has recommended the construction of 1,200 miles (1,920 km) of bicycle lanes, wide curb lanes, and paths. The Bicycle and Pedestrian Program is now planning to ask for more bicycle paths from the City's Transportation Improvement Plan 2000. Funding from this plan will come from City and Federal government grants. The Sidewalk Task Force had recommended, in part, plans such as an annual expenditure of $1,000,000 to retrofit curbs in compliance with the

Americans with Disabilities Act, funding of sidewalk projects, and conjoining of transit stops with sidewalks.

In FY 1996, The U.S. Department of Transportation granted the Bicycle and Pedestrian Program a total of $1,028,783. In FY 1997, the program received another grant for $1,602.293. These grants are meant to be spent for specific projects, such as added sidewalks, bicycle lanes, paths, ramps, bridges, the purchase and installation of 1,400 bicycle racks, and the installation of 100 bicycle sensitive quadrapole loop inductance sensors. In 1998, Austin's Department of Public Works and Transportation used these funds to install five of its first bicycle sensors, or Bicycle Sensitive Quadruple Loop Inductance Sensors. These stenciled sensors (20 inches by 10 inches) (51 cm by 25 cm), detect the metal in a bicycle and change the traffic light so that the bicyclist does not have to wait for a car to activate the automobile sensor. Another 55 bicycle sensors are scheduled to be tested.

Public Perception

Mr. Snodgrass, the new Program Coordinator of the Bicycle and Pedestrian Program, reports that complaints do arise concerning the displacement of curbside parking in place of bicycle lanes and/or paths. However, the public generally seems to be in favor of the program and its goals as a whole.

Contact Information: Keith Snodgrass, Program Coordinator
Bicycle and Pedestrian Program
City of Austin
(512) 499-7240

Reference

City of Austin. "Bicycle and Pedestrian Program." Accessed: 9 November 1998. <http://www.ci.austin.tx.us/bicycle/1stroutes.htm>

Madison, WI

MADISON BICYCLE AND PEDESTRIAN DIVISION

Highlights

- Sponsors: Wisconsin DOT (WisDOT Bicycle and Pedestrian Committee), the Governor's Bicycle Advisory Council, and the City of Madison, Traffic Engineering Division
- Cost: Not available
- Funding: Federal funds transferred by WisDOT's Transportation Program, Surface Transportation Program (STP) and STP Urban funds, the City of Madison, and State Operating Funds
- Implementation Date: 1970s
- Primary Services: Bike lanes (13 mi/21km), bike paths (20 mi/32 km), mixed traffic routes (59 mi/94 km), sidewalks (7) as of 1990
- Attainment Region

Background

The State of Wisconsin vigorously supports MPOs and communities in their efforts to plan and organize alternative transportation routes through the Wisconsin TransLinks 21 program, a state transportation plan involving bicycle planning guidance. The State stresses TransLink 21's goal of moving people and goods while strengthening the economy, protecting the natural environment, and maintaining the quality of life. Even before the Intermodal Surface Transportation Efficiency Act (ISTEA), which promotes the use of increased bicycle use, the Wisconsin State Legislature passed State Statute 85.023, which states that the Wisconsin DOT will assist regional or municipal agencies or commissions in the planning, development, and promotion of bikeways and/or their facilities, not primarily for recreation, but for utilitarian purposes. Plans set by TransLink 21 include the development of bike lanes, wide curb lanes, bicycle paths, and paved shoulders. The City of Madison utilizes its Traffic Engineering Division and Madison DOT to coordinate any motor vehicle, bicycle, and pedestrian plans, designs, and infrastructure improvements. Since the 1970s, under the Division's guidance, Madison has become well recognized as an effective innovator and promoter of commuter bicycling. The City now has 99 miles (158 km) of bicycle facilities, including: paths (20 mi/32 km), lanes (13 mi/21 km), mixed-traffic routes (59 mi/94 km), and sidewalk routes (7 mi or 11.2 km). In terms of bicycle safety, the City DOT's duties include the registration of bicycles (which aids in the return of stolen bicycles to their owners, as well as to maintain data on the number of bicycles utilized in the area). To enhance the safety of pedestrian travel, the City also maintains a web site to educate citizens about pedestrian facilities and safety tips.

Effects

In a study by the City's DOT using loop detectors at intersections, the City's university area (which has a two-way bicycle lane) was monitored for user levels. The daily volume of bike traffic on these eight-foot (2.4 m) lanes in December (a severely cold period of the season in Wisconsin) averaged 2,309. Peak hour traffic was roughly between the hours of 10:00 and 11:00 am, and between 3:00 and 4:00 pm. Seasonal peaks of bicycle use were found to occur during the months of September and October, when students have returned to campus and the weather is amenable to outdoor travel. Bicycle volumes in the summer months are quite higher than in the winter (697 and 138, respectively). Studies conducted on use over a week's period showed that, much unlike other cities, bicycle use in Madison was higher on the weekends than on weekdays (three to four times higher). In terms of annual rates of use, Madison, like other cities between 1988 and 1992, saw a 4.7% decrease in facility utilization. This drop, however, was less than four times the decrease in other cities.

Public Perception

The City reports receiving thousands of complaints, requests, and suggestions related to bicycle facilities each year. Typical requests include the installation of more bicycle lanes/paths. Suggestions of giving bicycles right-of-way over automobiles on certain city streets have been made to create a "Bicycle Boulevard."

Contact Information: David Dryer, Division Coordinator
Bicycle and Pedestrian Division
City of Madison
(608) 266-4761

Arthur Ross, Bicycle/Pedestrian Coordinator
Bicycle and Pedestrian Division
City of Madison
(608) 266-4761

Reference

Hunter, William W., and Herman F. Huang. "User Counts on Bicycle Lanes and Multiuse Trails in the United States." *Transportation Research Record 1502.* National Academy Press: Washington D.C. (1995): 45-57.

OTHER EXAMPLES/CITIES WITH BICYCLE / PEDESTRIAN PATHS

Tallahassee, FL
- "Training courses on bicycle and pedestrian facility design."
- "Current nationally accepted bicycle and pedestrian facility design standards for use by the development community and local governments."

Reference
Florida Public Works. "Florida Public Works, Bike and Pedestrian Services." Last revised 9 February 1998.
<http://www.state.fl.us/citylh/public_works/bikesvcs.html>

Lexington, MA
- Thirteen routes within Lexington
- Minuteman Commuter Bikeway

Reference
Lexington Massachusetts. "Recommended Bicycle Routes in Lexington, Massachusetts." Accessed: 9 November 1998.
<http://www.tiac.net/users/bingham/lexbike/routes.htm>

Rocklin, CA
- Pedestrian sidewalks and bicycle lanes leading to two schools
- $380,000 in federal funding

Reference
U.S. Department of Transportation, Federal Highway Administration. "Visual Database of Transportation Enhancements Rocklin Bike Lanes." Last revised 26 April 1997. <http://www.bts.gov/trans-enh/dx/caa03.html>

Portland, OR
- Selected as the most bike friendly city in the U.S. by *Bicycling* magazine
- 2,000 bicyclists per day utilized the Hawthorne Bridge in 1995.

Reference
City of Portland Bicycle Program. "City of Portland Bicycle Master Plan." Accessed: 9 November 1998. <http://www.trans.ci.portland.or.us/Traffic_Management/Bicycle_Program/EXECSUM.HTML>

St. Joseph, MO

- "Urban Trail" using a historical corridor
- Approximately five miles (eight kilometers)

Reference

Bucher, Willis, & Ratliff. Urban Trail Master Plan, Final Report. Bucher, Willis & Ratliff: St. Joseph, MS. (1995).

ADDITIONAL REFERENCES

Krawczyk, Paul. "Creating Pedestrian and Bicycle Systems in Conjunction with New Development." *ITE Journal.* Vol. 65, No. 5. (May 1995): 24-26.

Hunter, William W., and Herman F. Huang. "User Counts on Bicycle Lanes and Multiuse Trails in the United States." *Transportation Research Record 1502.* National Academy Press: Washington D.C. (1993): 45-57.

CHAPTER 15
TRAFFIC SIGNALIZATION

	San Francisco Bay Area, CA	Montgomery County, MD	Detroit, MI	Laredo, TX	Houston, TX
Implementation Date	1993	1980	1993	1991	1996
Implementation Cost (thousands of dollars)	$18,000	$3,000 (Annually)	$7,000 FY 1998	~ $820	$7,540
Population (1990)	6,249,881	4,222,830	4,266,654	133,239	3,321,926
Sq. Miles (Sq. km)	7,368 (19,084)	6,510 (16,682)	3,898 (10,094)	3,357 (8,595)	5,921 (15,336)
Population Density (pop. per sq. mi.) (pop. per sq. km)	848 (327)	649 (253)	1,095 (423)	40 (15)	561 (217)

Improving traffic signalization systems can have a very large impact on traffic congestion. These improvements include the installation, replacement, and/or upgrade of traffic signals, and/or the coordination and synchronization of a series of traffic signals. Technologies presented within this chapter include a spectrum of devices including airplane surveillance, loop systems, on-line computerized systems, and video cameras. When used properly, these systems improve travel time, and lower fuel consumption and vehicle emissions.

This page intentionally left blank.

San Francisco Bay Area, CA

REGIONAL TRAFFIC SIGNALIZATION AND OPERATIONS PROGRAM

Highlights

- Sponsor: Metropolitan Transportation Commission (MTC)
- Cost: $18,000,000
- Funding: 88.5% Federal funding (primarily Intermodal Systems Transportation Efficiency Act of 1991), 11.5% State (Transportation Development Act funds)
- Implementation Date: 1993
- Primary Services: Retiming or replacement of existing regional traffic signals
- Non-attainment region for CO

Background

MTC plans, funds, and coordinates transportation for the local jurisdictions within the nine counties included in the Bay Area Region. In 1993, the Metropolitan Transportation Commission (MTC) created both the Regional Traffic Signalization and Operations Program (RTSOP) and the Traffic Engineering Technical Assistance Program (TETAP). The MTC's arterial operations program, whose goal it is to relieve traffic congestion and reduce stop-and-go traffic, is funded by RTSOP. RTSOP supplies funding for the retiming, replacement, and/or coordination of traffic signal networks. TETAP gives consulting advice to municipalities in the event that they cannot afford the expense of maintaining a traffic signal system. TETAP has completed 40 projects in 38 municipalities (affecting more than 150 traffic signals). At this time, RTSOP has now funded 96 signal programs involving the retiming of over 2,165 separate traffic signals in the area. RTSOP has also replaced 515 outdated traffic signal control devices.

Effects

The benefits derived from this program include an average 15% improvement in travel times, a $1,200,000 fuel cost savings, and reduced auto emissions of approximately 110 tons (100 Mg) per year.

Public Perception

None available

Contact Information: Shawn Gage, Planner
Metropolitan Transportation Commission
(510) 464-7764

Reference

Skabardonis, Alexander. "Estimating Impact of Signal Hardware Improvements." *Transportation Research Record 1554.* National Academy Press: Washington D.C. (1996): 53-60.

Montgomery County, MD
TRANSPORTATION MANAGEMENT CENTER

Highlights

- Sponsors: County of Montgomery, U.S. DOT and Maryland DOT
- Cost: approximately $3,000,000 (annually)
- Funding: County Bonds and Tax Revenue, State ($1,500,000 in 1997)
- Implementation Date: 1980
- Primary Services: Traffic responsive signal system, inductance loops, microwave detection, machine vision, traffic video, camera system, aerial traffic monitoring
- Non-attainment region for ozone

Background

Montgomery County is approximately 500 square miles large (1,280 km), and contains 3,000 miles (4,800 km) of roadway. The county is adjacent to Washington D.C., with approximately 65% of the population working within the county. Montgomery County utilizes an ATMS system with the Transportation Management Center as the hub, which is a combination of multiple subsystems. ATMS is an integration of these subsystems, managed and operated by common workstations to provide control, monitoring, and information to motorists. One of the primary devices utilized by ATMS is the traffic responsive signal system. This signal system controls approximately 1,500 traffic signals (700 of those being on-line). The system is capable of second-by-second traffic signal control and monitoring, traffic responsive operation, control of 1,500 traffic signals, and more.

To monitor traffic flow, volume, and speed, ATMS utilizes such devices as video detection (46 on-line cameras), real-time detector graphics, microwave detection, and inductance loop detection. ATMS currently utilizes 1,000 loop detectors, with the capability to support another 2,000. Another 10,000 vehicle presence loops are in place at approach lanes on minor streets and left turn lanes to perform signal actuation. Radar, sonic detectors, and machine vision technology (Autoscope) are currently being tested for future use.

An added feature of the signalization system is an enforcement system. Montgomery and Howard Counties are cooperating in a joint trial of red light enforcement cameras. Drivers running a red light are detected by loop detectors and/or video surveillance. The "speeder camera" takes three color photos and sends the information to the police for investigation.

ATMS also utilizes a MC-10 airplane which, among other duties, seeks out traffic problems and relays the information back to the TMC which then adjusts signal timing to mitigate the problem. Currently, the county is in the process of installing the first phases of FiberNet (Fiber Network) to the current 300 miles (480 km) of copper-wire that are in place. The hope is to integrate the entire ATMS with a broadband, fiber optic network. The county expects to save $200,000,000 over the next 20 years from this technology that provides a much larger transmission capacity.

Effects

The system reportedly increases rush hour travel speeds by 14% - 20%, and decreases delay by approximately 17% - 37%.

Public Perception

None available

Contact Information: Emil Wolanin, Section Chief
Transportation Management Center
Montgomery County Department of Transportation
(301) 217-2237

Greater Detroit (Oakland County), MI

FAST-TRAC

Highlights

- Sponsor: The County of Oakland
- Cost: $7,000,000 for Fiscal Year 1998
- Funding: 80% Federal ISTEA (Transportation Enhancement funds), 20% municipal matching funds
- Implementation Date: June 2, 1993
- Primary Services: Upgrade, maintain, coordinate, and replace traffic signal systems
- Attainment region

Background

Faster and Safer Travel through Traffic Routing and Advanced Controls (FAST-TRAC) is currently operating throughout the Oakland County area (in the Greater Detroit area). At the time when FAST-TRAC was still a demonstration project, they received funds via the Federal Transportation Bill. Once implemented, FAST-TRAC received 80% of its funding through ISTEA Transportation Enhancement funds. The remaining 20% was provided by local jurisdictions within Oakland County who benefit from FAST-TRAC's consulting and upgrading services. FAST-TRAC utilizes an Intelligent Transportation System (ITS) that now controls more than 200 intersections. This on-line system uses the Sidney Coordinated Adaptive Traffic System (SCATS). The on-line traffic signal system relays messages back to a central building where a coordinator can adjust the traffic signal according to the congestion situation, rather than using a pre-timed signal system which is not responsive to traffic changes.

Effects

Reports are that communities like Troy, Rochester, and Auburn Hills have experienced positive effects (such as reduced traffic accidents, etc.) as a result of the increased signalization.

Public Perception

None available

Contact Information: Beata Lamparski, Project Manager
FAST-TRAK
Road Commission for Oakland County
(248) 858-4804

Laredo, TX

TRAFFIC SIGNALIZATION SYSTEM

Highlights

- Sponsor: Texas Department of Transportation (TxDOT)
- Cost: Four new signals are installed each year at $200,000, plus $20,000 are spent on annual upgrades and maintenance
- Funding: State Traffic Management Grant ($200,000 in 1991), State Traffic Light Signal One fund ($100,000 in 1992), General City funds (~ $30,000 per year), Hazard Elimination Safety Program
- Implementation Date: 1991
- Primary Services: 63 traffic signals utilizing a closed loop, on-line NAZTEZ program
- Attainment region

Background

The sixth fastest growing city in America, Laredo implemented a signalization program in 1991 that utilized a closed-loop system which monitored and allowed transportation staff to alter signal timing primarily in the downtown region. In that year, a Traffic Management Grant from the State of Texas provided funds in the amount of $200,000. There are now 42 signals in the downtown region that are connected to Laredo's closed-loop system. The traffic signal system utilizes the NAZTEZ program. The City of Laredo uses loop detectors, microwave detectors, and video detectors to monitor traffic congestion. Modems relay data between traffic signals and operators which allows for real-time signal timing to be accomplished. On Laredo's I-35 service road, seven diamond locators are connected to the system as well as 14 signals along US-83.

Effects

Due to the traffic relief benefits of the system, the department is seeking approval for nine intersection upgrades on US-59, as well as the acquisition of fiber optics technology.

Public Perception

None available

Contact Information: Mr. Tony Garcia, Traffic Supervisor
Traffic Safety Agency
City of Laredo
(956)795-2550

Houston, TX

TranStar

Highlights

- Sponsors: City of Houston, Harris County, Metropolitan Transit Authority of Harris County (METRO), and Texas Department of Transportation (TxDOT)
- Cost: ISTEA/CMAQ funds ($7,514,000), ISTEA/FTA funds ($1,500,000), City of Houston matching funds ($4,440,000)
- Funding: CMAQ, FTA Major Capital Investment (Section 3)
- Implementation Date: 1996
- Primary Services: Computerized traffic signals, computerized freeway management system, roadway sensors, automatic vehicle location systems
- Non-attainment region for ozone

Background

In response to growing rates of traffic congestion throughout the 1980s, Houston began planning a system (TranStar) to plan, design, operate, and maintain services to relieve traffic congestion. TranStar is the combination of parts of four different agencies under one roof. These agencies include the City of Houston, METRO, and TxDOT. TranStar's mission is to maximize the usage of existing infrastructure to lower the amount of air pollution in the region and increase traffic flow. A large component of this infrastructure are the numerous signalized intersections.

Effects

The signalization systems that TranStar utilizes include computerized traffic signals, roadway sensors, and video cameras. TranStar utilizes what is referred to as a closed-loop system. Those who monitor roadway sensors must phone traffic signal controllers who adjust signal timing. On a very congested roadway, signal controllers leave signals green longer, relieving traffic by rerouting it to other streets and increasing flow. When traffic congestion is detected on highways equipped with video cameras, changeable highway signs inform drivers of alternative arterial routes where, at that point, traffic signal controllers can increase traffic flow on these arterials by modifying the timing along a series of signals. Houston will soon be implementing a regional computer traffic signal system (RCTSS) which will automatically operate the system described above. Currently, METRO alone utilizes the Regional Computerized Traffic Signal System (RCTSS) which has been in operation since 1995 and has managed 3,000 intersections. This on-line, real-time, computerized system uses the PASSER IV program and is one of the largest undertakings of its kind in the U.S.

Public Perception

None available

Contact Information: John Gaynor, Manager
Transportation Management Systems
Texas Department of Transportation
(713) 881-3060

Reference

Liu, Chang, Nadeem A. Chaudhary, Harry C. Simeonidis, and Sireesha Sirigiri. "Pioneer Application of Passer IV in the Houston Metro-RCTSS Project." *Transportation Research Record 1494.* National Academy Press: Washington D.C. (July 1995): 129-134.

OTHER EXAMPLES/CITIES WITH SIGNALIZATION

Santa Barbara, CA (Hollister Avenue)
- Eighteen multiphase fully actuated signals were coordinated
- Significant benefits were obtained

Reference
Skabardonis, Alexander. "Estimating Impact of Signal Hardware Improvements." *Transportation Research Record 1554.* National Academy Press: Washington D.C. (1996): 53-60.

Tucson, AZ (Ft. Lowell/Campbell)
- More green time for left turns

Reference
JHK & Associates. "Final Report: Tucson Transportation System Planning Study Update." Prepared for the City of Tucson. (1995).

ADDITIONAL REFERENCES

Dell'Olmo, Paolo, and Pitu B. Mirchandani. "REALBAND: An Approach for Real-Time Coordination of Traffic Flows on Networks." *Transportation Research Record 1494.* National Academy Press: Washington D.C. (July 1995): 106-108.

Gartner, Nathan H., Chronis Stamatiadis, and Philip J. Tarnoff. "Development of Advanced Traffic Signal Control Strategies for Intelligent Transportation Systems: Multilevel Design." *Transportation Research Record 1494.* National Academy Press: Washington D.C. (July 1995): 98-105.

CHAPTER 16
INTERSECTION IMPROVEMENTS

	Tucson, AZ	Albuquerque, NM	Amarillo, TX	Corpus Christi, TX	Vancouver, WA
Implementation Date	1996	1985	Not Applicable	Not Applicable	Not Applicable
Implementation Cost (thousands of dollars)	Not Available	Not Available	Not Available	$200	Not Available
Primary Services	Right Turn Channels	Left Turn Storage	Right Turn Channels	Right Turn Channels	Right Turn Channels
Population (1990)	411,480 [1]	384,915 [1]	157,571 [1]	257,453 [1]	463,634 [1]
Sq. Miles (Sq. km)	156 (405)	132 (342)	88 (228)	135 (350)	125 (323)
Population Density (pop. per sq. mi.) (pop. per sq. km)	2,638 (1,016)	2,916 (1,125)	1,791 (691)	1,907 (736)	3,709 (1,435)

[1] Population of city proper

Intersection improvements are useful in a number of ways, including their ability to reduce accidents at a particular junction and/or relieve congestion. However, the cost to implement these improvements is sometimes impossible to determine due to the great number of variables involved with each particular intersection, as will be shown in this chapter. In other instances, these figures are simply not available due to the fact that they are incorporated within the improvements of other larger projects. Intersection improvements include the incorporation of storage bays and channels that allow through traffic to more rapidly and safely pass vehicles that are decelerating to make left or right turning movements.

Tucson, AZ

INTERSECTION IMPROVEMENTS, DEPARTMENT OF TRANSPORTATION, PLANNING DIVISION

Highlights

- Sponsor: City of Tucson
- Cost: Not applicable
- Funding: May 17, 1994 City Bond Special Election to "Improve City Streets"
- Primary Services: Right turn channelization, dual left lanes
- Attainment region

Background

The City of Tucson began in the early 1990s to research the growing problem of traffic congestion at 30 of its most congested intersections. A cost-benefit analysis entitled "The Tucson Transportation System Planning Manual" (TTSP), made it clear that intersection improvements, rather than road widening projects would be the least expensive, yet effective solution to mitigate traffic congestion. With the acquisition of funding from a 1994 bond election, the City began the improvement of intersections in 1996. Using criteria recommended in the TTSP manual, such as "total vehicle stop delay," pedestrian access, peak hour operations, cost effectiveness, and accident rates, the City set out to retrofit its approximately 290 intersections.

At the time of this report, five intersections have been treated. Three of the five intersections that were treated are on Speedway Boulevard. The improvements include additional lanes and raised medians. Another intersection was improved by the addition of a northbound left turn lane to create a dual left, and the addition of an exclusive right turn on the eastbound lane via re-designation. The final improvement was at the Broadway Boulevard/Kolb Road intersection where re-designation created an exclusive right turn lane and an exclusive through-lane. JHK & Associates prepared the TTSP for the City and provided cost estimates for particular intersection improvements. The firm estimated that an additional left-turn lane would cost approximately $44,000, while right-turn lanes were $35,000. An additional through lane is estimated to cost roughly $90,000. These figures vary widely according to the exact location at which improvements are to be made.

Effects

Due to the fact that the City's major road improvements, like that at Kolb Road and the Broadway intersection, were not scheduled to be completed until September 1998, this case study is not able to provide the reader with information of any data concerning the effectiveness of the intersection improvements.

Public Perception

In a sense, public perceptions are what initiated this program. Media coverage of a number of accidents at one particular intersection prompted City action, to a degree. The reduction of this sort of publicity is a sign that public perception about these improvements is positive (not to mention that 27,135 voters out of 38,196, voted yes on the multi-million dollar bond election to fund these projects).

Contact Information: Albert Aliez, Director
Transportation Planning
Arizona Department of Transportation
(520) 791-4372

This page intentionally left blank.

Albuquerque, NM
PUBLIC WORKS DEPARTMENT

Highlights

- Sponsor: City of Albuquerque
- Cost: Not available
- Funding: City Bonds and ISTEA funds
- Primary Services: Left turn storage (or bays), dual left turn lanes
- Attainment region

Background

The Department of Public Works was created in 1985 by combining the Departments and Divisions of Transportation, Municipal Development, Water Utilities, and Hydrology. The Department oversees the development and maintenance of over 3,538 lane-miles (5,661 lane-km). The City reportedly improves one or two intersections per year, on average. The City also estimates that 80% of the 515 signalized intersections are equipped with left turn storage or left turn arrows.

David Harmon, Director of Transportation Development, reports that Albuquerque does not look at one, single factor in its decisions to implement change at an intersection. Rather, the Transportation Development Division takes into account all factors, including available resources, traffic capacity, public complaints, accidents, and side streets and intersections in the vicinity.

Effects

The same data that determines whether to improve an intersection is used in analysis to determine whether the project has been a success. However, this information is available to the Division only.

Public Perception

None available

Contact Information: Dave Harmon, Director
Transportation Development
Department of Public Works
(505) 768-2680

Reference

City of Albuquerque. "Public Works - Streets and Traffic." Last revised 19 November 1997. <http://www.cabq.gov/streets/index.html>

Amarillo, TX
PUBLIC WORKS DIVISION

Highlights
- Sponsor: Texas Department of Transportation (TxDOT)
- Cost: Not available
- Funding: ISTEA and the City's general funds
- Primary Service: Right turn channelization
- Attainment region

Background

Currently, the City employees 25 engineers to work in this division. Located along Interstates 40 and 27, Amarillo has 894 miles (1430.4 km) of roadway. Amarillo utilizes virtually all means of intersection improvement, including: left turn storage, right turn storage, right turn channelization, lane designation, and dual left lanes. Right turn channelization is reportedly the most widely used intersection improvement in Amarillo. Reportedly, up to 15 intersections are improved each year, with an average of five per year. An increase in the number of accidents at an intersection is the primary determinant in the City's decision to make intersection improvements. A recent right turn channelization project cost the Division approximately $20,000. Funding comes primarily from City general funds. For more major improvements, ISTEA funds distributed by the state, and administered by the City's MPO are utilized.

Effects

The City of Amarillo does not keep records of how an intersection improvement has affected their streets.

Public Perception

None available

Contact Information: David Szmagalski, Traffic Engineer
Department of Public Works
Traffic Engineering Department
City of Amarillo
(806) 378-9334

Corpus Christi, TX
METROPOLITAN PLANNING ORGANIZATION

Highlights

- Sponsor: City of Corpus Christi
- Cost: $200,000 to $250,000 annually
- Funding: 50% Federal, 25% state, 25% local
- Primary Services: Right turn channelization and left turn channelization
- Attainment region

Background

The City of Corpus Christi does not improve specific intersections on a singular basis. Rather, intersection improvements are done in relation to a larger project (i.e., a street capital improvements project). Street capital improvement projects of major arterials and collectors account for approximately 15 - 20 intersection improvements per year. Criteria used to determine whether an intersection is in need of improvement include traffic accidents, traffic volume, and transportation plan requirements. Most often, the City utilizes right turn storage, left turn storage, and right turn channelization. While there is no exact figure as to the cost of an intersection improvement (since they are not bid out as such), the estimated annual expense for improvements in Corpus Christi is approximately $200,000 to $250,000.

An example of an intersection improvement that was part of a larger capital improvement project occurred at Holly and Weber Roads. Holly Road, a two lane road, was widened to five lanes. A left-turn-only lane was placed in the center of the roads so as to provide automobiles with a left-turn-only space, out of the way of the two straight-only lanes. Right-turn-only bays were added to the intersection as well. These bays are 100 feet (30 m) long.

Effects

The City of Corpus Christi reports that the capital improvement project, which included the improvements at Holly/Weber, have increased traffic volumes greatly. Compared to the number of accidents that occurred at this intersection in 1996, there has been a drastic decrease. At this intersection, there was a 28% decrease in accidents between December 1996 and 1997.

Public Perception

None available

Contact Information: Mr. Mohammad Farhan, Transportation Planner
Corpus Christi Metropolitan Planning Organization
(512) 884-0687

Vancouver, WA

PUBLIC WORKS, TRANSPORTATION AGENCY

Highlights

- Sponsors: U.S. DOT and State of Washington DOT
- Cost: Double left turn lane ($400,000), signal and intersection improvements ($135,000 - $550,000), signal modification and provision of dual left-turn lane ($146,000)
- Funding: General City funds, Federal ISTEA funds (Surface Transportation Program), Hazard Elimination System funds, private developers pay Traffic Improvement Funds (TIF), State gas tax (which must be matched by the City)
- Primary Services: right turn channels (most with a raised median), left turn pockets, and islands for traffic signals
- Maintenance region

Background

Vancouver bases its decisions to improve an intersection on an increase in traffic accidents. The City of Vancouver primarily utilizes the right turn channelization treatment. Most right turn channels in the City utilize a raised median (rather than road buttons or paint stripes) which affords pedestrians a safety area in which to pause while crossing the street. Other techniques in use, or being proposed, are left turn storage bays, lane designation/redesignation, and dual left turn lanes. The City reports that intersection improvements can vary greatly in effectiveness and cost depending on a number of variables including construction, traffic control problems, the purchase of surrounding land, utility conflicts (electrical wires in particular), and right of way problems. For example, the costs for two different projects under the same heading of "signal and intersection improvements" ranged from $135,000.00 to $550,000.

The City of Vancouver reports that a very large number of traffic accidents were occurring at the intersection of Northeast 112th Avenue and Northeast 18th Street. In fact, this intersection was ranked number one in the City in terms of traffic accidents. This particular signalized intersection featured two-lanes of traffic with unprotected left turns. The City installed a left turn pocket to mitigate the effects of the traffic accidents (mostly "approach turn" wrecks).

Effects

After the improvement of this intersection, the City reports that this intersection was no longer the sight of nearly as many traffic accidents.

Public Perception

None available

Contact Information: Sharon Wannamaker
Public Works Department
City of Vancouver
(360) 696-8290

CHAPTER 17
EXPRESS LANES

	Chicago, IL	State of Maryland	San Antonio, TX	Austin, TX	Seattle, WA
Implementation Date	1960	1986	1984	1971	I-90: 1992 I-5: 1964
Implementation Cost (millions of dollars)	Not Available	$190	$272	$5	Not Available
Freeway Miles (km)	356 (570)	474 (759)	250 (400)	50.3 (81)	~ 3,722 (5,955)
Population (1990)	7,410,858	Not Applicable	1,324,749	846,227	2,033,128
Sq. Miles (Sq. km)	5,065 (13,117)	Not Applicable	3,327 (8,617)	4,226 (10,945)	4,216 (10,920)
Population Density (pop. per sq. mi.) (pop. per sq. km)	1,463 (565)	Not Applicable	398 (154)	200 (77)	482 (186)

Express lanes provide dedicated capacity on freeways for vehicles that are traveling a significant distance within or through a portion of a metropolitan area. Motorists are able to bypass several interchanges and the associated congestion while driving in express lanes. The design of express lanes varies from separate overhead structures to lanes that follow the grade of adjacent general purpose lanes. Some express lanes exist for relatively short distances (i.e., less than two miles [3.2 km]), while others span several miles (kilometers).

As the chart above shows, express lanes can be quite expensive ventures. Hence, their use is somewhat limited to cities of greater size or corridors between cities. As in the cases of San Antonio and Austin, these facilities can be relatively simple in design. If the facility is not of an overhead design, the technology involved in keeping express traffic separated can become quite complex, as in the case of Chicago.

Chicago, IL
KENNEDY EXPRESSWAY

Highlights
- Sponsor: Illinois Department of Transportation
- Cost: Part of a $425,000,000 overall highway reconstruction
- Funding: Federal Highway Matching Funds
- Implementation Date: 1960
- Primary Services: Kennedy Express Lane is 7.5 miles (12 km)
- Non-attainment region for ozone, SO2, and PM10

Background

In the process of planning the Kennedy Expressway, designers added express lanes in the center of the local lanes to mitigate the effects of traffic congestion. Cost for the construction of the express lanes is indeterminable; this expense was not separated from the overall cost of the entire project. There are a total of ten reversible lanes on the Kennedy Expressway. These express lanes reverse to accommodate peak traffic flow. The overall project, dubbed Operation Kennedy, included, among other things, the reconstruction of all express lanes, inbound lanes and outbound lanes. It also included the reconstruction and widening of bridges and entry and exit ramps. The original "REVERSIBLE Lane And Control" (REVLAC) system, installed in 1960, required workmen to move barricades and operate a motorized barrier to reroute the over 250,000 vehicles which used the express lanes each day. A new REVLAC System was planned and constructed between 1990 and 1995. The new REVLAC system, part of Operation Kennedy, is operated off-sight by computer and video, requiring only one person to be posted on the expressway, thus increasing human safety and monetary savings. Funds from Operation Kennedy also went to the construction of six inbound slip ramps and six outbound expressway slip ramps (three for entering and three for exiting). Great technology was applied in the design and construction of the new ramp signage and barricade system. Multiple rotating drum message signs are the first devices which advise drivers of the directional status of the expressway. Second, are a series of breakaway paddles which swing into the barrier wall when the lanes are open to through traffic. Finally, a system using a catch net (adapted from technology used on aircraft carriers to stop jets) is lowered from above to stop any traffic which has passed through the other devices. This net has the ability to stop a car within only 70 feet (21 m). Finally, on top of the structure which holds the catch net is a fiber optic sign which also indicates whether the ramp is closed or not.

Effects

The expressway has lowered commute times as well as increased safety for travelers coming to or from the Chicago area. In addition, the new gate system cost $15,000,000, yet will save the Illinois Department Of Transportation an estimated $1,500,000 each year in operational costs.

Public Perception

The public was actually involved in the design of the gate system. Members of the community were allowed to participate in a simulated drive down the Kennedy Expressway in order to test their response, or lack thereof, to various devices and situations.

Contact Information: John Koss, District Engineer
Schaumburg District Office
Illinois Department of Transportation
(847) 705-4000

References

Anderson, Martin E., and Grib D. Murphy. "REVLAC: Turning the Flow in Chicago." *Traffic Technology International Magazine.* (February/March 1998): 41-45.

Illinois Department of Transportation. "News: John F. Kennedy Expressway Reconstruction." *Operation Kennedy Fact Sheet.* (October 1994).

The State of Maryland

INTERSTATE 270

Highlights

- Sponsor: Maryland Department of Transportation
- Cost: Part of a $200,000,000 project
- Funding: State of Maryland
- Implementation Date: 1986
- Primary Services: Eight express lanes divided from four local lanes by Jersey Barriers
- Non-attainment region

Background

The I-270 express lanes were developed for the purpose of safe and uncongested travel to and from the Washington, D.C. area. The expressway extends from the Washington, D.C. Beltway, northwest, to the City of Frederick, Maryland. I-270 has a total of 12 lanes and is approximately 17 miles (27.2 km) long. It is equipped with two local lanes traveling in each direction which are posted as 45 mph (72 kph) zones. Divided by Jersey Barriers are four express lanes on each side of the Interstate. The number one lane of each of the four lane expressways is for HOV 2 traffic only. These HOV lanes were included in 1993, seven years after the completion of the express lanes. Speeds on the express lanes are 55 mph (80 kph). At every interchange, there is a slip ramp for traffic to exit the express lanes. Shortly thereafter are acceleration lanes which allow traffic from local lanes to enter the express lanes. From Frederick City to Clarksburg City, the number of express lanes decreases. Between these two points, there is only one express lane and one HOV lane on each side of the Interstate.

Effects

The express lanes have been proven to cut down the amount of weaving and reduction in speeds that result on the adjacent local lanes.

Public Perception

None available

Contact Information: Roger Brown, Director
Office of Construction
Maryland Department of Transportation of Montgomery County
(301) 513-7385

Austin, TX
I-35 ELEVATED EXPRESS LANES

Highlights

- Sponsor: Texas Department of Transportation (TxDOT)
- Cost: $5,617,809
- Funding: Federal Interstate Matching Funds (90 %), State funds (10%)
- Implementation Date: December 1971
- Primary Services: Two, double lane, 1.3 mile (2 km) long elevated express lanes
- Attainment region

Background

Interstate 35 runs through Austin and is now a component of the NAFTA Superhighway. Prior to the addition of the express lanes, the portion of I-35 immediately north of downtown was below-grade, with several short, hazardous on- and off-ramps. The Texas Department of Transportation (TxDOT) alleviated congestion and danger on this segment of I-35 by constructing two elevated pairs of express lanes over this 1.3-mile (2.1 km) stretch. Construction began on the project in December 1971 and was completed in April 1974. Both north- and south-bound traffic enter separate two lane, elevated expressways. Traffic flow enters from the right two lanes of I-35 onto the elevated lanes. Once on these express lanes, there are no exits until the express lanes rejoin the highway after approximately 1.3 miles (2.1 km). Travelers can remain on the lower section if they wish to exit in this area.

Effects

For those not stopping in the downtown area of the city, the express lanes are a much more efficient and desirable alternative to the lower highway section of roadway. Accidents are much more common and serious on the lower levels of I-35, where entrance and exit ramps are frequent and of extremely short length.

Public Perception

Once built, the project was received well by the public and the media.

Contact Information: Glen McVey, Congestion Management Engineer
Austin District
Texas Department of Transportation
(512) 832-7087

San Antonio, TX

"DOWNTOWN Y" PROJECT

Highlights

- Sponsor: Texas Department of Transportation (TxDOT)
- Cost: $272,000,000
- Funding: 10% State Highway Funds, 90% federal highway funds
- Implementation Date: 1984
- Primary Services: approximately 10 miles (16 km) of double-decked, 8 to 10 lane, segmental winged-T bridge
- Attainment region

Background

The Texas Department of Transportation (TxDOT) planned the "Downtown Y" Project (so named for the resemblance to the letter "Y" that is created by the intersection of I-35 and I-10) to construct 10 miles (16 km) of double-decked freeway aided in the City of San Antonio's goal of ensuring a 30 - 45 minute commute to reach the downtown area from anywhere in the Bexar County region. The Downtown Y also aids the State of Texas and the United States as an improvement of part of the NAFTA Superhighway. Construction on the Downtown Y lasted from 1984 to 1994 and was funded, designed, and constructed by TxDOT. Initially, TxDOT funded the project 100%. Eventually, the State was reimbursed 90% of the $272,000,000 cost by federal highway funds. To alleviate congestion in this area during construction, the massive segmental winged-T portions of the bridge, which support the deck, were precast off-site, trucked in, and assembled. On North I-35, classified as a "heavy" traffic area, 10 lanes of freeway (6 upper, and 4 lower) were double-decked. This constitutes about a 1.5 mile (2.4 km) piece of the freeway in the downtown area. South I-35 was equipped with 8 lanes of double-decked freeway from just north of South Alamo St. to just south of South Laredo St. (roughly 1 mile or 1.6 km). Posted speeds are 50 mph (80 kph) at these locations. The northern portion of the project, West I-10, traverses 3.0 miles (4.8 km) of the fastest growing area of the city as a 10-lane, double-decked freeway. Traffic on this freeway is classified as "heavy" to "extremely heavy." On East I-10, two miles (3.2 km) of freeway were double-decked, creating a total of eight lanes. Speeds on both the West and East I-10 double-decked express lanes are posted at 50 mph (80 kph).

Effects

As a result of these improvements, increases of 38% in Average Daily Traffic (ADT) were obtained between 1990 and 1996. Drivers are reportably able to reach the central business district from anywhere in the Bexar County region in under 45 minutes as well.

Public Perception

Public Relations spokesman for the TxDOT San Antonio District Office reports that media and public response to the Downtown Y has been extremely positive.

Contact Information: David Otwell, Public Information Officer
San Antonio District
Texas Department of Transportation
(210) 615-5922

References

Brian's Place. "San Antonio Freeways Primer and general site information." Last revised 14 July 1998. <http://www.enconnect.net/greengrl/geninfo.htma> **NOTE: THIS IS NOT AN OFFICIAL TxDOT SITE.**

Seattle, WA

I-5 AND I-90 EXPRESS LANES

Highlights

- Sponsor: Wisconsin Department of Transportation
- Cost: Not available
- Funding: 90% Interstate Completion Funds, 10% State funds
- Implementation Date: I-90: 1991, I-5: 1965
- Primary Services: HOV and SOV manually reversible lanes
- Non-attainment region for PM10

Background

The two I-5 and I-90 express lane facilities are auxiliary lanes parallel to the highway local lanes. They are both manually reversible, running to and from the Seattle CBD. It was decided that manually reversible express lanes would preclude the possibility of an automated malfunction which might lead to head-on collisions. Both express lanes' facilities are open to all traffic. The I-5 Express Lane extends from the Seattle central business district (CBD) north to N. 103rd Street in the Northgate area. The I-5 facility is a combination of two single-occupant-vehicle (SOV) lanes and one high-occupancy-vehicle (HOV) lane (for vehicles with 2 or more passengers). On- and off-ramps are provided exclusively for the HOV lane. The I-90 facility consists of two express lanes that extend from the Seattle CBD eastward to I-405. The I-90 Express Lanes were constructed with one SOV lane and one HOV lane, west of Mercer Island. Once motorists travel east of Mercer Island, past Island Crest Way, the SOV lane becomes a two-lane HOV facility. The I-90 HOV lanes, as in the I-5 facility, have on- and off-ramps exclusively for their use. The I-5 Express Lanes operate towards the CBD from 5:00 am to 11:00 am. The I-90 Express Lanes operate to the CBD from 1:30 am until 12:00 pm. The I-5 and I-90 Express Lanes operate away from the CBD from 12:00 pm to 11:00 pm, and from 1:00 pm to 12:00 am, respectively. On the weekend, the I-5 Express Lanes operate outbound from 7:00 am to 11:00 pm. The I-90 Express Lanes operate continuously outbound on weekends. These schedules can vary with conditions such as sporting events, concerts, and construction.

Effects

Whether the amount of congestion or utilization has been altered in a positive or negative way since the express lanes were constructed cannot be determined due to the fact that the express lanes were built in combination with the widening of I-5 and I-90. That is, there is nothing to compare the present congestion or utilization amounts to. Observations, however, seem to indicate that traffic is not as peak-directional as engineers had predicted. Inbound traffic is nearly as heavy, if not as heavy, as outbound traffic during evening peak hours, and visa-versa. Drive times are generally reported to be shorter on the express lanes. However, congestion is prevalent at ingress and egress points in the express lane. Currently, there have been suggestions within WSDOT to add express lanes to the planned I-405 project.

Public Perception

While WSDOT does not report any general complaints about the express lane system concept, there have been complaints in relation to express lane operations. That is, commuters have suggested that express lanes should be opened for inbound and outbound traffic on the weekends; all express lanes should be utilized for inbound traffic during sporting events and concerts, etc.

Contact Information: Claudia Cornish, Public Information Officer
Northwest Region
Washington Department of Transportation
(206) 440-4000

Reference

WSDOT Northwest Region. "Traveler and Commuter Information." Last revised 23 July 1998. <http://www.wsdot.wa.us.gov/regions/Northwest/explanes/>

CHAPTER 18
BORDER CROSSINGS

	Nogales, AZ	San Diego, CA	Detroit, MI	El Paso, TX	Laredo, TX
Implementation Date	Not Available	1985	1929	1996	1994
Implementation Cost (millions of dollars)	Not Available	Not Available	Proprietary Information	$16	$59
Primary Services	17 total lanes	24 inbound, 4 outbound	4-lane bridge and 4-lane tunnel	7 new structures	8 lane Intl. bridge
Population (1990)	19,489 [1]	1,110,623 [1]	1,027,974 [1]	515,342 [1]	122,899 [1]
Sq. Miles (Sq. km)	21 (54)	324 (839)	139 (359)	245 (636)	33 (85)
Population Density (pop. per sq. mi.) (pop. per sq. km)	928 (361)	3,428 (1,323)	7,395 (2,863)	2,103 (810)	3,724 (1,445.87)

[1] Population of city proper

Border crossings are quite often bottlenecks on highways that cross international boundaries. The development of Free Trade Zones has accelerated these problems as truck freight movement through international points of entry has dramatically increased. This truck traffic is in addition to people who cross the border for recreational and job-related purposes. Queues at the border crossings can extend onto the traffic network of the adjacent cities. This phenomenon creates congestion, not only at the crossings, but in the adjacent cities as well.

Nogales, AZ
MORLEY AVENUE, MARIPOSA ROAD AND GRAND AVENUE BORDER CROSSINGS

Highlights

- Sponsors: U.S. Customs Department, Immigration and Naturalization Service, General Services Administration, and Department of Transportation
- Cost: Not available
- Funding: General Federal Budget Funds
- Implementation Date: Not available
- Primary Services: 17 total lanes designated for commercial, passenger, and pedestrian traffic
- Non-attainment region for PM10

Background

Nogales, Arizona, is located in south central Arizona. Main corridors, including U.S. I-19, connect to interstates that stretch from Calgary, Alberta, Canada to Mexico City, Mexico. I-19 is also connected to one of Mexico's largest highways, Highway 15, which runs along Mexico's Pacific Coast.

There are three border crossings in the City of Nogales, including the Mariposa Road, Grand Avenue, and Morley Avenue. The Mariposa Road crossing is utilized by commercial, passenger, and pedestrian traffic. It consists in part of four passenger lanes inbound and one outbound lane. There are also two commercial inbound lanes and one outbound lane. The Grand Avenue crossing, open 24 hours a day, consists of strictly passenger and pedestrian traffic. There are a total of seven lanes which are utilized for inbound passenger traffic. During a peak traffic period (usually from 8:00 am to 10:00 pm), six of the lanes are utilized for automobile traffic, while one lane is used strictly for large vehicles, such as buses and motor homes. There are also two outbound lanes. The Grand Avenue Crossing is located in close proximity to the downtown area and was renovated approximately five years . The Grand Avenue Crossing was also recently renovated approximately 5 years ago, widening the street from three lanes to seven lanes. The Morley Avenue Crossing is strictly for pedestrian traffic.

On I-19, a 1996 proposal for the construction of a permanent Border Patrol checkpoint, 27 miles (43 km) outside of Nogales, was presented to the public. The construction of this facility would have significantly lowered traffic levels at the border. A total of $850,000 was allocated for the project in 1995, but the local chamber of commerce, realtors, and concerned citizens opposed the construction on grounds that it was "almost like an official surrender [of the border]," or, that illegal traffickers would simply bypass the permanent facility. The Border Patrol reports that the permanent structure was nearly impassible, would have allowed for less traffic congestion at the border, cut the cost of returning illegal aliens, allowed for computer installation, and would be beyond the 25 mile (40 km) legal zone beyond which Mexican citizens with border-crossing cards cannot pass. In 1997, the allocated funds were removed.

Effects

The introduction of NAFTA has obviously increased the traffic heading to and from Mexico, yet, the effects for officials at check points on the U.S. side have not been overwhelmed. The present facilities are proving effective at serving the great numbers of those traveling in- and outbound. For instance, traffic heading outbound from Grand Avenue rarely, if ever, queues back to the nearest stop signal, 0.12 miles (0.2 km) away.

Public Perception

The public's perception is generally positive. As facilities to increase traffic capacity increase, the number of businesses and out of town travelers increase. Hence, growth and/or prosperity is inevitable. Criticism from U.S. citizens is usually aimed at the slow pace of the Mexican Border Patrol. As for U.S. Border Patrol activity, due to the heat experienced in the Arizona desert in the summer of 1998, the U. S. Border Patrol restricted all activity (including the manning of its five mobile units) to the border itself, due to public concern of heat related illness and/or death of illegal aliens crossing the desert.

Contact Information: Mr. Joe Lafara
Port Administrative Offices
United States Customs
(520) 287-1427

References

The Associated Press. "Border Enforcement in Arizona." Last revised 19 May 1996. <http://www.iom.ch/News/Clip_960519~1.htm>

Nogales, Arizona. "Nogales." Last revised 1 September 1998. <http://www.nogales.com/>

San Diego, CA
SAN YSIDRO AND OTAY MESA LAND -BORDER PORTS

Highlights

- Sponsors: U.S. Customs Department, Immigration and Naturalization Service, and the Department of Agriculture
- Cost: Not available
- Funding: General U.S. Government Funds
- Implementation Date: The Otay Mesa Port was opened in 1985
- Primary Services: San Ysidro port was the largest land-border port in the world in 1996
- Non-attainment region for ozone and CO

Background

The San Ysidro land-border port, about 20 miles (32 km) south of San Diego, is strictly for passenger, bus, trolley, and pedestrian traffic. Conversely, the Otay Mesa crossing is a north and southbound passenger and commercial crossing six miles (9.6 km) to the east of the San Ysidro port.

The San Ysidro crossing consists of 24 northbound lanes (controlled by the U.S.) and four southbound lanes (controlled by Mexico). The San Ysidro port's 24 northbound lanes vary in use. Four lanes are designated as HOV lanes for vehicles carrying three or more passengers. Another lane is designated for buses only. There is also a covered pedestrian walkway, which in 1996 was upgraded with added security, lighting, emergency communications systems, and security cameras and monitors. Each lane is provided with one booth in a port manned with roughly 200 U.S. Customs Agents. INS and other divisions share use of the port as well. The regional U.S. Customs office is presently considering the addition of another six lanes.

The Otay Mesa port is six miles (9.6 km) to the east and is equipped with 13 inbound and two outbound lanes for commercial, passenger, and pedestrian traffic. The port physically divides commercial and passenger traffic on the 13 inbound lanes. Once travelers reach the port, there are four different x-ray devices used to inspect commercial and passenger vehicle cargo. Recently, 20 commuters who use the crossing regularly were invited to participate in a test of a new technology. The In-Vehicle Voice Verification System (IVVVS), sponsored by the U.S. Immigration and Naturalization Service, uses a wireless transceiver to send a commuter's voice to a computer which verifies the speaker's identity. Tests on this new technology that will eventually lower traffic congestion levels and enhance security have been very successful.

Effects

In 1995, more than 13,000,000 vehicles and 7,000,000 pedestrians crossed into the U.S. at the San Ysidro port from Tijuana, Mexico. Today, approximately 45,000 vehicles are believed to cross here each day. Depending on the time of year and the hour of day, the northbound delay can last 20 minutes to one hour.

Public Perception

None available

Contact Information: Rudy M. Camacho, Director
Southern California Customs Management Center
United States Customs Service
Department of the Treasury
(619) 557-5772

References

Mexico On-Line. "Mexico/Baja CA, San Diego Restaurants & Entertainment Online, Baja California Mexico." Last revised 14 October 1998. <http://www.sdro.com/mex.htm>

NYSTEC. "Border Technology Tested." Last revised 5 October 1998. <http://www.nystec.com/nwsspr98/spr98_02.htm>

United States Customs Office. "San Ysidro Pedestrian Bridge to Reopen Full Time." Last revised 31October 1996. <http://www.customs.ustreas.gov/hot-new/pressrel/1996/1031-00.htm>

Aguilera, Mario. "Car Poolers Get a Gift at San Ysidro Border Crossing." Last revised 28 November 1995. <http://www.sddt.com/files/library/95headlines/DN95_112803.html

World Wildlife Fund. "Border Shakedown at San Ysidro." Last revised 1996. <http://www.wwf.org/traffic/border.htm>

Detroit, MI

DETROIT / WINDSOR TUNNEL AND AMBASSADOR BRIDGE BORDER CROSSINGS

Highlights

- Sponsors: United States and Canada
- Cost: Private company information
- Funding: Funded privately by tolls
- Implementation Dates: Ambassador Bridge (1929), Detroit-Windsor Tunnel (1930)
- Primary Services: The Ambassador Bridge is the most heavily used port for commercial traffic traveling to Canada.
- Attainment region

Background

Canada and the U.S. are the world's largest trading partners, and in 1995, trade between the two countries totaled $272 billion. There are two border crossings in existence which connect the Cities of Detroit and Windsor, Ontario. The Ambassador Bridge and Detroit-Windsor Tunnel are privately owned crossings which date back to early this century (1929 and 1930, respectively). They have both serviced commercial and passenger traffic for nearly 70 years now.

Effects

Today, the Ambassador Bridge is the busiest crossing along the Canada/U.S. border, handling 27.5% of all cross-border shipments in 1993. In 1995, 10,000,000 vehicles crossed the Ambassador Bridge. The bridge has two lanes each for inbound and outbound traffic, and is linked to three major Interstates: I-75, I-96, and I-94. In 1993, the Ambassador Bridge was upgraded by the construction of a multi-million dollar Customs Inspection Center and Administration Building. Commercial traffic is diverted to a separate station containing seven Custom's booths. U.S. Customs uses a Line Release System for commercial traffic at this point, wherein approximately 50% of the traffic is allowed to pass unchecked once drivers present the proper paperwork. The 50% that are detained for closer inspection are led into a bay which can accommodate 13 trucks. Here, the trucks may be inspected by one of two mobile x-ray vans. Passenger traffic is routed through a 12-booth station.

Recently, the Ambassador Bridge installed a commuter card and a PORTPASS system. Commuter cards can be used for those making regular trips to Canada for the purpose of education, employment, or health care services. The card allows one to receive a $0.50 reduction in cost each time they cross the border and allows travelers to use specially designated express lanes once they enter the U.S. Customs plaza area on their return trip. The PORTPASS is a program developed by the Ambassador Bridge Company, in conjunction with the U.S. Customs Department and U.S. Immigration. The Ambassador Bridge also recently installed the North American Trade Automation Prototype (NATAP), that will one day standardize data, documents, and processes for all border crossings between Mexico and the U. S. The owners of the Ambassador Bridge sought to relieve inbound traffic on the bridge by spending $2,500,000 on land for U.S. Customs use. The owners tried to lease, then sell the space at cost, and finally offered it for free, but the GSA has still declined to accept the land.

The Detroit-Windsor Tunnel was constructed in 1930 and provides two lanes of roadway inbound and outbound for commercial and passenger traffic. On the U.S. side, there are five outbound toll booths. Heading inbound, seven U.S. Customs booths are in place, five for passenger traffic and two for commercial. The secondary checkpoint, where commercial vehicles are inspected and have their paperwork processed, can facilitate approximately 20 to 30 semi-trucks.

Public Perception

Commercial trucking associations from Canada (in particular) have been quite vocal in their complaints against recently proposed U.S. Government policy that would slow traffic inbound to the U.S. These groups seek reduced paperwork at border crossings, the sharing of personnel and facilities, and the movement of check points to areas away from the congested border crossings.

Contact Information: Jon Batt, Port Director
Immigration and Naturalization Service
(313)226-3177

References

Canada NewsWire. "US Immigration Changes Could Turn Windsor Into World's Biggest Parking Lot: Canadian Truckers." Last revised 5 November 1997.
<http://www.newswire.ca/releases/November1997/05/c0640.htm>

Crary, David. SOURCE: News & Reports. "Canada Warns of Border Chaos Unless U.S. Law Changed." Last revised 17 September 1997.
<http://www.sddt.com/files/librarywire/97wireheadlines/09_97/DN97_09_17/DN97_09_17_1a.html>

City of Windsor. "Transportation." Last revised 9 April 1998.
<http://www.city.windsor.on.ca/wecdc/trans.htm>

The Ambassador Bridge. "The Ambassador Bridge." Last revised 9 October 1998.
<http://www.websdot.com/ambassador-bridge/an_overview_directions.html>

El Paso, TX

ZARAGOZA BRIDGE AND BRIDGE OF THE AMERICAS

Highlights

- Sponsors: Texas Department of Transportation and the City of El Paso
- Cost of Upgrades: $8,000,000 for the Bridge of the Americas and $8,000,000 for the Zaragoza Bridge
- Funding: Texas Department of Transportation, the City of El Paso, and the local business community
- Implementation Date: 1996 (Renovation)
- Primary Services: An increase in the number of structures and lanes for passenger and commercial traffic, safer pedestrian walkways, and greater numbers of check points
- Non-attainment region for ozone, CO, and PM10

Background

The City of El Paso has serious traffic congestion problems at its border crossings. Traffic delays can last anywhere from a few minutes to over an hour. According to the Texas Department of Transportation, El Paso area bridges have seen increases of 15.1% and 22.3% in non-commercial and commercial vehicles, respectively, between 1988 and 1993. There are four major bridges in the City of El Paso that span the Rio Grande River and take travelers into or out of Ciudad Juarez, Mexico. These bridges are the Bridge of the Americas (the most heavily congested, since no toll is required, and because it is the terminus of Highway 54), the Santa Fe Street Bridge, the Stanton Street Bridge, and the Zaragoza Bridge. In response to mounting traffic congestion stemming from the North American Free Trade Agreement, the City has not only rebuilt many of its existing bridges, but it has also encouraged tourists to use alternative means of transport to enter and exit Ciudad Juarez, Mexico.

The City of El Paso encourages tourists to utilize such amenities as the El Paso-Juarez Trolley Company. This five year old company provides tourists with an all-day pass for $11. Tour companies are also promoted as safe and customized ways of seeing Mexico. Walking is another means of transport that is promoted as a safe and simple alternative to driving. The Santa Fe Bridge, in particular, provides pedestrians quick and easy access to the Mexican Border for a nominal fee of $0.50. Each of the four bridges cater to pedestrian crossing, some with parking near the U.S. border.

On July 1998, improvements to the Bridge of the Americas were completed, ending 18 months of labor. Total funding raised for the project exceeded $8,000,000. The project included enlarging the bridge from one structure holding six passenger lanes and two commercial lanes, to four new structures with eight passenger and four truck lanes. The Zaragoza Bridge was enlarged to three structures with eight lanes (four commercial and four passenger). The number of passenger inspection stations on this bridge has also increased to 20 for traffic traveling north. Cost for the structural improvements on the Zaragoza Bridge were $6,000,000, while toll booth and computer technology added additional cost of $2,000,000. Improvements for pedestrian traffic (e.g., lighting and fencing) have been made here as well. The Stanton Street Bridge may be rebuilt as well, adding a northbound lane to the exclusively southbound structure. TxDOT has also recommended the extension of I-10 from Zaragoza Street to the City of Fabens. But, whether to proceed has not been decided. TxDOT does report that highway construction in the El Paso region at the end of FY 1994 totaled more than $100,000,000.

Effects

TxDOT reports that the total value of imports and exports in 1994 was $18,167,000,000, or 21.1% of total border trade in 1994.

Public Perception

None available

Contact Information: Ted Marquez, Chief Traffic Engineer
Engineering Department
Public Works Department
(915) 541-4035

References

Laredo Development Foundation. "Welcome to Los Laredos: Trade Center of the Americas." Last revised 1996. <http://www.laredo-ldf.com/wel.htm>

Citi-Guide and El Paso/Horizon, Inc. "Citi-Guide, Juarez, Mexico Bridges." Last revised 1997. <http://www.citi-guide.com/j-bridge.htm>

Border Net. "Border Network (Laredo, Texas)." Accessed: 9 November 1998. <http://www.border.net/laredo.links/geograf.html>

Laredo, TX

LAREDO NORTHWEST INTERNATIONAL BRIDGE

Highlights

- Sponsors: U.S. Department of Transportation and Texas Department of Transportation
- Cost: $59,300,000
- Funding: Presidential Permit
- Implementation Date: Authorized in 1994
- Primary Services: Eight lane international bridge; a Laredo-managed toll plaza and export lot; federal inspection offices and processing facilities; state-managed highway facilities
- Attainment region

Background

Laredo, one of the fasted growing cities in the U.S., is virtually in the middle of the primary trade route between Canada, the U.S., and Mexico, i.e., the Pan American Highway. Mexico's largest rail and highway systems converge at Laredo's I-35 and two major U.S. rail line junctions. Laredo is also the only American city to provide border crossings into two Mexican States, Nuevo Leon and Tamualipas. In fact, the City's Customs District reportedly conducted more trade in 1996 than the ports of New Mexico, Arizona, Southern California, and West Texas combined.

For now, the City of Laredo is responsible for monitoring border crossings for three international bridges within its borders. Bridge I, the Gateway to the Americas Bridge (formerly known as the International Bridge), has a total of two inbound lanes for both commercial and passenger traffic. Between 1988 and 1993, Bridge I saw a 58.8% drop in commercial traffic and a 24.9% drop in passenger traffic. Bridge II, the Lincoln/Juarez Bridge, has three inbound lanes for commercial and passenger traffic. According to TxDOT, from 1988 to 1993, Bridge II (the Lincoln/Juarez Bridge) experienced a 21.6% increase in passenger traffic and a 637% increase in commercial traffic. On Bridge III, or the Laredo/Columbia Bridge, there are four passenger and eight commercial lanes.

In 1994, the City was granted, by Presidential Permit, $59,300,000 for a new eight-lane, state-of-the-art bridge and additional facilities. These facilities include a Laredo-managed toll plaza and export lot; a federal inspection office and processing facility; and a state-managed highway facility. The purpose of the Laredo Northwest International Bridge (Bridge IV) is to eliminate massive amounts of traffic on International Bridge I and II, because Bridge IV will cater solely to commercial truck traffic. As of July 1998, the City of Laredo had not begun construction on the bridge (Mexico has begun construction) but hopes to have the project completed sometime in the next two to three years. To further mitigate traffic congestion near the border, there are plans to widen I-35 by one lane, restricting commercial truck traffic to the far left lane. At the time of this report, this has not been done.

Effects

TxDOT reported that, in 1994, the total estimated value of imports and exports was $29,445,000,000, or 34.2% of total border trade.

Public Perception

None available

Contact Information: Raphael Garcia, Bridge Manager
City Bridge System
City of Laredo
(956) 795-2040

Reference

Kelly, Mary. The Bridges of Cameron and Hidalgo Counties. Texas Center for Policy Studies: Austin, TX. (June 1995).

OTHER EXAMPLES/CITIES WITH BORDER CROSSINGS

New Mexico

- Three approved border crossings in the state: Antelope Wells, Columbus, Santa Teresa

Reference

New Mexico Trade. "New Mexico/Mexico Border Crossings." Accessed: 9 November 1998. <http://www.edd.state.nm.us/TRADE/ISSUES/cross.htm>

ADDITIONAL REFERENCES

U.S. Department of Transportation, Federal Highway Administration. "Border Technology Exchange Program." Accessed: 9 November 1998. <http://international.fhwa.dot.gov/tmpl.cfm?title+BrdrTech>

General Accounting Office. "GAO Annual Index - FY 1996." Accessed: 9 November 1998. <http://www.gao.gov/AIndexFY96/abstracts/rc96061.htm>

CHAPTER 19
ADDED SINGLE OCCUPANT VEHICLE LANES

	Flagstaff, AZ	Wichita, KS	Amarillo, TX	Waco, TX
Implementation Date	1990	1998	1997	1998
Implementation Cost (thousands of dollars)	$5,400	$7,112	$499	$1,600
Primary Services	5-lane arterial	4-lane, urbanized	restriping	4-lanes and a center-turn lane
Population (1990)	45,857 [1]	304,017 [1]	157,571 [1]	103,590 [1]
Sq. Miles (Sq. km)	63 (164)	56 (298)	88 (228)	76 (196)
Population Density (pop. per sq. mi.) (pop. per sq. km)	728 (280)	5,429 (1,020)	1,791 (691)	1,363 (529)

[1] Population of city proper

Adding single occupancy vehicle (SOV) lanes may be accomplished in at least two ways, restriping or reconstruction. A roadway may be restriped to make room for added lanes by removing parking spaces along the curb, the conversion of shoulders to travel lanes, or lanes may simply be narrowed so as to allow more space for an additional travel lane. Conversely, a roadway may be widened by increasing the curb-to-curb width through reconstruction. Which ever technique is chosen, the goal is to increase carrying capacity and traffic flow on that roadway and decrease the number of traffic accidents.

Flagstaff, AZ
CEDAR FOREST REALIGNMENT PROJECT

Highlights

- Sponsor: City of Flagstaff
- Cost: $5,400,000 for engineering, management, right-of-way acquisition, and construction
- Funding: City bond revenue
- Implementation Date: 1990
- Primary Services: Five-lane arterial
- Attainment region

Background

The City of Flagstaff has a very unique feature; there is a mesa in the center of town. The city is basically divided into two parts. Four arterials connect these two halves, US-66, I-40, Butner Road, and Cedar Forest Road. The first three arterials travel south around the mesa. Cedar Forest Road, however, was a two-lane roadway that traverses the northern section of the mesa. To decrease the amount of congestion and improve safety on this roadway, the City chose to widen the two-lane road to a five-lane arterial, realign the roadway (to travel south of a neighborhood it had once traveled through), landscape, add gutters, and construct one sidewalk and two 5½-foot (1.7 m) bike lanes. The Cedar Forest Realignment Project spanned an 8,000-foot (2,424 m) long stretch of roadway, from Turquoise Drive on the west side to West Street. Land adjacent to Cedar Forest Road is generally undeveloped, with the exception of a city park. The project, which was completed in 1990, widened the roadway from two lanes to five lanes. While no median was deemed necessary, a gutter on both sides was installed. The project also included landscaping (tree planting), a five-foot (1.5 m) wide sidewalk on one side of the roadway, and two 5½-foot (1.7 m) wide bicycle lanes.

Effects

As a result of the widening and realignment project, average daily traffic counts have increased from 16,000 to 24,000.

Public Perception

None available

Contact Information: Jerry Craig
Traffic Engineering
City of Flagstaff
(520) 779-7629

Wichita, KS
MAIZE ROAD PROJECTS

Highlights

- Sponsor: City of Wichita
- Cost: $7,112,000
- Funding: 80% Surface Transportation Program (STP) federal funds, and 20% from a local general obligation bonds and a 1% local sales tax
- Implementation Date: September 1997
- Primary Services: Four-lane, urban section of roadway
- Attainment region

Background

Due to increased growth and traffic congestion, the City of Wichita began the first of four projects to widen Maize Road (a two-lane county highway), into a four-lane "urban" section of roadway. All of Maize Road was once a two-lane asphalt road with roadside drainage ditches. However, the development of more housing and businesses in the area created a demand for increased traffic flow. Each of the four projects called for Maize Road to be widened from two to four lanes. Each project would cover a one-mile (1.6 km) segment of the roadway heading north from Kellogg Expressway (US 54/US 400). At each mile (1.6 km) is a major intersection where Maize crossed a large arterial roadway. Before construction began on the first of the four projects, these intersections had been equipped with fully actuated traffic signal systems. Design of the projects was paid for and completed by the City of Wichita. The construction was paid for in an 80% - 20%, federal - local split. The first Maize Road widening project began in 1991. The projects included such features as drainage gutters feeding into underground storm sewer lines, six- and seven-lane intersections, sidewalks, and landscaping. The fourth Maize Road project was completed in 1998. As of August 1998, construction is underway on another 1/3-mile (0.5 km) extension to widen Maize Road. The City of Wichita will continue widening the road to their corporate limits, at which point, the county will carry on until the roadway is widened to the Maize city limits.

Effects

The effect on congestion has been positive. Increased capacity has led to less congestion and higher levels of safety.

Public Perception

None available

Contact Information: Gene Rath, Assistant City Engineer
Traffic Engineering
City of Wichita
(316) 268-4446

Amarillo, TX

S.W. 9th AVENUE, WASHINGTON ST., COULTER ST., S.W. 45th AVE., AND EASTERN ST.

Highlights

- Sponsors: Craig Methodist Retirement Center and the City of Amarillo
- Cost: $2,000; Not available; $493,928; $499,851; $1,105,621; respectively
- Funding: The City of Amarillo and the Texas Department of Transportation
- Implementation Dates: 1997,1996, 1996, 1996, 1995, respectively
- Primary Services: Increased lanes via restriping and/or reconstruction.
- Attainment region

Background

Amarillo has experienced rapid growth and undesirable levels of traffic congestion and automobile collisions. This phenomenon is particularly true on S.W. 9th Avenue between Avondale and Bell, where six collisions occurred in 1996 and eight in 1997. These accidents prompted residents of the Craig Methodist Retirement Center to petition the City of Amarillo for a solution to the problem. The City increased the number of lanes on this segment of S.W. 9th Avenue from at the request of the retirement center after numerous rear end collisions. Drivers were reporting that those behind them were following too closely, or that they, themselves, had misjudged the correct time at which to make a left turn. The S.W. 9th project involved the restriping of this 52-foot (16 m) wide road, adding a center left turn lane. The outside lanes are now 11 feet wide (3.3 m) and the inside and turn lanes are 10 feet (3.0 m) wide. The project was completed in November 1997 by an independent contractor (who removed the striping at a cost of $2,000) and the City (which dotted and restriped the roadway).

In August 1996, the 52-foot (16 m) wide Washington Road was restriped from Wolflin Avenue to 22nd Street as part of a street overlay project to increase flow entering a community college parking lot that had recently been built. The cost of this project is not available.

In 1996, there were alterations of three roads. In November of that year, two projects were completed, including the alterations of S.W. 45th Avenue and Coulter Street. Each of these two streets were widened from two-lane to four-lane urban sections. The S.W. 45th Avenue project included the rebuilding of the roadway between Coulter Street and Soncy at a cost of $499,851. The Coulter Street project was an operation completed by TxDOT which cost $493,928. Coulter Street was physically widened to add an additional three lanes to the two-lane arterial.

In 1995, the City completed, at a cost of $1,105,621, a project on Eastern Street from S.E. 10th to Amarillo Boulevard. This project involved the widening of the street surface to alter the two-lane arterial into a four-lane urban section.

Effects

Since the restriping, the City of Amarillo's Traffic Engineering Department reports that while inconclusive, data so far seem to suggest that the restriping has had a beneficial effect on traffic flow and has led to a decrease in the number of traffic collisions.

Public Perception

Those in the public who take advantage of the increased number of lanes find the improvements welcome. However, businesses along the improved street disapproved of the increase in the number of lanes to the S.W. 9th Avenue roadway accomplished via restriping, saying that the lanes are now too narrow.

Contact Information: Mr. Taylor N. Withrow, Traffic Engineer
City of Amarillo
(806) 378-4218

Waco, TX

GARDEN DRIVE WIDENING AND EXTENSION PROJECT

Highlights

- Sponsors: City of Waco and the Texas Department of Transportation
- Cost: $1,600,000
- Funding: Texas Department of Transportation
- Implementation Date: 1998
- Primary Services: Four travel lanes and a center turn lane
- Attainment region

Background

The extension and widening of Garden Road was part of a 30-year long range plan to improve the City of Waco's existing roadway system. The project called for the extension and widening of an existing collector road which had terminated at I-35. Construction on the existing and new road segments began in November 1997. The collector road now extends beyond I-35, to US Highway 77. The old roadway was previously only two lanes wide and has now been widened to four lanes with a center turn lane. The extension of the collector road has the same features as the older, recently widened portion.

Effects

There have been no studies conducted which pertain to this extension and widening project.

Public Perception

None available

Contact Information: Mark Hines, Chief
Civil Engineering Agency
Department of Public Works
(817) 751-8540

SECTION 5

PUBLIC TRANSIT

CHAPTER 20
BUS

	Ottawa-Carleton, Ontario, Canada	Portland, OR	Pittsburgh, PA	Bremerton, WA
Implementation Date	1996	1978	Not Available	1992
Implementation Cost (millions of dollars)	$420	$15.8	$399.6	$4.5
Population (1990)	313,987 [1]	1,515,452	2,394,811	189,731
Sq. Miles (Sq. Km)	43 (110)	3,743 (9,694)	4,624 (13,261)	396 (1,026)
Population Density (pop. per sq. mi.) (pop. per sq. km)	7,302 (2,854)	405 (156)	518 (181)	479 (185)

[1] Population of city proper

Public transportation moves people safely and efficiently while producing significantly less air pollution from transit buses than the equivalent number of automobiles. The transit bus is more efficient in its use of roadway space and energy resources than all other highway modes of transportation.

Buses come in different shapes and sizes and the roadway system, including traffic signal timing, is designed to accommodate these vehicles. Fixed route bus service operates on regularly scheduled routes, transporting passengers to and from specified locations. Express bus service is a variation of fixed route service in that a portion of the route is operated without any stops.

Operational or capital transit improvements can have significant impacts on the amount of transit ridership. Strategies that could be used to improve transit operations are transit routing, service enhancement and expansion, transit service quality, transit coordination, marketing, and transit information systems. Other transit use incentives include bus bypass ramps and bus lanes.

Ottawa-Carleton, Ontario, Canada

PUBLIC TRANSPORTATION, BUS-TRANSITWAY (BUS ROADWAY)

Highlights

- Sponsors: Federal, Regional operations and capital, Reserves, Passenger fares
- Cost: $420,000,000
- Funding: Federal, Regional operations and capital, Reserves, Passenger fares
- Ridership: 265,000 people daily
- Elements: 21 mainline routes, 79 routes during peak hours only, 24 stations, fixed routes

Background

In 1978, it was decided that a busway (transitway) would have an impact on the city by convincing motorists that there is a better way to commute rather than in their personal automobiles. The project was approved, and the entire busway system was completed in 1996. It is a system dedicated exclusively to buses and the efficient movement of people. Without the transitway, the buses would be required to use general purpose roadways which were congested.

Effects

Over 265,000 people use the transitway each day on their way to and from work. A total of over 700 buses use the transitway and local routes to carry an annual ridership of 71,800,000. New buses are being designed to make boarding and exiting the buses easier for wheelchairs. The low-floor buses with beam activated doors , manufactured by Nova Bus Corp., are designed so that the mobility challenged and wheelchair patrons can enter and exit with minimal difficulty. The front of the bus can be lowered, and there is an extendable telescopic ramp at the front door.

Public Perception

All decisions of the transit system are subject to public scrutiny and, as a public enterprise, meetings take place once a month to determine the public's perception of the transit system.

Contact Information: Oxana Sawaka, Manager of Customer Services
OC-Transpo
(613) 842-3632

Helen Gault, Manager of Planning and Development
OC-Transpo

Reference

Meagher, Joan., ed. "Bus Service in U.S. Deteriorating." *The Urban Transportation Monitor*. Vol. 8. No. 14. (22 July 1994): 1.Meagher, Joan., ed. "Electric Buses Improved Substantially to Meet Operator Requirements in Northeast." *The Urban Transportation Monitor.* Vol. 12, No. 9. (8 May 1998): 6.

Portland, OR

PUBLIC TRANSPORTATION-PORTLAND TRANSIT MALL

Highlights

- Sponsors: Federal, State, and Local
- Cost: $15,800,00
- Funding: Federal, State, and Local
- Ridership: Not available
- Elements: 32 shelter television kiosks, 8 information kiosks, 13 drinking fountains, 209 historic street lamps, widened brick sidewalks, 11 works of art, 5 fountains, 287 London plane (Sycamore) trees (transit mall trademark), 36 banner poles
- Attainment region

Background

As early as 1971, there was an interest in the Portland region in developing an effort to improve the air quality. As a result, a transit mall for downtown was recommended to begin solving the air quality problems. Another intent of the mall was to make room for people and minimize the on-going conflict between automobiles, buses, and pedestrian traffic. On March 17, 1978, while providing transportation for shoppers and commuters throughout the Central Business District (CDB), a 22 block transit mall was officially dedicated for use by the Tri-Met transit system.

Effects

The transit mall development removed 308 curbside parking spaces and compensated for this by building two public parking garages with almost 1,300 parking places. The transit mall has offered the benefits of fewer vehicles downtown, thereby decreasing the number of traffic accidents. The transit mall was built as part of a $1.3 billion dollar effort to develop the downtown area and increase the safety and efficiency of the transit system for people who work downtown, 50% of which now regularly commute using Tri-Met.

Public Perception

Not available

Contact Information: Steve Johnson, Communications
Tri-Met Transit
(503) 238-5854

Reference

The Gilmore Research Group. Tri-Met Fact Sheet. Gilmore Research Group: Portland, OR. (1997).

Pittsburgh, PA

PUBLIC TRANSPORTATION, BUS-EAST ROADWAY EXTENSION

Highlights

- Sponsors: Pittsburgh Turnpike Commission, City of Pittsburgh
- Cost: $326,800,000
- Funding: City of Pittsburgh
- Ridership: Over 30,000 people use the buses during a weekday
- Elements: Over 900 buses are part of the transit system
- Non-attainment region for ozone, S02, and PM10

Background

The City of Pittsburgh has developed a fixed guideway system designed exclusively for buses, but allowances are made for emergency vehicles and private bus companies. The east fixed guideway was designed to extend further than was actually built. Various communities in the area opposed its development and, as a result, its length was reduced. Once the fixed guideway was designed and built, the benefits were recognized, and the once opposing communities requested that the busway be extended to their neighborhoods.

Pittsburgh currently has two busways, the Martin Luther King Jr., East and South. The Martin Luther King Jr. East fixed guideway was opened in 1983 and is currently awaiting the approval for development based upon recommendations from the Pittsburgh Turnpike Commission. The Commission is considering the opportunity for an existing turnpike road meeting the new busway extension. Decision makers see this as an opportunity for the traveling public to access the busway from the highway with their primary destination being the airport or the downtown area. The guideway has nine stops and is set up to be a multimodal connection with the light rail system.

Effects

The success of the two current busways has prompted the development of a 5 mile (8 km) long busway called the Airport/Wabash. Park-and-ride facilities and an exclusive HOV lane one mile (1.6 km) long will be included in the project. Estimated operating, maintenance, and upkeep of the entire facility is $326,800,000 annually. In addition, the new busway will extend beyond congestion points and gives the buses exclusive right-of-way.

A significant amount of development has occurred around the busway. The results of one survey revealed that there had been 54 businesses opened near the busway with a combined fair market share value of $302,000,000.

Public Perception

The general public has expressed more enthusiasm as it has became increasingly involved in the development of the future busway extension.

Contact Information: Gary Antonella, Associated Transportation Planner
Port Authority of Allegheny County
(412) 237-7254

Reference

Meagher, Joan., ed. "Pittsburgh Busway Extensions Moving Ahead." *The Urban Transportation Monitor.* Vol. 12, No. 2. (30 January 1998): 3.

Bremerton, WA
PUBLIC TRANSPORTATION, BUS-PREEMPTION SIGNALS

Highlights

- Sponsors: Federal and State
- Cost: $4,500,00 for start-up cost of entire preemption system
- Funding: State sales tax
- Ridership: 14,114 passengers daily
- Elements: Between 50-60 intersections with preemption, 40 fixed bus routes
- Attainment region

Background

In 1992, the Kitsap County transit system needed to improve ridership and service to the public in the area surrounding Seattle, Washington. The problems associated with air pollution and traffic congestion were becoming a serious threat to the environment and future quality of life. In an effort to combat this growing issue, Kitsap Transit began a campaign to encourage commuters to leave their vehicles at home and to ride the bus to work.

These buses use 3M's Opticom Priority Control System to communicate to the system that, when activated by a special strobe light, allows operators of authorized vehicles to gain control of traffic signal lights. Implementation of this system required that the area overcome a law which prohibited the use of any devices that controlled traffic lights. Kitsap Transit conducted a successful test which shifted support to the implementation of the system.

Effects

A new Integrated Fleet Operations (INFO) System is designed to improve the facilitation of the Opticom system. INFO helps buses stay on schedule by providing automatic vehicle location and up-to-the-minute tracking of buses. This is an asset to Opticom because, when the bus is running late, the on-board computer automatically activates the Opticom System, and a red light can be shortened, or a green light can be lengthened as the bus approaches the intersection. The system also has a built-in incident report feature which triggers a silent alarm, enabling drivers to inconspicuously signal for help if needed. A decrease in average travel time for buses is a direct result of implementing this system

Public Perception

Modern technology has helped change the public's perception of buses being a slower method of transportation when compared to the personal automobile.

Contact Information: Allen Jacob, Electronic Division Supervisor
City of Bremerton
(360) 478-5372

John Clauson, Service Director
City of Bremerton
(360) 478-6223

Bob Ferguson, Transportation Demand Management Administrator
Kitsap County Transit
(360) 478-5864

Reference

Jacobs, Allen. "ATMS FORUM: Re: Bus Preemption Strategies." Last revised 13 January 1998. <http://www.itsonline.com/atmsforum/messages/202.html>

OTHER EXAMPLES/CITIES WITH INNOVATIVE BUS SYSTEMS

Chattanooga, TN

- Shuttle system using an electric bus
- 17 electric buses

Reference

US Department of Transportation. "Mass Transit critical to Chattanooga's Turnaround, Secretary Slater Says." Last revised 8 April 1998. <http://www.dot.gov/affairs/fta0998.htm>

New York, NY (Port Authority Bus Terminal)

- Largest bus terminal in the United States
- 85% of customers surveyed rated their experience with buses "good to very good"

Reference

Goldberg, Rhonda., ed. "Port Authority Bus Terminal Rates High in Customer Survey," *Passenger Transport.* Vol. 55, No. 45. (17 November 1997): 2.

Tampa, FL (Hillsborough Area Regional Transit Authority)

- 32 local bus routes, 13 express routes with a fleet of 174 vehicles
- Increased its ridership and lowered its cost per passenger
- Mobility management agency, rather than a traditional bus company
- Not funded through MPO; it has more independence

Reference

Murray, G., D. Kaufmann, C. Chambers, and P. Webb. "Strategies to Assist Local Transportation Agencies in Becoming Mobility Managers." *TCRP Report* 21, Project B-7. Transportation Research Board: Washington D.C. (1997).

Denver, CO (Regional Transportation District)

- Contracting 20% of fixed-route service
- $88,000,000 dollars saved over a 10-year period as a result of competitive contracting
- Service levels increased by more than 15%

Reference

Cox, Wendell, Janet E. Kraus, and Subhash R. Mundle. "Competitive Contracting/Competitive Tendering: Denver Transit / Public Transport." Last revised 29 May 1997. <http://www.publicpurpose.com/uttbden.htm>

CHAPTER 21
LIGHT and COMMUTER RAIL

	Sacramento, CA	San Diego, CA	St. Louis, MO	Portland, OR	Dallas/Fort Worth, TX
Implementation Date	1973	1981	1993	1986	1983
Implementation Cost (millions of dollars)	$350	$552	$420	$1,600	$928.5
Primary Services	36 Light Rail Cars	123 Light Rail Cars	31 Light Rail Cars	72 Light Rail Cars	40 Light Rail Cars, 13 Commuter
Freeway Miles (km)	51 (82)	299 (366)	490 (784)	81(130)	579 (926)
Population (1990)	1,481,220 [1]	2,498,016	2,492,348	1,515,452	4,037,282 [1]
Sq. Miles (Sq. km)	5,094 (13,194)	4,204 (10,890)	6,393 (16,558)	5,028 (13,021)	9,105 (23,582)
Population Density (pop. per sq. mi.) (pop. per sq. km)	291 (113)	594 (229)	390 (151)	301 (116)	443 (171)

[1] Population of CMSA

Since rail transit systems are physically attached to their routes, their service areas can be somewhat limited to dense population and activity centers. The functional service areas are limited to the distance people are willing to travel, by walking or some other means, to a rail transit stop.

Population densities in Texas are characteristically lower than some of the major cities of the Northeast. U.S. rail transit has not been a primary mode, since automobiles are usually required to reach specific transportation destinations in the Texas region. Rail transit is readily available in many of the Northeast cities where specific destinations can be reached with relative ease.

While light rail systems, such as trolleys, have been in use for approximately 100 years, it has been only recently that the utilization of high speed light rail has occurred. Light rail systems refer to rail cars that operate on electric power received from an overhead cable, or through the rail system. Additionally, they are typically manned by an onboard driver, travel in small groups, and often share the right-of-way with vehicular traffic. Commuter rail systems, on the other hand, tend to be bi-level cars powered by diesel locomotives. Typically, commuter systems may travel between metropolitan areas and stop less frequently than do light rail systems. Rapid growth of businesses and housing can be observed in areas adjacent to transit rail systems.

Sacramento, CA

SACRAMENTO REGIONAL TRANSIT DISTRICT

Highlights

- Sponsors: City of Sacramento, Sacramento County, Sacramento Area Council of Governments, and the State of California
- Cost: $350,000,000 (implementation), Operating cost in 1995: $13,951,314
- Funding: $34,261,207 Local; $15,962,997 Passenger Fares; $3,074,020 Federal; $0 State (1995)
- Implementation Date: 1987
- Primary Services: 36 light rail cars, 18.3 miles (29.3 km) of track
- Non-attainment region for ozone, CO, and PM10

Background

In 1973, the Sacramento Regional Transit District (RT) began service with 103 new buses and a new maintenance facility. However, as the suburbs of Sacramento grew, city, county, regional, and state officials began to focus attention on the feasibility of a light rail system. By 1987, construction on the system was completed. The 18.3 mile (29.3 km) system now leads from the northeastern suburbs to downtown, and out again towards the City's eastern suburbs. The RT is governed by members of the Sacramento City Council and Sacramento County Supervisors and currently services a 418 square mile (1,071 sq. km) area. There are 36 light rail cars that operate by electricity received from an overhead electric cable. The cars are accessible to the handicapped and offer limited space for bicycles. The system operates 365 days a year from 4:30 am to 1:00 am, arriving at a station every 15 minutes. There are 36 light rail stations in all, which incorporate 10 bus transfer stations, 19 two-way platforms, eight one-way platforms, and 15 central city stations. There are also nine free park-and-ride centers along the route. RT has also built sound barrier walls along most of the rail line.

The Sacramento Regional Transit District's future plans include a 2.3-mile (3.7 km) westward extension, which is expected to be completed in the Fall of 1998. Once this extension to Mather Field Road is completed, construction will continue until the rail line eventually extends to the city of Folsom. A southern extension, the Southline project will span 6.3-miles (10.1 km), eventually linking downtown Sacramento to the more transit-reliant south side. Matching funds were made available by the city, which raised its share from sales taxes. This Southline project includes a 1.0-mile (1.6 km) extension to a multi-modal facility where the light rail will connect with Amtrak as well as local and commuter buses. The Southline project is the first phase in a larger project that will eventually reach to the Sacramento International Airport. Completion of this project is expected in the year 2003.

Effects

Sacramento's light rail cars serve 27,500 riders on an average weekday. Ridership is constantly increasing on the Sacramento Regional Transit District Light Rail System. RT Light Rail service accounted for 30% of RT's total system ridership in 1997.

Public Perception

None available

Contact Information: Ed Scofield, Public Information Officer
Sacramento Regional Transit District
(916) 321-2800

References

Sacramento Regional Transit District. "Home beta 1.000001 rev by ET." Last revised 4 September 1998. <http://www.sacrt.com/>

Sheck, Ronald C., et al. Guideway Transit and Intermodalism: Function and Effectiveness: Case Study, Sacramento. U.S. Department of Transportation, Federal Transit Administration: Washington, D.C. (November 1996).

San Diego, CA
SAN DIEGO TROLLEY INC.

Highlights

- Sponsor: Metropolitan Transit Development Board (MTDB)
- Cost: $552,000,000 (Projects as of 1998)
- Funding: Federal Transit Administration, the State of California, TransNet, the County of San Diego, and the City of San Diego
- Implementation Date: 1981
- Primary Services: 123 vehicles, 40 miles (64 km) of track
- Non-attainment region for ozone and CO

Background

The use of the word "trolley" in the transit system's title is more of a marketing term, as there are strictly modern rail cars within San Diego Trolley Inc.'s light rail fleet. San Diego Trolley Inc. operates, along with five other bus transit organizations under the parent company, the Metropolitan Transit Development Board (MTDB). The MTDB was created in 1975 by the California Legislature to study the feasibility and implementation of a light rail system. The MTDB plans and constructs the rail's regional system, while San Diego Trolley Inc. is responsible for the operation of the system. San Diego introduced modern light rail into its transit system with a 16.0-mile (25.6 km) starter line. San Diego Trolley Inc. now operates a fleet of 123 articulated light rail cars powered by overhead electric lines. The cars typically operate in coupled groups of four. These cars seat 64, but can hold up to 150 persons during peak operation. Bicycles are allowed on the light rail cars with storage provided at the front and back of the cars. The rail cars are also equipped with a ramp and lift system to accommodate the physically challenged. Currently, there are roughly 46.2 miles (73.9 km) of double-track which make stops at 48 stations along the Orange and Blue Line routes. These two lines make stops at locations such as a professional sports stadium, a state park, the San Diego Convention Center, and a shopping mall. Opened for service in 1986, The East Line (a.k.a., Orange Line) now extends 21.0 miles (33.6 km) from the downtown San Diego area. The Blue Line, created in 1981, also intersects with the downtown area. The South Line portion of the Blue Line extends 16.0 miles (25.6 km) to California's border with Mexico, stopping within 100 feet (30 m) of Tijuana. The North Line portion of the Blue Line extends away from the CBD, turning east where it becomes the Mission Valley Line (this portion opened in 1997). In the planning stages is a 5.9-mile (9.4 km) extension of the Mission Valley segment which will link the Blue and Orange lines. Construction is planned to begin in 2000 and be completed by 2004. The $361,000,000 project will include the construction of four new stations (San Diego State University Station will be located underground), two bridges, and a tunnel. Other plans include the construction of a multimodal facility at the San Ysidro border station and a 10 mile (16 km) extension of the North Line along I-5, named the Mid-Coast LRT extension.

Effects

Today, there are approximately 19,700,000 rail riders annually using the system during the week, or, 70,000 daily weekday riders. The system accommodates approximately 27% of the area's roughly 64,000,000 total daily trips. San Diego Trolley's busiest day was during Super Bowl XXXII, when they transported 25,000 of the 72,000 fans that attended the event.

Public Perception

Ridership on the light rail is continuously increasing. However, unlike most cities, San Diego reports that its improved relationship with the business and housing community has come more slowly. They report that efforts to increase the quantity and value of land adjacent to the rail lines has taken larger than normal amounts of effort and time. However, studies conducted by MTDB show evidence that property values along the rail line have increased since its construction.

Contact Information: John Haggerty
Public Relations
San Diego Trolley Inc.
(619) 557-4508

Reference

Goldberg, Rhonda., ed. "Rapid Transit Conference Kicks Off in San Diego: More Turning to San Diego Trolley Service." *Passenger Transport.* Vol. 56, No. 23. (8 June 1998): 3.

Sheck, Ronald C., et al. Guideway Transit and Intermodalism: Function and Effectiveness: Case Study, Sacramento. U.S. Department of Transportation, Federal Transit Administration: Washington, D.C. (November 1996).

St Louis, MO
<u>METROLINK</u>

Highlights

- Sponsor: Bi-State Development Agency
- Cost: $420,000,000 (Projects as of 1998)
- Funding: Passenger Fares, Local and Federal Sources
- Implementation Date of MetroLink: 1993
- Primary Services: 31 light rail cars, 17 miles (27.2 km) of track, 18 stations
- Non-attainment region for ozone, PM10, and lead

Background

In 1949, the States of Missouri and Illinois created an agreement under which the Bi-State Development Agency (Bi-State) was formed. In response to ever increasing traffic levels in the metropolitan area, Bi-State sought to provide a safe, inexpensive, and efficient means of transporting the citizens of the St. Louis area to major transportation, employment, business, retail, recreational, cultural, educational, and medical facilities. In 1963, Bi-State successfully purchased and consolidated 15 privately operated transit firms in the area. By 1993, the Agency opened and began operation of its light rail service, MetroLink. Today, Bi-State operates a bus, rail, and paratransit system serving the St. Louis metropolitan area, including St. Louis County, Missouri, and Madison and St. Clair Counties, Illinois.

Effects

The MetroLink system consists of 31 double-ended, articulated, light rail cars powered by overhead electrical cables. The cars are operated by one driver and travel at a maximum speed of 55 mph (88 kph). The rail cars seat 72 people with additional capacity for 34 to stand. MetroLink extends from Lambert International Airport, through downtown St. Louis, and eastward across the Mississippi River into Illinois, operating from 5:00 am to 1:00 am. Travel from Lambert International Airport to the downtown area cost one dollar and takes approximately 35 minutes. For those commuting from the suburbs into downtown St. Louis, there are also 2,500 park-and-ride spaces along the MetroLink route. MetroLink provides a "Free Ride Zone," within the downtown area between the hours of 11:00 am and 2:00 pm. Operating costs for the light rail system were $14,715,802 in 1995. 1995 capital costs were $5,692,890. No funds were provided by the two states, only from local, federal, and "other" sources. While the majority (67%) of operating funds for all of the Bi-State Development Agency were derived from local sources in 1995, the largest part (87%) of capital funds came from federal sources.

MetroLink's next project is a plan to extend the rail system 26 miles (41.6 km) eastward into the St. Clair County region. Phase one calls for a 17.4 mile (27.8 km) double track to extend to St. Clair's Belleville Area College. The final phase will extend the track to the Mid America Airport, another 8.6 miles (13.8 km) away. The plan includes the acquisition of 20 new light rail cars and the construction of eight new stations, 3,500 additional parking spaces, and 15 major bridges. The estimated cost of this project is approximately $400,000,000. The federal government has agreed to pay $244,000,000 of the cost. Local revenue will be derived from a half-cent sales tax paid by the citizens in the St. Clair County Transit District. After construction is completed, the St. Clair County Transit District will pay the operating costs for this portion of the extension. Construction of the project should begin in Spring 2001.

Effects

After only four years of service, MetroLink, the Agency's light rail system, received the American Public Transit Outstanding Achievement Award. Average weekday ridership on MetroLink during FY 1997 was 42,500. The highest ridership count on record for a single day was on July of that same year.

Public Perception

The MetroLink system is vital to St. Louis and its surrounding areas. The neighboring City of St. Clair was willing to impose its own half-cent sales tax in order to have MetroLink service in its area.

Contact Information: Linda Hancock, Director
Office of Communications
Bi-State Development Agency
(314) 982-1440

Reference

St. Louis Regional Transit. "St. Louis Regional Transit." Accessed: 9 November 1998. <http://www.bi-state.org/index.html>

Portland, OR
MAX LIGHT RAIL SYSTEM

Highlights

- Sponsors: Federal Transit Administration (FTA), Federal Highway Administration (FHWA), Oregon DOT, the Cities of Beaverton, Hillsboro, and Portland, and the Counties of Multnomah and Washington
- Cost: $1,600,000,000
- Funding: Tri-Met, Metro, Federal Transit Administration, Federal Highway Administration, ODOT, the Cities of Beaverton, Hillsboro, and Portland, and the Counties of Multonomah and Washington
- Implementation Date: 1986
- Primary Services: 33 miles (53 km) of track, 46 stations, 72 light rail cars, and a bicycle and ride program
- Attainment region

Background

In 1969, the Portland City Council voted to create Tri-Met (the transit agency in charge of bus, paratransit, trolleys, and light rail), with approval granted by the State of Oregon. In 1986, MAX Light Rail began service. As of September 1998, MAX was operating 33 miles (52 km) of light rail track and 46 rail stations. September 1998 is the expected opening date for the Westside Extension, which hopes to increase ridership by 20,000 people after the first year. The Extension, which is 18 miles (28.8 km) long, will link Gresham, downtown Portland, and Hillsboro, and include 20 new stations (nine with park-and-ride facilities which have 3,700 spaces). The Extension to Hillsboro is open track, lying on a former rail line. The Extension also includes the purchase of new rail cars which will increase the fleet to 72 cars. Each car will be air conditioned and fitted with video surveillance. The 46 new rail cars purchased as part of the Extension will be "low floor cars" costing a total of $115,000,000. The new cars allow quick exit or entrance for those who cannot step over the four-inch (10 cm) gap between the platform and the rail car. Ramps are lowered from the doors to the platform for those with wheelchairs and strollers. Each of the new cars will also have a skirt next to each steel wheel so as to reduce noise. Sound barrier walls have been constructed adjacent to the track, and the City has paid for the installation of insulated glass in numerous houses near the route. MAX and the Oregon Department of Transportation also worked together to improve Highways 26 and 217, while further plans call for the addition of a pedestrian overpass, a new bridge, and a three- mile (4.8 km) twin tunnel. State funding for the Westside Extension totaled $114,000,000. FTA and FHWA funds totaled $704,000,000. Regional and local funds (including those from the Cities of Portland, Beaverton, and Hillsboro, the Counties of Multonomah and Washington, the Tri-Met and Metro) totaled $146,000,000. In all, the Westside Expansion Project will cost a total of $964,000,000 of which 75% will be federal funding and 25% will be local funding. The Tualatin Valley along the Westside Expansion was the sight of wetlands which required draining during construction. To remedy the loss of these valuable natural ecosystems, Tri-Met built even larger wetland areas along the light rail route.

Future plans call for another extension northward towards the Portland International Airport (PDX). The Airport MAX Plan calls for an extension from the downtown area along a 5.5 mile (8.8 km) long corridor, stopping along the route at four different stations. The Airport Extension, or PDX MAX, will also provide commuter service to Columbia South Shore and East Clark County. Construction is slated to begin in February 1999 and end in July 2001. The Airport Extension is different from the Westside Extension in that it is both publicly and privately funded, so as to avoid the delays inherent in the federal appropriations process. The Port of Portland hopes to gain approval from the FAA to charge a $3.00 Passenger Facilities Charge (PFC) that will contribute $49,000,000. Tri-Met plans to contribute $48,000,000 in general funds. The City of Portland will contribute $30,000,000. Metro will contribute $15,000,000. Finally, Bechtel and the Trammel Crow Companies will provide $41,000,000, or 20% of the total cost in exchange for a long term lease of 120 acres (0.48 sq. km) of the 458 acre (1.83 sq. km) Portland International Center (PIC) business park that will lie along the PDX MAX route.

Effects

Annual ridership has increased by a total of 60% since the system's opening in 1986. With the creation and expansion of the light rail system, the City has been able to avoid the expansion of any roads in the downtown area for 20 years. Instead of investing in roads, the city now invests in Tri-Met. In fact, the program has been so successful that Portland was able to demolish a six-lane expressway and replace it with a downtown waterfront park. The planned Westside Extension hopes to increase ridership by 20,000 people after the first year. MAX also estimates that $776,000,000 in new development next to MAX rail lines has occurred. Additionally, prices on housing near the rail lines have gone up, which indicates adequate levels of efficiency, convenience, safety, and silence associated with the system.

Public Perception

The public is clearly in favor of the MAX and its operations judging from ridership, voting, business development, and housing patterns. The public has voted for increasing the rail system four-fold, and surveys show support has grown from 42% six months before the MAX lines opened to over 90% in the last few years.

Contact Information: Steve Johnson, Public Affairs Officer
Tri-Met
4012 Southeast 17th St.
Portland OR, 97202
(503) 238-5854

Reference

Tri-Met. "Tri-Met Home Page, Portland, Oregon." Last revised 23 September 1998. <http://www.tri-met.org/>

Dallas, TX

DALLAS AREA RAPID TRANSIT (DART) / LIGHT AND COMMUTER RAILS

Highlights

- Sponsors: City of Dallas and 12 suburban cities
- Cost: $928,500,000 (construction); Light Rail Operational Cost: $27,000,000 for FY 1997; Commuter Rail Operational Cost: $5,000,000 for FY 1997
- Funding: ISTEA 1991, federal and state motor fuel taxes, state vehicle registration fees, sales tax, transit fares, and local government bonds
- Implementation Date: 1997
- Primary Services: 40 light rail cars accommodating 160 passengers per car and traveling 20 miles (32 km) of light rail track; 13 commuter rail cars traveling 10 miles (16 km) of commuter line
- Non-attainment region for ozone and lead

Background

The Dallas/Fort Worth Metroplex is also one of the fastest growing areas in the nation, where the population is expected to rise to 5,500,000 by the year 2020, a 39% increase from 1998. As of 1995, more than 30% of the Metroplex's roads were congested during peak hours, costing drivers $2,800,000,000 in congestion delay. With tremendous foresight, Dallas Area Rapid Transit (DART), the Fort Worth Transportation Authority ("the T"), the Texas Department of Transportation, the Texas Natural Resource Conservation Commission, the Texas Turnpike Authority, RAILTRAN, the Dallas-Fort Worth International Airport, and local governments submitted and gained approval in 1993 of the Mobility 2010 Plan by the Regional Transportation Council (RTC) and the North Central Texas Council of Governments (NCTCOG). The Mobility Plan, updated every three years, was completed again in 1996 by NCTCOG and is currently referred to as the Mobility 2020 Plan. In accordance with the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA) and the Clean Air Act Amendments of 1990, the *Mobility 2020: The Metropolitan Transportation Plan* has a 24-year implementation period and is a comprehensive solution to predicted increases in traffic congestion. The Plan requires the expenditure of $32,500,000,000 and consists of two components: Transportation System Management (TSM) and Travel Demand Management (TDM). The former pertains to the improvement of existing structures, while the latter pertains to the strategies which seek to alter attitudes and behavior as they pertain to ride-sharing and public transit. The primary component in the Mobility 2020 Plan is the expansion of the light and commuter rail systems. The plan proposes 46 miles (73.6 km) of additional light rail track. Provided that there is additional funding available, the Plan suggests an additional 135 miles (216 km) of rail service. The 20 mile (32 km) long DART electric light rail starter system was an eight-year, $854,000,000 project completed in 1997. The North Central Corridor descends from its northernmost station at Park Lane, along a double-track system adjacent to US-75, traveling through the Dallas central business district (CBD), and south past the City Zoo, with 20 passenger stations in between. The light rail system will procure another 34 vehicles in 1999 and extend in length to Plano, a far north suburban city, by 2003, and reach northeast, to the City of Garland in 2002. While the Plano extension will be funded in large part by reappropriation of 1991 ISTEA funds, the extension reaching Garland will be 100% locally funded.

The commuter rail, dubbed the Trinity Railway Express, is a joint project of DART and "the T". This system will operate on tracks owned by Fort Worth and Dallas. The Trinity Railway Express, which began operation in 1996, extends from Union Station in downtown Dallas, stopping at Dallas County's Parkland Hospital, and ending 10 miles (16 km) to the west at the South Irving Station which is roughly an 18 minute commute. The commuter rail line was completed under the $73,600,000 budget. The commuter rail line utilizes rail cars leased from Amtrak and the Connecticut Department of Transportation, and seats roughly 92 people. By the year 2000, DART and "the T" hope to have completed the extension of the commuter rail line into Fort Worth and northward to the Dallas-Fort Worth International Airport. Four locomotives and two of sixteen bi-level coach cars have arrived in anticipation of the extension.

Effects

Average daily ridership is roughly 30% higher than DART anticipated. After only after six months of operation, average daily ridership on the light rail tracks totaled 35,000 people. Between FY96 and FY97, light rail ridership increased by roughly 6,000,000. Revenue miles (revenue kilometers) for all DART modes of transit including bus and paratransit increased from 27,500,000 (44,000,000) to 28,900,000 (46,240,000) between FY95 and FY97. During the same period, passengers per mile (passengers per kilometer) on all DART modes increased from 1.62 (1.01) to 1.8 (1.12).

Public Perception

The public's appeal for the new rail system is much greater than expected. Public outreach programs have been extensive and varied, including a 3,500-person mailing list, public meetings, an Internet web site, presentations, transit safety education programs for children and teachers, special how-to-ride tours for the elderly, and an interactive voice response (IVR) system for route and schedule information. Additionally, in the fall of 1997, the American Public Transit Association named DART the Transit Agency of the Year.

Contact Information: Janie Pena, Assistant Vice President
External Affairs Office
Dallas Area Rapid Transit
(214) 749-6263

References

Bauman, Sue. DART Annual Report: Fiscal Year 1997. Dallas Area Rapid Transit: Dallas, TX. (1997).

Dallas Area Rapid Transit. Transit System Plan. Dallas Area Rapid Transit: Dallas, TX. (14 November 1995).

OTHER EXAMPLES/CITIES WITH LIGHT OR COMMUTER RAIL

Miami, Florida (TRI-Rail)

- Miami is serviced by TRI-Rail, Metro-Rail, and Metro Mover
- As of 1998, there were 26 bi-level rail cars and 10 diesel electric locomotives

Reference

Rathbone, Daniel B. "Characteristics of Commuter Rail in North America (Part 1)." *The Urban Transportation Monitor*. Vol. 12, No. 4. (27 February 1998): 9-11.

San Jose, CA (Santa Clara Valley Transportation District)

- 20 mile (32 km) local light rail system
- Electrically powered, articulated light rail vehicles

Reference

Sheck, Ronald C., et al. "Guideway Transit and Intermodalism: Function and Effectiveness: Case Study, San Francisco Bay Area." U.S. Department of Transportation, Federal Transit Administration: Washington D.C. (1997).

Hartford, CN (The Griffin Line Corridor)

- Extends 15 miles (24 km) from Hartford to Bradley International Airport
- The line links together residential, educational, business, medical, retail, and cultural centers

Reference

Vozzolo, David J. "Collaborative Planning in the Griffin Line Corridor MIS." *Conference on Major Investment Studies in Transportation*. (1996): 39.

ADDITIONAL REFERENCES

Gray, Christine. "North American Passenger Rail is Worth More Than $1 Trillion." *METRO Magazine*. Vol. 94, No. 4. (June 1998): 18.

Luczak, Marybeth. "Is There a People-Mover in Your Future?" *Railway Age*. Vol. 199, No. 7. (July 1998): 53.

Organization for Economic Co-operation and Development. "Light Rail Transit Systems." *European Conference of Ministers of Transport.* (1994).

American Public Transit Association, Transportation Research Board. *Seventh National Conference on Light Rail Transit: Vol.1*. National Academy Press: Washington D.C. (1995).

CHAPTER 22
MULTIMODAL FACILITIES

	Baltimore, MD	Battle Creek, MI	Meridian, MS	Gallup, NM	Dallas, TX
Implementation Date	1979	1982	1997	1997	1995
Implementation Cost (thousands of dollars)	\$400 (Annually)	\$2,127	\$5,016	\$2,000	\$1,200 (Annually)
Primary Services	Rail, Airport Shuttle, Taxi	Rail, Bus, Taxi	Rail, Bus, Airport Shuttle, Taxi	Amtrak and Bus Service	Light and Heavy Rail, Bus, Taxi
Population (1990)	2,382,172	429,453	41,036 [1]	19,157 [1]	2,676,248
Sq. Miles (Sq. km)	2,609 (6,679)	1,882 (4,873)	36 (92)	11 (29)	6,186 (16,024)
Population Density (pop. per sq. mi.) (pop. per sq. km)	913 (352)	228 (88)	1,140 (446)	1,742 (661)	433 (167)

[1] Population of city proper

The term multimodal facility refers to a transfer point at which various modes of transportation converge, including automobiles, trains, buses, airports, paratransit shuttles, taxis, bicycles, and pedestrians. By converging paths for these modes of transportation at one point, passengers who utilize public transportation are serviced better, and the area surrounding the facility experiences economic growth.

Many multimodal facilities operate from renovated, preexisting rail facilities, which serve to commemorate the city's or regions's history. The renovated facilities often also include various auxiliary services (e.g., gift shops, museums, conference rooms, and restaurants).

Baltimore, MD

BALTIMORE-WASHINGTON INTERNATIONAL (BWI)

AMTRAK RAIL STATION

Highlights

- Sponsor: Amtrak
- Cost: $400,000 (annual operations)
- Funding: State Transportation Trust Fund
- Implementation Date: 1979
- Primary Services: Amtrak High Speed Rail, Maryland Rail Commuter (MARC), Maryland Aviation Administration (MAA) Airport Shuttles, Baltimore Central Light Rail, Local Taxi and Limousine Service.
- Non-attainment region for ozone

Background

The Baltimore-Washington International (BWI) Amtrak Rail Station operates within a few miles of BWI Airport. It opened for operation in 1980. Unlike some other multimodal facilities, this station was not a restoration and/or renovation of an existing facility. Nor does it provide any auxiliary facilities such as food courts and gift shops.

BWI Amtrak Rail Station is owned and operated by Amtrak and accommodates two rail service providers, Amtrak and MARC (Maryland Rail Commuter). Amtrak utilizes the BWI rail station as one of its many terminals along its Northeast Corridor which extends from Washington D.C. to Boston, MA. MARC, which shares the BWI rail station with Amtrak, is a unit of the Maryland Mass Transit Administration (MTA) and leases rail from Amtrak. MARC operates commuter rail from northeast Maryland, through the BWI Station, south to Washington D.C.

At the BWI Rail Station, a person transferring from one of these two rail lines can travel to BWI Airport via a Maryland Aviation Administration (MAA) shuttle bus. MAA shuttle buses depart from the rail station every 10 minutes during peak hours, and every 20 minutes during non-peak hours. MAA shuttles also transport passengers from the airport to downtown Baltimore and halfway to Washington D.C.

The BWI Rail Station also operates a parking facility that can accommodate 1,605 automobiles. Inside the facility, one can purchase tickets to ride either the Amtrak or MARC rail lines.

At the BWI Airport itself, there are also a number of transit modes a traveler can utilize. In December 1997, Maryland's Governor opened a new light rail extension that travels from downtown Baltimore to the airport. The Maryland MTA operates MARC, a commuter rail service, and completed a Central Light Rail Line which has a terminus within the BWI airport itself. From Penn Station in downtown Baltimore, one can board this Central Light Rail Line (which can also be accessed by MTA's subways or buses) and travel directly into the BWI Airport terminal. The new light rail station opened within the BWI Airport cost $13,400,000 to construct. In downtown Baltimore, MTA has provided 5,000 park-and-ride spaces for automobiles for the light rail line, with two of the lots offering free parking for up to seven days. The MTA Central Light Rail Station will be redesigned beginning in 1998, with construction ending in the year 2001. Plans include the implementation of a third platform and the renovation of the entire station.

Effects

In FY 1993, MARC had an annual ridership of 485,000 traveling to and from the BWI Airport Station; Amtrak's annual ridership for the BWI Airport Station was 147,220; and BWI Airport, adjacent to BWI Rail Station, serviced 8,696,274 passengers. In only six months, ridership to the BWI Airport on the light rail line had already reached 1,000 passengers per day.

Public Perception

None available

Contact Information: Linda Davenport
Amtrak Public Relations
(202) 906-3479

Reference

Fulton, Frank, Jr. "Intermodal Rail Station Connects BWI Airport to N.E. Corridor." *Passenger Transport.* Vol. 56, No. 12. (8 June 1998): 20.

Battle Creek, MI
BATTLE CREEK TRANSPORTATION CENTER

Highlights
- Sponsors: Battle Creek Transit and the City of Battle Creek
- Cost: $2,127,000 for design and construction
- Funding: Federal Transit Administration (Section 3) provided $1,701,600. State Matching Funds Provided $425,400. The City of Battle Creek donated land and purchased the old Greyhound Terminal
- Implementation Date: 1982
- Primary Services: Amtrak, Greyhound and Indian Trails Bus Service, Battle Creek Local Bus Service, Taxi, Parking
- Attainment region

Background

In 1981, a Railroad Consolidation Project was undertaken to examine a long standing problem involving passenger vehicle and train congestion in the downtown Battle Creek area. The project initiated the consolidation of all train traffic at one rail line (the Grand Trunk tracks) south of the downtown area.

The previous Amtrak station was located on tracks on the north side of downtown at the general trunk. Two blocks away from that old Amtrak station were the Greyhound and Indian Trails Bus Stations. Battle Creek Transit was given an open grant to construct a local bus transfer station and the new station. Hence, the decision was made to consolidate both the local and intercity services provided by Battle Creek Transit, Amtrak, and Greyhound at the new facility. The new facility, which was planned and constructed between 1981 and 1982, is now owned by the City of Battle Creek.

The first tenant to move into the facility was Amtrak in 1982. Presently, there are two lines, one owned by Amtrak, the other leased by Amtrak from Conrail.

There are 15 free, long-term parking spaces at the center, while additional parking is available adjacent to the BCTC. The BCTC is also only blocks away from Linear Park, which provides bicycle and pedestrian paths to and from the Battle Creek central business district.

Effects

In FY 1993, Amtrak's annual ridership had reached 51,542 passengers arriving and departing from this facility. Battle Creek Transit experienced an increase in ridership of 5% in the 1990s.

The project has helped revitalize the Battle Creek downtown area as well. Newly constructed facilities include a hotel, an arena, the Kellogg Company world headquarters, the Kellogg Foundation headquarters, and an upscale restaurant.

Public Perception

None available

Contact Information: James D. Walker, Transit Manager
Battle Creek Transportation Center
(616) 966-3588

Reference

U.S. Department of Transportation Intermodal Terminal Committee, U.S. Department of Transportation. Intermodal Passenger Terminal Facilities Project Summaries: A Compendium of Proposed, Active, and Completed Intermodal Passenger Terminal Facilities. (December 1994): 132.

Meridian, MS

UNION STATION MULTIMODAL TRANSPORTATION CENTER

Highlights

- Sponsors: City of Meridian and the Federal Transit Authority (FTA)
- Cost: $5,016,000
- Funding: Federal Highway Administration Enhancement Program, Meridian City Tax Levy
- Implementation Date: December 11, 1997
- Primary Services: Meridian Transit System, Passenger and Commercial Rail, Inter-City bus, Paratransit Airline Shuttles, Local Taxi Service
- Attainment region

Background

In July 1991, the City of Meridian, contributing $25,000, and the Federal Transit Administration (FTA), which contributed $30,000 under Section 8, began work on a feasibility study concerning the use of the old Norfolk and Southern Station as a multimodal facility. Three years later, in 1994, the City Council approved a tax levy to raise $1,500,000 for the design and renovation of the facility. Federal funding totaled $3,516,000. The official opening of the facility occurred on December 11, 1997.

Union Station brings together inter-regional rail and bus service with local transit, paratransit, and private transportation. Amtrak provides inter-regional passenger rail services at the station. Norfolk-Southern Rail Corridor uses part of Union Station for its cargo and goods transportation. A section of the station is provided to Greyhound and Trailways bus lines to service intercity and inter-regional travel. The Meridian Transit System provides city buses which are loaded and unloaded under covered ports. Paratransit airline shuttles are given space to operate. They provide service to the Meridian Regional Airport. Local taxi companies are provided on-site queuing space from which to operate. Finally, 28 short-term parking spaces are available with additional spaces planned to be built.

An array of auxiliary services include a travel agency, railroad museum, outdoor exhibit area, welcome center, restaurant, food court, lounge, farmers market, and festival park.

Effects

An estimated $8,000,000 of private development has occurred around the center as a result of the renovated facility.

Public Perception

None available

Contact Information: Sharon Smith, Director
Union Station Multi-Modal Transportation Center
(601) 485-1926

Reference

U.S. Department of Transportation, Federal Highway Administration. "USDOT/FHWA Transportation Enhancement Project: Meridian, Mississippi - Union Station Multi-Modal Transportation Center." Last revised 30 September 1995.
<http://www.bts.gov/trans-enh/msf01.html>

Gallup, NM

THE GALLUP CULTURAL CENTER

Highlights

- Sponsor: Southwest Indian Foundation
- Cost: $2,000,000 (construction)
- Funding: Federal Highway Administration (STP), Federal Transit Administration (Section 3), the City of Gallup (HUD Community Development Block Grant), County of McKinley, State of New Mexico (legislative appropriations and severance tax)
- Implementation Date: 1997
- Primary Services: Amtrak, Local, Regional, and National Bus Service
- Attainment region

Background

Gallup, New Mexico, is a city rich in culture and history. To accommodate those seeking to experience the culture, history, and attractions that the city and region have to offer, the Multimodal Cultural Center was built to serve as the hub for the regions's transportation network.

In 1988, the Federal Railroad Administration gave New Mexico a $75,000 grant for a feasibility study to be conducted on the cities of Gallup and Raton to determine ways in which these cities could best make use of existing rail stations. As a result of this study and with financial support of two prominent local interest groups, the Downtown Development Group and the Main Street Program, the City of Gallup purchased and renovated a pre-existing, two-story Amtrak Station from Santa Fe Railroad, originally built in 1918. The newly renovated Gallup Multimodal Cultural Center is managed by the Southwest Indian Foundation, a non-profit organization which works to better the lives of native Americans in the region.

The Multimodal Cultural Center provides an improved depot for Amtrak and its passengers. Greyhound is also located in this center. Gallup Express, a bus service of the regional Council of Governments, operates from the station, providing service for the disabled. Another bus service, the Navajo Nation Transit Bus provides transit to several locations: the regional hospital; a branch of the University of New Mexico; the local shopping mall; and Window Rock, Arizona (the capital of the Navajo Nation). The City of Gallup has two taxi companies that operate within the city. These companies provide limited service from the center.

A variety of auxiliary services are provided within and outside of the center. The inside of the Multimodal Cultural Center contains the Dibea Cinema, the Navajo Café, a gift shop, a historical museum, and the Ceremonial Gallery (an area where citizens meet for political and cultural events).

Outside the facility, dances and live musical performances are held each night for the public. Cost of construction for the facility was roughly $2,000,000, the bulk of which ($1,000,000) came from a state severance tax. Future plans include a tour service and the inclusion of the Zuni Transportation Service (a bus service similar to Navajo Nation Transit).

Effects

Greyhound earns $350,000 per year from its service provided in the center.

Public Perception

The Gallup Cultural Center is very well received by the community and is busy on a daily basis.

Contact Information: Kent Hodges
Southwest Indian Foundation
(505) 863-4131

Reference

U.S. Department of Transportation Intermodal Terminal Committee, U.S. Department of Transportation. Intermodal Passenger Terminal Facilities Project Summaries: A Compendium of Proposed, Active, and Completed Intermodal Passenger Terminal Facilities. (1994).

Dallas, TX
UNION STATION

Highlights
- Sponsors: Dallas Area Rapid Transit, the City of Dallas, and the Federal Transit Administration (FTA)
- Cost: $1,200,000 (annual operation)
- Funding: City of Dallas and the Woodvine Corporation
- Implementation Date: Renovated in 1995
- Primary Services: Amtrak, Dallas Area Rapid Transit (light and commuter rail, bus, paratransit), local taxi service
- Non-attainment region for ozone and lead

Background

Union Station was originally built in 1914 and is located south of Houston Street, a highly accessible and well-used roadway in Dallas' downtown area. The station sits on the edge of Dallas' central business district (CBD), only a short walk from City Hall, the Dallas Public Library, Reunion Arena, and other downtown attractions and offices. The recently renovated station is owned by the City of Dallas, managed by the Woodvine Corporation, and maintained by the Hyatt Regency Corporation.

Union Station mainly facilitates light rail and commuter rail transit. Other modes of transportation service the station, however, not in the same frequency or intensity as the Dallas Area Rapid Transit's (DART) rail transit.

The headway of DART's light rail cars at the station is five minutes during peak hours. In 1998, the light rail service provided 20 miles (32 km) of service from southwest Dallas through the CBD, and northward along US-75 toward the populous suburban cities.

The Trinity Railway Express, DART's commuter rail, headway is 20 minutes during peak hours. In 1997, the Trinity Railway Express ran along 10 miles (16 km) of track from Union Station, passing the Medical/Market Center northwest of the CBD, and headed west to the South Irving Transit Center. Plans for the commuter rail line are for its extension to the Dallas-Fort Worth International Airport and the City of Fort Worth CBD.

Other rail services access Union Station tracks and facilities. Inter-regional Amtrak service is provided at Union Station. These passenger trains arrive and depart from the station roughly each day. Freight rail service, including Union Pacific, Burlington Northern Santa Fe, Dallas/Garland, and Northeastern, utilize the station's tracks as well.

Union Station's connections to street-side transportation include traditional transit, private auto parking, taxi, and access to inter-regional bus service. In 1997, DART's bus and rail systems were fully integrated. DART buses and paratransit vans both service the station on a frequent basis. Covered bay access to DART buses is not provided; however, some covered bay access is available to the natural-gas fueled paratransit vans at the rear of the station. Parking at Union Station is provided only for employees of, or lessees of Union Station offices. A 20-space, short-term, privately-owned parking lot is located across the street from the station for motorists. Taxi positions are also provided at the station for passengers. While Greyhound Bus does not operate out of Union Station, it is only a short walk away.

The station has limited auxiliary facilities. Within the station, the auxiliary facilities include an Amtrak ticket counter and gift shop. Offices, meeting/banquet rooms, and a restaurant are located on the second floor of the station.

Public Perception

None available

Contact Information: Paul Moser
Woodvine Corporation
(214) 855-6000

SECTION 6

EMPLOYER TRIP REDUCTION STRATEGIES

CHAPTER 23
COMPRESSED WORK WEEK

	Tucson, AZ	Princeton, NJ	San Antonio, TX
Implementation Date	1992	1995	1971
Implementation Costs	Quoted as zero	Quoted as zero	Quoted as zero
Population (1990)	666,957	325,824	1, 324,749
Sq. Miles (Sq. km)	9,187 (23,794)	226 (585)	3,327 (8,617)
Population Density (pop. per sq. mi.) (pop. per sq. km)	73 (28)	1,442 (557)	398 (154)

The compressed work week (CWW) has developed as a viable congestion mitigation technique. Employees are no longer restricted to the traditional 5-day/40-hour work week. Companies are now allowing their employees to work alternative schedules which require them to commute only 3 or 4 days per week and work an increased number of hours per day. This offers the benefit of fewer vehicles on the roadway each day as well as fewer vehicles using the roadway during peak periods. Compressed work weeks have more benefits than just those related to congestion mitigation. Employers have noted increased productivity and higher employee moral. Employees prefer the schedule flexibility of compressed work weeks which allows them to better coordinate their work and personal responsibilities. CWW is generally most viable for employers that have very large numbers of employers at one facility or office.

Other alternative work hour programs are flextime and staggered work hours. A flextime program allows employees to vary their times for reporting to work and leaving in the evening as long as these times are within guidelines for available workday hours set by the employer. Staggered work hours are similar to flextime hours except that this option applies to groups of employees rather than individuals. Examples of these are found at the end of this section.

Tucson, AZ
Tucson Electric Power Company

Highlights
- Sponsors: Tucson Electric Power Company employees
- Cost: Not available
- Participation: 900 employees
- Key Benefits: Less time required for commuting during non-peak hour traffic; decrease in overall miles driven per week
- Attainment region

Background

The Tucson Electric Power Company (TEP) implemented a compressed work week program for their employees in March 1992. The two main options for work schedules were a four, ten-hour day work week (4/10) or a three, twelve-hour day work week (3/12). The company wanted to provide flexible, alternative work schedules for its 900 employees. The program was originally an employee-sponsored request that gained support within the company.

Effects

A company-wide survey was conducted including employees both using and not using the compressed work week schedules. The findings indicated that the travel time to and from work was reduced for CWW participants. The CWW participants had benefits of less time spent in rush hour traffic and a decrease in commuting distance driven per week.

Public Perception

Half of the employees working the 4/10 schedule were surveyed to determine their feelings for this program. A majority of the employees enjoyed working the "four-tens" and felt good about their jobs. Fatigue was an issue when employees first started working the new schedule but was later deemed not an important issue for the participating employees. The availability of the compressed work week program helped improve employee moral.

Contact Information: Cathie Bryan, Transportation Support Director
Tucson Electric Power Company
Mail Stop TR101
Tucson, Arizona 85702
(520) 745-3521

References

Valley Metro. "CWW Fact Sheet." Last revised 30 October 1997. <http://www.valleymetro.maricopa.gov/cwwfact.html>

Sullivan, Carleen, Chris Zearley, and Velia Robson. Tucson Electric Power Company Compressed Work Week Evaluation. Prepared by University of Arizona Marketing Research Team. (May 1994).

Martinez, Rich. A Research Study to Determine the Effects and Attitudes of TEP's Compressed Workweek - The Four-Ten's. Prepared by the Tucson Electric Power Company. (November 1994).

Princeton, NJ

Educational Testing Service (ETS)

Highlights

- Sponsors: New Jersey Department of Transportation (NJDOT), ETS Internal Departments
- Cost: No operating cost
- Participation: 700 employees
- Key Benefits: Employees noted the decrease in required commuting time; employees noted increased work productivity
- Attainment region

Background

Educational Testing Services (ETS) employs a total of 2,375 people in New Jersey. It is the world's largest private educational measurement institution and a leader in educational research. A total of 700 employees participate in the company's compressed work week program. The program began in January 1995 as part of ETS's Employer Trip Reduction (ETR) strategies. The strategies were developed to comply with the regulation of large companies reducing their peak hour traffic by 25%. Company officials did not tell their managers how to manage the program but gave them some guidelines and a few questions to address. The questions related to each individual employee's potential for success in participating in a compressed work week program. The normal work week was 37.5 hours/5 days. Two alternatives were available in the compressed work week program of either 12.5 hours/3 days or 9.5 hours/3 days plus one 9 hour day.

Effects

The employees indicated that the compressed work week program cut down on their amount of commuting time. After one year of operation, approximately 30% of the employees switched to the program. Of those employees, 92% preferred the four-day week and the remaining 8% preferred a three-day week.

Public Perception

Employees liked the program because it fit in well with their other responsibilities. Staff members noted that they were more productive due to less work day start up and shut down time, as well as fewer interruptions. An unanticipated benefit was an improved sense of teamwork by company employees. Even nonparticipating CWW employees indicated that there were many benefits of a CWW program.

Contact Information: Mr. Lynn Aris, Director
Educational Testing Service (ETS)
Administrative and Conference Services
(609) 734-5004

Reference

Keep Middlesex Moving, Inc. Compressed Work Week: How to Set Up Your Program. Prepared by KMM. Inc.

San Antonio, TX

United Services Automobile Association (USAA)

Highlights

- Sponsor: Internal company management
- Cost: Quoted as none
- Participation: 12,000 employees
- Key Benefits: Employee commute times shifted outside of peak traffic hours; employee commute cost was reduced by 20%
- Attainment region

Background

The concept of compressed work weeks (CCW) was implemented in the early 1970s by USAA in response to the tremendous energy crisis of the time. Initially, 90% of the USAA workforce were working extended hours Monday through Thursday. Over the years, the employees were given more flexibility concerning their work schedule. Employees can now work the four-day work week and spread the four days among any of the seven days of a calendar week. The company also has employees working 4-, 5-, and 6- day work weeks of varying hours. There is a move within the company to have all employees work 38 hours per week. Currently, over 12,000 employees are using the compressed work week program.

Effects

Employee productivity was a concern of management early in the program. This concern proved to be unfounded with employees actually showing a 3% increase in individual productivity. During the first year of the program, employee turnover, overtime hours, and sick leave were reduced. The employees benefitted by having 42 extra days off each year along with reducing commuting cost by 20%. The compressed work week program has allowed the employees to commute back and forth to work during non-peak hours, thereby decreasing the amount of traffic on the roadway during rush hour.

Public Perception

Company management has noted that the availability of compressed work weeks has helped increase employee morale levels. The employees were noted as being "delighted" with the program.

Contact Information: Gloria Morales, Human Resources
USAA
9800 Fredericksburg Road
San Antonio, TX 78288
(210) 498-1513

OTHER EXAMPLES/CITIES WITH COMPRESSED WORK WEEK PROGRAMS

Los Angeles, CA (Los Angeles County Department of Public Works)

- 4 days/ 10 hours
- Average weekly reduction per employee in Vehicle Miles Traveled was 46 (74 VKT)
- Average time employees spent commuting only decreased slightly

Reference
Valley Metro. "CWW Fact Sheet." Last revised 31 October 1997.
<http://www.valleymetro.maricopa.gov/ccwreport.html>

Denver, CO (Federal Employees Compressed Work Week)

- 9,000 employees participated in the program
- 15% reduction in Vehicle Miles Traveled for participating employees

Reference
Ridewise. "Workwise." Last revised 2 September 98.
<http://www.ridewise.org/programs/workwise.htm>

NJ (New Jersey Department of Environmental Protection)

- Four variations of CWW schedules

Reference
Keep Middlesex Moving, Inc. Compressed Work Week: How to Set Up Your Program. Prepared by KMM. Inc.

Somerville, NJ (The County of Somerset)

- Two variations of CWW schedules
- Increased employee attendance and a decrease in employee sick days

Reference
Case Study - Navy Federal Credit Union. "Transportation Demand Credit Union." Last revised 25 May 1997.
<http://www.co.arlington.va.us/arlcty/commute/navy.htm>

Vienna, VA (Navy Federal Credit Union)

- CWW and other Transportation Demand Management (TDM) options saved nearly $1,400,000 in parking facility construction costs
- Helped employees avoid traffic congestion and decreased vehicle miles traveled

Reference

Case Study - Navy Federal Credit Union. "Transportation Demand Credit Union." Last revised 25 May 1997.
<http://www.co.arlington.va.us/arlcty/commute/navy.htm>

San Francisco, CA (Pacific Gas and Electric Company)

- Reported annual savings from flextime of $20,000 in decreased sick leave
- Reported annual savings of $46,000 in decreased work time from personal business

Reference

Meyer, Michael D. A Toolbox for Alleviating Traffic Congestion and Enhancing Mobility. Prepared by the Institute of Transportation Engineers. (1997): 204-205.

Honolulu, HI

- 11,000 employees participated in the staggered work hours program
- Travel time savings of seven minutes or 18% improvement in travel time

Reference

Meyer, Michael D. A Toolbox for Alleviating Traffic Congestion and Enhancing Mobility. Prepared by the Institute of Transportation Engineers. (1997): 204-205.

CHAPTER 24
TELECOMMUTING

	Irvine, CA	Bellevue, WA	Redmond, WA
Implementation Date	1993	1991	1990
Implementation Costs (thousands of dollars)	Not Available	$135	$5-7
Population (1990)	2,410,668	2,033,128	2,033,128
Sq. Miles (Sq. km)	790 (2,045)	4,216 (10,920)	4,216 (10,920)
Population Density (pop. per sq. mi.) (pop. per sq. km)	3,051 (1,179)	482 (186)	482 (186)

The use of telecommuting has grown significantly in recent years. Company executives have recognized the technological advancements in the areas of telecommunications and computers. These advances have provided alternatives to the traditional employee daily commute. Certain tasks can now be performed at an employee's home or alternate work site on a personal computer and communicated outside via a telecommunications network. The concept is being implemented across the nation in public and private organizations of every size. Larger metropolitan areas are using the telecommuting concept for the development of centralized telework centers. These telework centers still require a commute by the employees, but the commute times and distances can be significantly reduced.

Irvine, California

PACKARD-HUGHES INTERCONNECT *(Formally Hughes Electronics)*

Highlights

- Sponsors: Packard-Hughes Interconnect company management
- Cost: Not available
- Funding: Packard-Hughes Interconnect
- Participation: 60 employees in pilot study
- Key Benefits: Reduction in commute distance; reduction in commute time; employees impacted less by freeway damage caused by Northridge Earthquake
- Non-attainment region for ozone, CO, PM10, and NO2

Background

Hughes Electronics, a subsidiary of the General Motors Corporation, tested the concept of telecommuting in 1993. Selected employees from one department were allowed to work from home one day a week to determine how telecommuting impacted their performance, departmental operations, and compliance with air quality regulations. Sixty employees participated in the pilot study.

Results

The employees participating in the telecommuting program had an average reduced driving distance of about 60 miles (96 km) per week. This equates to approximately two hours of driving time per telecommuter. Telecommuting was a great asset to those employees impacted by the 1994 Northridge earthquake which severely damaged the transportation infrastructure. These employees were allowed to telecommute two days per week, which lessened the traffic demand on routes not damaged by the earthquake.

Public Perception

Both employees and managers participated in the study and reported positive effects on telecommuters' performance and attitudes. The managers reported higher employee morale, and half the managers reported that productivity had increased during the pilot project. One telecommuter stated that the flexibility telecommuting offers was the most important benefit. Others noted the reduction in commute time was a much appreciated program benefit. Many of the study participants strongly recommended the program be expanded to permit telecommuting more than one day per week.

Contact Information: Scott Decker, Telecommuting Specialist/Trainer
Washington State University (Energy Program)
925 Plum St. S.E. Bldg. #4
P.O. Box 43165
Olympia, WA 98504-3165
(360) 956-2218

Reference

The Southern California Telecommuting Partnership. "Case Study: Hughes Electronics." *The New Buzz In Business.*

Bellevue, Washington
WASHINGTON STATE TELEWORK CENTER

Highlights

- Sponsors: State of Washington and participating companies
- Cost: Setup $135,000
- Funding: State of Washington and participating companies
- Participation: Not available
- Key Benefits: Saved a total of 60,000 miles (96,000 km) annually; saved an average of two commute hours per day; telecommuters reported reduced levels of stress
- Non-attainment for PM10

Background

The telework center implemented in 1991 provided telecommuting workstations for employers and their employees living in the Seattle and Bellevue area. These employees had a commute of one hour or more, and the telework center was provided to eliminate the lengthy commutes, reduce fuel consumption, and improve air quality. This telecommuting project was part of the Strategic Initiatives Proposal submitted to the Washington State Department of Information Systems. The proposal was accepted, and funding was granted for design, development, and implementation of the first public sector telework center in the nation. The center operated for 18 months but was closed due to the lack of subsidized funding and the unwillingness of agencies using the facility to pay the true monthly costs for a workstation.

Effects

The telework center saved telecommuters a total commuting distance of approximately 60,000 miles (96,000 km) annually. Six (25%) of the telecommuters contributed to 80% of the mileage savings. These telecommuter used the center several days per week. The telework center did not reduce the number of commute trips since the telecommuters still had to commute to the telework center, and most of them used a single occupant vehicle. The telework center saved an average of two hours of commuting time per day.

Public Perception

A survey of the telecommuters included both positive and negative responses. Telecommuting increased the level of employee retention. Many employees indicated that they would not have taken their present job without the availability of telecommuting. Others cited the availability of the telework center as helping reduce the stress that they usually experience on their daily commute. Some telecommuters found it more convenient to telecommute from home than to travel to the telework center.

Contact Information: Scott Decker
Washington State University (Energy Program)
Telecommuting Specialist/Trainer
925 Plum St. S.E. Bldg. #4
P.O. Box 43165
Olympia, WA 98504-3165
(360) 956-2218

Reference

Kunkle, Rick. "Puget Sound Telecommuting Demonstration: Case Studies." WSEO Publication #92-146. Washington State Energy Office. (November 1992).

Redmond, Washington

CITY OF REDMOND

Highlights

- Sponsors: State of Washington, The City of Redmond, Washington
- Cost: Setup $4,500-$7,000
- Funding: The City of Redmond, Washington
- Participation: 10 telecommuters (Pilot Project); 15 telecommuters (Demonstration Project)
- Key Benefits: Eliminated 450 commute miles (720 km) and 35 commute hours per week during pilot project; eliminated 295 commuter trips per year
- Non-attainment for PM10

Background

The City of Redmond conducted a pilot telecommuting project in early 1990. The primary goal of the project was to set an example of how one employer can take positive steps in reducing demand on the region's transportation network. The City studied telecommuting as one approach for reducing peak-hour commuting and air pollution, which accompanies traffic congestion. The City provided a telecommuting coordinator to support the participating staff including orientation and promotion of telecommuting. The City of Redmond's pilot telecommuting project was a precursor to the Puget Sound Telecommuting Demonstration, which began in October 1990. The demonstration included 10 telecommuters who participated in the pilot project, and 15 telecommuters who were added during the demonstration.

Effects

In October 1991, the City's telecommuting coordinator produced a report concerning the status of the pilot project. The project included 22 registered telecommuters telecommuting at least one day per week. The telecommuters were eliminating a commute distance of approximately 450 miles (720 km) and 35 commute hours per week during the pilot project. Results of the Puget Sound Telecommuting Demonstration showed the10 pilot project telecommuters were now saving about 295 commuter trips per year, which equates to a commuting distance of 9,000 miles (14,400 km) decreased annually. The average reduction in annual commuting distance for those telecommuters added to the study after the demonstration began was 872 miles (1,395 km).

Public Perception

The employees indicated that telecommuting was meeting a variety of work-related needs. The telecommuting coordinator's report recommended continued support from the City and expansion of the telecommuting program. Most of the telecommuters interviewed in the City's pilot program planned on continued participation in the program. Although many telecommuters saved money as a result of telecommuting, the primary benefit was increased quality of life.

Contact Information: Scott Decker
Washington State University (Energy Program)
Telecommuting Specialist/Trainer
925 Plum St. S.E. Bldg. #4
P.O. Box 43165
Olympia, WA 98504-3165
(360) 956-2218

Reference

Kunkle, Rick. "Puget Sound Telecommuting Demonstration: Case Studies." WSEO Publication #92-146. Washington State Energy Office. (November 1992).

OTHER EXAMPLES/CITIES WITH TELECOMMUTING/ TELEWORK CENTERS

Los Angeles, CA (County of Los Angeles)

- 4,050 telecommuters with over 25,000 eligible for the program
- Savings of $16,600,000 annually from increased employee productivity
- Eliminated 144,000 hours of travel time

Contact Information: Scott Decker
Washington State University (Energy Program)
Telecommuting Specialist/Trainer
925 Plum St. S.E. Bldg. #4
P.O. Box 43165
Olympia, WA 98504-3165
(360) 956-2218

Los Angeles, CA (Antelope Valley Telebusiness Center)

- 20 workstations
- 28 telecommuters from 11 different companies
- Each day there are 11-14 telecommuters using the facilities

Reference
UC Davis, College of Engineering. "UC Davis." Last revised February 1998. <http://nachos.engr.ucdavis.edu/~its/telecom/r12/r12_1.htm>

Greenville, SC (Greenville Hospital Home Health)

- Mobile telecommunications allows physicians to interact with patients within their own homes

Reference
Appalachian Regional Commission. "ARC Programs - Telecommunications." Last revised 20 October 1998. <http://www.arc.gov/programs/reginit/telecom.htm>

Elizabethtown, KY (Developed by the Kentucky Science and Technology Council)

- Rural Televillages in five eastern Kentucky counties
- Services include distance learning, teleconferencing, and access to databases

Reference
Appalachian Regional Commission. "ARC Programs - Telecommunications." Last revised 20 October 1998. <http://www.arc.gov/programs/reginit/telecom.htm>

Phoenix, AR (250 employers in Phoenix have active programs)

- Seven percent of employees telecommute one or more days per week
- Eliminates 93,800 commuting trips per day in Phoenix metro area
- Eliminates more than 900,400 commute miles (1,440,640 km) per day in the Valley area

Reference

Valley Metro. "CWW Fact Sheet." Last revised 31 October 1997. <http://www.valleymetro.maricopa.gov/telefact.html>

Houston, TX (Texas Natural Resource Conservation Commission-Region 12)

- 32 out of the 170 employees in the office participate in the program
- Telecommuters are saving 60-75 minutes per one-way trip

Reference

Turnbull, K., K.M. Hall, C.A. Weatherby, and Carol Lewis. Telecommuting Programs in Texas: TTI Research Report 1446-2F. Texas Transportation Institute: College Station, TX. (1996).

Bend, Oregon (ORCOM Software Company)

- 28 out of the 110 employees in the office participate in the program
- The 28 employees saved 23,296 commuter miles (37,274 km) during a one-year pilot project

Reference

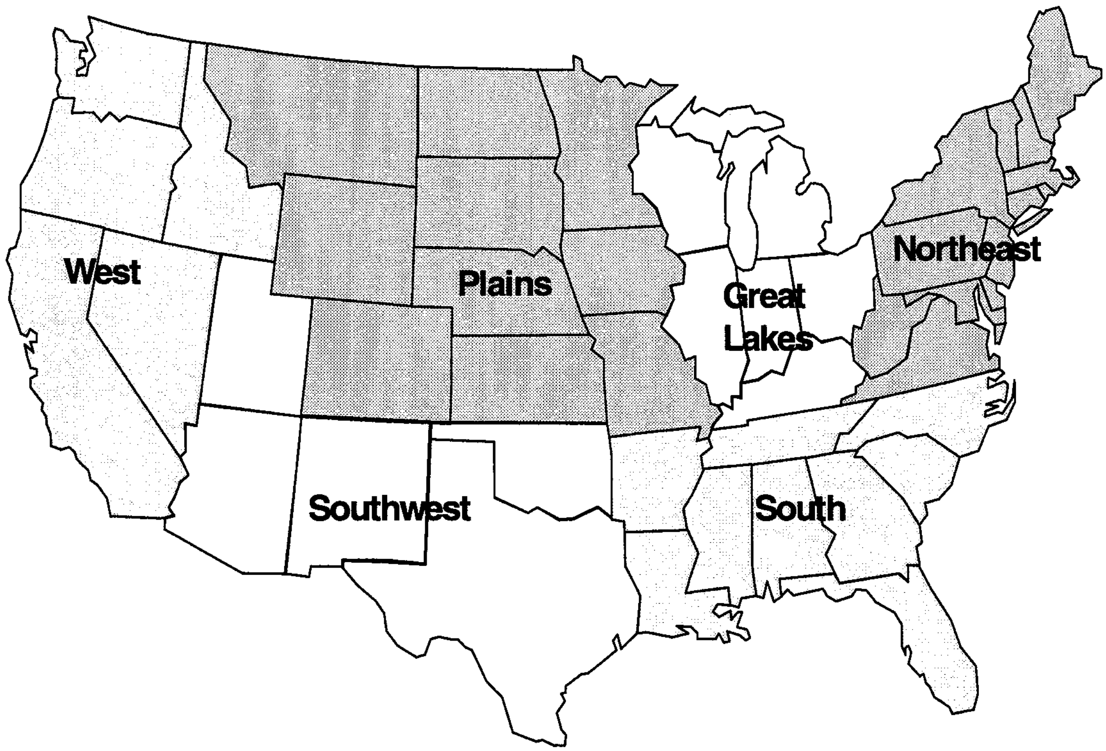
Oregon Office of Energy. "Telecommunicating Helps Central Oregon Businesses and Agencies Do More With Less." Last revised 15 April 1996. <http://www.cbs.state.or.us/external/ooe/telework/descotel.htm>

Appendix

Case Study City/Area Indices

Cities/Areas Sorted by Geographic Region

Geographical Key to Index



Region	Population	City/Area	Techniques
Canada	941,814	Ottawa	Bus (5-5)
Great Lakes	7,410,858[2]	Chicago, IL	Express Lanes (4-64)
Great Lakes	4,266,654[2]	Detroit, MI	Traffic Signalization (4-48), Border Crossings (4-78)
Great Lakes	2,202,069[2]	Cleveland, OH	Variable Message Signs (1-28)
Great Lakes	1,432,149[2]	Milwaukee, WI	Transportation Management Centers (1-56)
Great Lakes	1,380,491	Indianapolis, IN	Incident Management (1-36)
Great Lakes	1,345,450	Columbus, OH	Night Construction (3-6)
Great Lakes	429,453	Battle Creek, MI	Multimodal Facilities (5-30)
Great Lakes	367,085	Madison, WI	Bicycle/Pedestrian Paths (4-38), Variable Message Signs (1-31)
Northeast	n/a	State of Maryland	Express Lanes (4-66)
Northeast	4,222,830[2]	Montgomery Co., MD	Rideshare (2-32), Traffic Signalization (4-46)
Northeast	2,609,212[2]	Long Island, NY	High Occupancy Vehicle Lanes (2-8)
Northeast	2,394,811	Pittsburgh, PA	Bus (5-8)
Northeast	2,382,172[2]	Baltimore, MD	Lane Closures (3-22), Multimodal Facilities (5-28)
Northeast	1,134,350	Providence, RI	Transportation Management Centers (1-53)
Northeast	587,986	Harrisburg, PA	Night Construction (3-7)
Northeast	325,824[2]	Princeton, NJ	Compressed Work Week (6-6)

Region	Population	City/Area	Techniques
Plains	2,538,776	Minneapolis, MN	Freeway Service Patrols (1-8), Transportation Management Centers (1-50), High Occupancy Vehicle Lanes (2-6), Bicycle/Pedestrian Paths (4-32)
Plains	2,492,348	St. Louis, MO	Night Construction (3-5), Light and Commuter Rail (5-18), Bicycle/Pedestrian Paths (4-34)
Plains	1,622,980[2]	Denver, CO	Ramp Meters (1-21), Freeway Service Patrols (1-6), Rideshare (2-30)
Plains	1,582,874	Overland Park, KS	Access Management (4-25)
Plains	485,270	Wichita, KS	Added Single Occupant Vehicle Lanes (4-87)
Plains	225,339[2]	Boulder, CO	Rideshare (2-29), Traffic Calming (4-4)
Plains	73,142	Cheyenne, WY	Variable Message Signs (1-32)
Plains	7,141[1]	Detroit Lakes, MN	Construction and Public Awareness/Relations (3-11)
South	2,959,500	Atlanta, GA	Transportation Management Centers (1-48), Access Management (4-22)
South	1,162,140	Charlotte, NC	Freeway Service Patrols (1-10), Incident Management (1-38)
South	858,485	Raleigh, NC	Construction and Public Awareness/Relations (3-12)
South	513,117	Little Rock, AR	Lane Closures (3-19)
South	453,932	Columbia, SC	Construction and Public Awareness/Relations (3-13)
South	398,978	Melbourne, FL	Access Management (4-20)
South	335,113	Lee Co., FL	High Occupancy Toll Lanes and Congestion Pricing (2-22)
South	292,517	Montgomery, AL	Construction and Public Awareness/Relations (3-10)
South	233,609	Tallahassee, FL	Lane Closures (3-20)
South	41,036[1]	Meridian, MS	Multimodal Facilities (5-32)
Southwest	3,321,926[2]	Houston, TX	Freeway Service Patrols (1-12), Variable Message Signs (1-29), High Occupancy Toll Lanes and Congestion Pricing (2-24), Traffic Signalization (4-50)
Southwest	2,676,248[2]	Dallas, TX	High Occupancy Vehicle Lanes (2-10), Lane Closures (3-23), Light and Commuter Rail (5-22), Multimodal Facilities (5-36)
Southwest	2,676,248[2]	Plano, TX	Access Management (4-26)
Southwest	2,238,498	Phoenix, AZ	Incident Management (1-34), High Occupancy Vehicle Lanes (2-4)
Southwest	1,361,034[2]	Ft. Worth, TX	Construction and Public Awareness/Relations (3-14), Traffic Calming (4-10)
Southwest	1,324,749	San Antonio, TX	Transportation Management Centers (1-54), Express Lanes (4-68), Compressed Work Week (6-8)
Southwest	1,072,227	Salt Lake City, UT	Ramp Meters (1-24)
Southwest	852,646	Las Vegas, NV	Traffic Calming (4-6)
Southwest	846,227	Austin TX	Rideshare (2-35), Bicycle/Pedestrian Paths (4-36), Express Lanes (4-67)
Southwest	666,957	Tucson, AZ	Intersection Improvements (4-54), Compressed Work Week (6-4)
Southwest	591,610	El Paso, TX	Border Crossings (4-80)
Southwest	589,131	Albuquerque, NM	Intersection Improvements (4-57)

Region	Population	City/Area	Techniques
Southwest	349,894	Corpus Christi, TX	Intersection Improvements (4-59)
Southwest	189,123	Waco, TX	Added Single Occupant Vehicle Lanes (4-90)
Southwest	187,514	Amarillo, TX	Intersection Improvements (4-58), Added Single Occupant Vehicle Lanes (4-88)
Southwest	133,239	Laredo, TX	Variable Message Signs (1- 30), Traffic Signalization (4-49), Border Crossings (4-82)
Southwest	101,760	Flagstaff, AZ	Added Single Occupant Vehicle Lanes (4-86)
Southwest	19,489[1]	Nogales, AZ	Border Crossings (4-74)
Southwest	19,157[1]	Gallup, NM	Multimodal Facilities (5-34)
West	8,863,052[2]	Los Angeles, CA	Night Construction (3-4)
West	6,249,881[3]	San Francisco Bay Area, CA	Traffic Signalization (4-45)
West	2,410,668[2]	Irvine, CA	Access Management (4-18), Telecommuting (6-12)
West	2,410,668[2]	Orange Co., CA	High Occupancy Toll Lanes and Congestion Pricing (2-18)
West	2,033,128[2]	Bellevue, WA	Telecommuting (6-14)
West	2,033,128[2]	Redmond, WA	Telecommuting (6-16)
West	2,033,128[2]	Seattle, WA	Incident Management (1-42), High Occupancy Vehicle Lanes (2-12), Night Construction (3-8), Traffic Calming (4-12), Express Lanes (4-70)
West	1,515,452[2]	Portland, OR	Ramp Meters (1-22), Incident Management (1-40), Traffic Calming (4-8), Bus (5-7), Light and Commuter Rail (5-20)
West	1,515,452[2]	Vancouver, WA	Intersection Improvements (4-60)
West	1,340,010[2]	Sacramento, CA	Light and Commuter Rail (5-14)
West	189,731[2]	Bremerton, WA	Rideshare (2-36), Bus (5-10)
West	141,210[2]	Davis, CA	Bicycle/Pedestrian Paths (4-30)
West	2,498,016	San Diego, CA	Freeway Service Patrols (1-4), High Occupancy Toll Lanes and Congestion Pricing (2-20), Border Crossings (4-76), Light and Commuter Rail (5-16)
West	2,080,434[2]	Oakland, CA	Ramp Meters (1-18)

Notes: Populations are for MSA unless otherwise noted.
n/a - not applicable
[1] City
[2] PMSA
[3] CMSA

Cities/Areas Sorted by Population of MSA (descending)

MSA Population	City/Area	Techniques
n/a	State of Maryland	Express Lanes (4-66)
8,863,052[2]	Los Angeles, CA	Night Construction (3-4)
7,410,858[2]	Chicago, IL	Express Lanes (4-64)
6,249,881[3]	San Francisco Bay Area, CA	Traffic Signalization (4-45)
4,266,654[2]	Detroit, MI	Traffic Signalization (4-48), Border Crossings (4-78)
4,222,830[2]	Montgomery Co., MD	Rideshare (2-32), Traffic Signalization (4-46)
3,321,926[2]	Houston, TX	Freeway Service Patrols (1-12), Variable Message Signs (1-29), High Occupancy Toll Lanes and Congestion Pricing (2-24), Traffic Signalization (4-50)
2,959,500	Atlanta, GA	Transportation Management Centers (1-48), Access Management (4-22)
2,676,248[2]	Dallas, TX	High Occupancy Vehicle Lanes (2-10), Lane Closures (3-23), Light and Commuter Rail (5-22), Multimodal Facilities (5-36)
2,676,248[2]	Plano, TX	Access Management (4-26)
2,609,212[2]	Long Island, NY	High Occupancy Vehicle Lanes (2-8)
2,538,776	Minneapolis, MN	Freeway Service Patrols (1-8), Transportation Management Centers (1-50), High Occupancy Vehicle Lanes (2-6), Bicycle/Pedestrian Paths (4-32)
2,498,016	San Diego, CA	Freeway Service Patrols (1-4), High Occupancy Toll Lanes and Congestion Pricing (2-20), Border Crossings (4-76), Light and Commuter Rail (5-16)
2,492,348	St. Louis, MO	Night Construction (3-5), Light and Commuter Rail (5-18), Bicycle/Pedestrian Paths (4-34)
2,410,668[2]	Irvine, CA	Access Management (4-18), Telecommuting (6-12)
2,410,668[2]	Orange Co., CA	High Occupancy Toll Lanes and Congestion Pricing (2-18)
2,394,811	Pittsburgh, PA	Bus (5-8)
2,382,172[2]	Baltimore, MD	Lane Closures (3-22), Multimodal Facilities (5-28)
2,238,498	Phoenix, AZ	Incident Management (1-34), High Occupancy Vehicle Lanes (2-4)
2,202,069[2]	Cleveland, OH	Variable Message Signs (1-28)
2,080,434[2]	Oakland, CA	Ramp Meters (1-18)
2,033,128[2]	Bellevue, WA	Telecommuting (6-14)
2,033,128[2]	Redmond, WA	Telecommuting (6-16)
2,033,128[2]	Seattle, WA	Incident Management (1-42), High Occupancy Vehicle Lanes (2-12), Night Construction (3-8), Traffic Calming (4-12), Express Lanes (4-70)
1,622,980[2]	Denver, CO	Ramp Meters (1-21), Freeway Service Patrols (1-6), Rideshare (2-30)
1,582,874	Overland Park, KS	Access Management (4-25)

MSA Population	City/Area	Techniques
1,515,452[2]	Portland, OR	Ramp Meters (1-22), Incident Management (1-40), Traffic Calming (4-8), Bus (5-7), Light and Commuter Rail (5-20)
1,515,452[2]	Vancouver, WA	Intersection Improvements (4-60)
1,432,149[2]	Milwaukee, WI	Transportation Management Centers (1-56)
1,380,491	Indianapolis, IN	Incident Management (1-36)
1,361,034[2]	Ft. Worth, TX	Construction and Public Awareness/Relations (3-14), Traffic Calming (4-10)
1,345,450	Columbus, OH	Night Construction (3-6)
1,340,010[2]	Sacramento, CA	Light and Commuter Rail (5-14)
1,324,749	San Antonio, TX	Transportation Management Centers (1-54), Express Lanes (4-68), Compressed Work Week (6-8)
1,162,140	Charlotte, NC	Freeway Service Patrols (1-10), Incident Management (1-38)
1,134,350	Providence, RI	Transportation Management Centers (1-53)
1,072,227	Salt Lake City, UT	Ramp Meters (1-24)
941,814	Ottawa	Bus (5-5)
858,485	Raleigh, NC	Construction and Public Awareness/Relations (3-12)
852,646	Las Vegas, NV	Traffic Calming (4-6)
846,227	Austin TX	Rideshare (2-35), Bicycle/Pedestrian Paths (4-36), Express Lanes (4-67)
666,957	Tucson, AZ	Intersection Improvements (4-54), Compressed Work Week (6-4)
591,610	El Paso, TX	Border Crossings (4-80)
589,131	Albuquerque, NM	Intersection Improvements (4-57)
587,986	Harrisburg, PA	Night Construction (3-7)
513,117	Little Rock, AR	Lane Closures (3-19)
485,270	Wichita, KS	Added Single Occupant Vehicle Lanes (4-87)
453,932	Columbia, SC	Construction and Public Awareness/Relations (3-13)
429,453	Battle Creek, MI	Multimodal Facilities (5-30)
398,978	Melbourne, FL	Access Management (4-20)
367,085	Madison, WI	Bicycle/Pedestrian Paths (4-38), Variable Message Signs (1-31)
349,894	Corpus Christi, TX	Intersection Improvements (4-59)
335,113	Lee Co., FL	High Occupancy Toll Lanes and Congestion Pricing (2-22)
325,824[2]	Princeton, NJ	Compressed Work Week (6-6)
292,517	Montgomery, AL	Construction and Public Awareness/Relations (3-10)
233,609	Tallahassee, FL	Lane Closures (3-20)
225,339[2]	Boulder, CO	Rideshare (2-29), Traffic Calming (4-4)
189,731[2]	Bremerton, WA	Rideshare (2-36), Bus (5-10)
189,123	Waco, TX	Added Single Occupant Vehicle Lanes (4-90)
187,514	Amarillo, TX	Intersection Improvements (4-58), Added Single Occupant Vehicle Lanes (4-88)
141,210[2]	Davis, CA	Bicycle/Pedestrian Paths (4-30)
133,239	Laredo, TX	Variable Message Signs (1- 30), Traffic Signalization (4-49), Border Crossings (4-82)
101,760	Flagstaff, AZ	Added Single Occupant Vehicle Lanes (4-86)
73,142	Cheyenne, WY	Variable Message Signs (1-32)
41,036[1]	Meridian, MS	Multimodal Facilities (5-32)
19,489[1]	Nogales, AZ	Border Crossings (4-74)

MSA Population	City/Area	Techniques
19,157[1]	Gallup, NM	Multimodal Facilities (5-34)
7,141[1]	Detroit Lakes, MN	Construction and Public Awareness/Relations (3-11)

Notes: Populations are for MSA unless otherwise noted.
n/a - not applicable
[1] City
[2] PMSA
[3] CMSA

Cities/Areas Sorted by Population of City Proper (descending)

Population: City Proper	Population: MSA	City/Area	Techniques
n/a	6,249,881[3]	San Francisco Bay Area, CA	Traffic Signalization (4-45)
n/a	n/a	State of Maryland	Express Lanes (4-66)
3,485,557	8,863,052[2]	Los Angeles, CA	Night Construction (3-4)
2,783,726	7,410,858[2]	Chicago, IL	Express Lanes (4-64)
2,609,212[1]	2,609,212[2]	Long Island, NY	High Occupancy Vehicle Lanes (2-8)
2,410,668[1]	2,410,668[2]	Orange Co., CA	High Occupancy Toll Lanes and Congestion Pricing (2-18)
1,637,859	3,321,926[2]	Houston, TX	Freeway Service Patrols (1-12), Variable Message Signs (1-29), High Occupancy Toll Lanes and Congestion Pricing (2-24), Traffic Signalization (4-50)
1,110,623	2,498,016	San Diego, CA	Freeway Service Patrols (1-4), High Occupancy Toll Lanes and Congestion Pricing (2-20), Border Crossings (4-76), Light and Commuter Rail (5-16)
1,027,974	4,266,654 [2]	Detroit, MI	Traffic Signalization (4-48), Border Crossings (4-78)
1,007,618	2,676,248 [2]	Dallas, TX	High Occupancy Vehicle Lanes (2-10), Lane Closures (3-23), Light and Commuter Rail (5-22), Multimodal Facilities (5-36)
984,310	2,238,498	Phoenix, AZ	Incident Management (1-34), High Occupancy Vehicle Lanes (2-4)
959,295	1,324,749	San Antonio, TX	Transportation Management Centers (1-54), Express Lanes (4-68), Compressed Work Week (6-8)
757,027[1]	4,222,830[2]	Montgomery Co., MD	Rideshare (2-32), Traffic Signalization (4-46)
736,014	2,382,172[2]	Baltimore, MD	Lane Closures (3-22), Multimodal Facilities (5-28)
731,278	1,380,491	Indianapolis, IN	Incident Management (1-36)
632,945	1,345,450	Columbus, OH	Night Construction (3-6)
628,088	1,432,149[2]	Milwaukee, WI	Transportation Management Centers (1-56)
516,259	2,033,128[2]	Seattle, WA	Incident Management (1-42), High Occupancy Vehicle Lanes (2-12), Night Construction (3-8), Traffic Calming (4-12), Express Lanes (4-70)
515,342	591,610	El Paso, TX	Border Crossings (4-80)
505,616	2,202,069[2]	Cleveland, OH	Variable Message Signs (1-28)
472,020	846,227	Austin TX	Rideshare (2-35), Bicycle/Pedestrian Paths (4-36), Express Lanes (4-67)
467,610	1,622,980[2]	Denver, CO	Ramp Meters (1-21), Freeway Service Patrols (1-6),

Population		City/Area	Techniques
City Proper	MSA		
			Rideshare (2-30)
463,634	1,515,452[2]	Portland, OR	Ramp Meters (1-22), Incident Management (1-40), Traffic Calming (4-8), Bus (5-7), Light and Commuter Rail (5-20)
463,634	1,515,452[2]	Vancouver, WA	Intersection Improvements (4-60)
447,619	1,361,034[2]	Ft. Worth, TX	Construction and Public Awareness/Relations (3-14), Traffic Calming (4-10)
419,539	1,162,140	Charlotte, NC	Freeway Service Patrols (1-10), Incident Management (1-38)
411,480	666,957	Tucson, AZ	Intersection Improvements (4-54), Compressed Work Week (6-4)
396,685	2,492,348	St. Louis, MO	Night Construction (3-5), Light and Commuter Rail (5-18), Bicycle/Pedestrian Paths (4-34)
393,929	2,959,500	Atlanta, GA	Transportation Management Centers (1-48), Access Management (4-22)
384,915	589,131	Albuquerque, NM	Intersection Improvements (4-57)
372,242	2,080,434[2]	Oakland, CA	Ramp Meters (1-18)
369,879	2,394,811	Pittsburgh, PA	Bus (5-8)
369,365	1,340,010[2]	Sacramento, CA	Light and Commuter Rail (5-14)
368,383	2,538,776	Minneapolis, MN	Freeway Service Patrols (1-8), Transportation Management Centers (1-50), High Occupancy Vehicle Lanes (2-6), Bicycle/Pedestrian Paths (4-32)
335,113[1]	335,113	Lee Co., FL	High Occupancy Toll Lanes and Congestion Pricing (2-22)
313,987	941,814	Ottawa	Bus (5-5)
304,017	485,270	Wichita, KS	Added Single Occupant Vehicle Lanes (4-87)
258,204	852,646	Las Vegas, NV	Traffic Calming (4-6)
257,453	349,894	Corpus Christi, TX	Intersection Improvements (4-59)
212,092	858,485	Raleigh, NC	Construction and Public Awareness/Relations (3-12)
190,766	367,085	Madison, WI	Bicycle/Pedestrian Paths (4-38), Variable Message Signs (1-31)
190,350	292,517	Montgomery, AL	Construction and Public Awareness/Relations (3-10)
175,727	513,117	Little Rock, AR	Lane Closures (3-19)
160,728	1,134,350	Providence, RI	Transportation Management Centers (1-53)
159,928	1,072,227	Salt Lake City, UT	Ramp Meters (1-24)
157,571	187,514	Amarillo, TX	Intersection Improvements (4-58), Added Single Occupant Vehicle Lanes (4-88)
127,885	2,676,248[2]	Plano, TX	Access Management (4-26)
124,773	233,609	Tallahassee, FL	Lane Closures (3-20)
122,899	133,239	Laredo, TX	Variable Message Signs (1- 30), Traffic Signalization (4-49), Border Crossings (4-82)
111,790	1,582,874	Overland Park, KS	Access Management (4-25)
110,734	453,932	Columbia, SC	Construction and Public Awareness/Relations (3-

Population			
City Proper	MSA	City/Area	Techniques
			13)
110,330	2,410,668[2]	Irvine, CA	Access Management (4-18), Telecommuting (6-12)
103,590	189,123	Waco, TX	Added Single Occupant Vehicle Lanes (4-90)
86,874	2,033,128[2]	Bellevue, WA	Telecommuting (6-14)
85,127	225,339[2]	Boulder, CO	Rideshare (2-29), Traffic Calming (4-4)
60,034	398,978	Melbourne, FL	Access Management (4-20)
53,516	429,453	Battle Creek, MI	Multimodal Facilities (5-30)
52,376	587,986	Harrisburg, PA	Night Construction (3-7)
50,008	73,142	Cheyenne, WY	Variable Message Signs (1-32)
46,322	141,210[2]	Davis, CA	Bicycle/Pedestrian Paths (4-30)
45,857	101,760	Flagstaff, AZ	Added Single Occupant Vehicle Lanes (4-86)
41,036	n/a	Meridian, MS	Multimodal Facilities (5-32)
38,142	189,731[2]	Bremerton, WA	Rideshare (2-36), Bus (5-10)
35,800	2,033,128[2]	Redmond, WA	Telecommuting (6-16)
19,489	n/a	Nogales, AZ	Border Crossings (4-74)
19,157	n/a	Gallup, NM	Multimodal Facilities (5-34)
12,016	325,824[2]	Princeton, NJ	Compressed Work Week (6-6)
7,141	n/a	Detroit Lakes, MN	Construction and Public Awareness/Relations (3-11)

Notes: Populations are for City Proper and MSA unless otherwise noted.
n/a - not applicable
[1] County
[2] PMSA
[3] CMSA

Cities/Areas Sorted by Population Density of MSA (descending)

MSA Population Density				
person/ sq. mi.	person/ sq. km.	MSA Population	City/Area	Techniques
n/a	n/a	941,814	Ottawa	Bus (5-5)
n/a	n/a	n/a	State of Maryland	Express Lanes (4-66)
n/a	n/a	41,036[1]	Meridian, MS	Multimodal Facilities (5-32)
n/a	n/a	19,489[1]	Nogales, AZ	Border Crossings (4-74)
n/a	n/a	19,157[1]	Gallup, NM	Multimodal Facilities (5-34)
n/a	n/a	7,141[1]	Detroit Lakes, MN	Construction and Public Awareness/Relations (3-11)
3,051	1,179	2,410,668[2]	Irvine, CA	Access Management (4-18), Telecommuting (6-12)
3,051	1,179	2,410,668[2]	Orange Co., CA	High Occupancy Toll Lanes and Congestion Pricing (2-18)
2,183	843	8,863,052[2]	Los Angeles, CA	Night Construction (3-4)
2,178	841	2,609,212[2]	Long Island, NY	High Occupancy Vehicle Lanes (2-8)
1,854	716	1,134,350	Providence, RI	Transportation Management Centers (1-53)
1,463	565	7,410,858[2]	Chicago, IL	Express Lanes (4-64)
1,442	557	325,824[2]	Princeton, NJ	Compressed Work Week (6-6)
1,427	551	2,080,434[2]	Oakland, CA	Ramp Meters (1-18)
1,095	423	4,266,654[2]	Detroit, MI	Traffic Signalization (4-48), Border Crossings (4-78)
981	379	1,432,149[2]	Milwaukee, WI	Transportation Management Centers (1-56)
913	352	2,382,172[2]	Baltimore, MD	Lane Closures (3-22), Multimodal Facilities (5-28)
848	327	6,249,881[3]	San Francisco Bay Area, CA	Traffic Signalization (4-45)
813	314	2,202,069[2]	Cleveland, OH	Variable Message Signs (1-28)
663	256	1,072,227	Salt Lake City, UT	Ramp Meters (1-24)
649	253	4,222,830[2]	Montgomery Co., MD	Rideshare (2-32), Traffic Signalization (4-46)
594	229	2,498,016	San Diego, CA	Freeway Service Patrols (1-4), High Occupancy Toll Lanes and Congestion Pricing (2-20), Border Crossings (4-76), Light and Commuter Rail (5-16)
584	225	591,610	El Paso, TX	Border Crossings (4-80)

MSA Population Density				
person/ sq. mi.	person/ sq. km.	MSA Population	City/Area	Techniques
561	217	3,321,926[2]	Houston, TX	Freeway Service Patrols (1-12), Variable Message Signs (1-29), High Occupancy Toll Lanes and Congestion Pricing (2-24), Traffic Signalization (4-50)
518	181	2,394,811	Pittsburgh, PA	Bus (5-8)
503	194	2,538,776	Minneapolis, MN	Freeway Service Patrols (1-8), Transportation Management Centers (1-50), High Occupancy Vehicle Lanes (2-6), Bicycle/Pedestrian Paths (4-32)
483	187	2,959,500	Atlanta, GA	Transportation Management Centers (1-48), Access Management (4-22)
482	186	2,033,128[2]	Bellevue, WA	Telecommuting (6-14)
482	186	2,033,128[2]	Redmond, WA	Telecommuting (6-16)
482	186	2,033,128[2]	Seattle, WA	Incident Management (1-42), High Occupancy Vehicle Lanes (2-12), Night Construction (3-8), Traffic Calming (4-12), Express Lanes (4-70)
479	185	189,731[2]	Bremerton, WA	Rideshare (2-36), Bus (5-10)
466	180	1,361,034[2]	Ft. Worth, TX	Construction and Public Awareness/Relations (3-14), Traffic Calming (4-10)
433	167	2,676,248[2]	Dallas, TX	High Occupancy Vehicle Lanes (2-10), Lane Closures (3-23), Light and Commuter Rail (5-22), Multimodal Facilities (5-36)
433	167	2,676,248[2]	Plano, TX	Access Management (4-26)
432	167	1,622,980[2]	Denver, CO	Ramp Meters (1-21), Freeway Service Patrols (1-6), Rideshare (2-30)
428	165	1,345,450	Columbus, OH	Night Construction (3-6)
417	161	335,113	Lee Co., FL	High Occupancy Toll Lanes and Congestion Pricing (2-22)
405	156	1,515,452[2]	Portland, OR	Ramp Meters (1-22), Incident Management (1-40), Traffic Calming (4-8), Bus (5-7), Light and Commuter Rail (5-20)
405	156	1,515,452[2]	Vancouver, WA	Intersection Improvements (4-60)
398	154	1,324,749	San Antonio, TX	Transportation Management Centers (1-54), Express Lanes (4-68), Compressed Work Week (6-8)
392	151	1,380,491	Indianapolis, IN	Incident Management (1-36)
392	151	398,978	Melbourne, FL	Access Management (4-20)
390	151	2,492,348	St. Louis, MO	Night Construction (3-5), Light and Commuter Rail (5-18), Bicycle/Pedestrian Paths (4-34)
344	133	1,162,140	Charlotte, NC	Freeway Service Patrols (1-10), Incident Management (1-38)
328	127	1,340,010[2]	Sacramento, CA	Light and Commuter Rail (5-14)
312	120	453,932	Columbia, SC	Construction and Public Awareness/Relations (3-13)

MSA Population Density				
person/ sq. mi.	person/ sq. km.	MSA Population	City/Area	Techniques
306	118	367,085	Madison, WI	Bicycle/Pedestrian Paths (4-38), Variable Message Signs (1-31)
304	117	225,339[2]	Boulder, CO	Rideshare (2-29), Traffic Calming (4-4)
295	114	587,986	Harrisburg, PA	Night Construction (3-7)
293	113	1,582,874	Overland Park, KS	Access Management (4-25)
246	95	858,485	Raleigh, NC	Construction and Public Awareness/Relations (3-12)
229	88	349,894	Corpus Christi, TX	Intersection Improvements (4-59)
228	88	429,453	Battle Creek, MI	Multimodal Facilities (5-30)
200	77	846,227	Austin TX	Rideshare (2-35), Bicycle/Pedestrian Paths (4-36), Express Lanes (4-67)
197	76	233,609	Tallahassee, FL	Lane Closures (3-20)
182	70	189,123	Waco, TX	Added Single Occupant Vehicle Lanes (4-90)
176	68	513,117	Little Rock, AR	Lane Closures (3-19)
164	63	485,270	Wichita, KS	Added Single Occupant Vehicle Lanes (4-87)
154	59	2,238,498	Phoenix, AZ	Incident Management (1-34), High Occupancy Vehicle Lanes (2-4)
146	56	292,517	Montgomery, AL	Construction and Public Awareness/Relations (3-10)
140	54	141,210[2]	Davis, CA	Bicycle/Pedestrian Paths (4-30)
103	40	187,514	Amarillo, TX	Intersection Improvements (4-58), Added Single Occupant Vehicle Lanes (4-88)
99	38	589,131	Albuquerque, NM	Intersection Improvements (4-57)
73	28	666,957	Tucson, AZ	Intersection Improvements (4-54), Compressed Work Week (6-4)
40	15	133,239	Laredo, TX	Variable Message Signs (1- 30), Traffic Signalization (4-49), Border Crossings (4-82)
27	10	73,142	Cheyenne, WY	Variable Message Signs (1-32)
22	8	852,646	Las Vegas, NV	Traffic Calming (4-6)
5	2	101,760	Flagstaff, AZ	Added Single Occupant Vehicle Lanes (4-86)

Notes: Populations are for MSA unless otherwise noted.
n/a - not applicable
[1] Central City
[2] PMSA
[3] CMSA

Cities/Areas Sorted by Population Density of City Proper (descending)

City Population Density		Population			
person/ sq. mi.	person/ sq. km.	City	MSA	City/Area	Techniques
n/a	n/a	n/a	6,249,881[3]	San Francisco Bay Area, CA	Traffic Signalization (4-45)
n/a	n/a	n/a	n/a	State of Maryland	Express Lanes (4-66)
12,263	4,734	2,783,726	7,410,858[2]	Chicago, IL	Express Lanes (4-64)
9,087	3,522	736,014	2,382,172[2]	Baltimore, MD	Lane Closures (3-22), Multimodal Facilities (5-28)
8,929	3,348	160,728	1,134,350	Providence, RI	Transportation Management Centers (1-53)
7,432	2,866	3,485,557	8,863,052[2]	Los Angeles, CA	Night Construction (3-4)
7,395	2,863	1,027,974	4,266,654[2]	Detroit, MI	Traffic Signalization (4-48), Border Crossings (4-78)
7,302	2,854	313,987	941,814	Ottawa	Bus (5-5)
6,698	2,594	368,383	2,538,776	Minneapolis, MN	Freeway Service Patrols (1-8), Transportation Management Centers (1-50), High Occupancy Vehicle Lanes (2-6), Bicycle/Pedestrian Paths (4-32)
6,647	2,567	372,242	2,080,434[2]	Oakland, CA	Ramp Meters (1-18)
6,605	2,569	369,879	2,394,811	Pittsburgh, PA	Bus (5-8)
6,566	2,528	505,616	2,202,069[2]	Cleveland, OH	Variable Message Signs (1-28)
6,547	2,494	52,376	587,986	Harrisburg, PA	Night Construction (3-7)
6,543	2,522	628,088	1,432,149[2]	Milwaukee, WI	Transportation Management Centers (1-56)
6,398	2,479	396,685	2,492,348	St. Louis, MO	Night Construction (3-5), Light and Commuter Rail (5-18), Bicycle/Pedestrian Paths (4-34)
6,146	2,379	516,259	2,033,128[2]	Seattle, WA	Incident Management (1-42), High Occupancy Vehicle Lanes (2-12), Night Construction (3-8), Traffic Calming (4-12), Express Lanes (4-70)
6,008	2,403	12,016	325,824[2]	Princeton, NJ	Compressed Work Week (6-6)
5,515	2,115	46,322	141,210[2]	Davis, CA	Bicycle/Pedestrian Paths (4-30)
5,429	2,644	304,017	485,270	Wichita, KS	Added Single Occupant Vehicle Lanes (4-87)
3,848	1,483	369,365	1,340,010[2]	Sacramento, CA	Light and Commuter Rail (5-14)

City Population Density		Population			
person/ sq. mi.	person/ sq. km.	City	MSA	City/Area	Techniques
3,724	1,446	122,899	133,239	Laredo, TX	Variable Message Signs (1- 30), Traffic Signalization (4-49), Border Crossings (4-82)
3,709	1,435	463,634	1,515,452[2]	Portland, OR	Ramp Meters (1-22), Incident Management (1-40), Traffic Calming (4-8), Bus (5-7), Light and Commuter Rail (5-20)
3,709	1,435	463,634	1,515,452[2]	Vancouver, WA	Intersection Improvements (4-60)
3,701	1,468	85,127	225,339[2]	Boulder, CO	Rideshare (2-29), Traffic Calming (4-4)
3,428	1,324	1,110,623	2,498,016	San Diego, CA	Freeway Service Patrols (1-4), High Occupancy Toll Lanes and Congestion Pricing (2-20), Border Crossings (4-76), Light and Commuter Rail (5-16)
3,341	1,278	86,874	2,033,128[2]	Bellevue, WA	Telecommuting (6-14)
3,314	1,281	632,945	1,345,450	Columbus, OH	Night Construction (3-6)
3,289	1,272	190,766	367,085	Madison, WI	Bicycle/Pedestrian Paths (4-38), Variable Message Signs (1-31)
3,111	1,195	258,204	852,646	Las Vegas, NV	Traffic Calming (4-6)
3,056	1,178	467,610	1,622,980[2]	Denver, CO	Ramp Meters (1-21), Freeway Service Patrols (1-6), Rideshare (2-30)
3,051	1,179	2,410,668[1]	2,410,668[2]	Orange Co., CA	High Occupancy Toll Lanes and Congestion Pricing (2-18)
3,033	1,172	1,637,859	3,321,926[2]	Houston, TX	Freeway Service Patrols (1-12), Variable Message Signs (1-29), High Occupancy Toll Lanes and Congestion Pricing (2-24), Traffic Signalization (4-50)
2,984	1,155	393,929	2,959,500	Atlanta, GA	Transportation Management Centers (1-48), Access Management (4-22)
2,946	1,136	1,007,618	2,676,248[2]	Dallas, TX	High Occupancy Vehicle Lanes (2-10), Lane Closures (3-23), Light and Commuter Rail (5-22), Multimodal Facilities (5-36)
2,916	1,125	384,915	589,131	Albuquerque, NM	Intersection Improvements (4-57)
2,881	1,112	959,295	1,324,749	San Antonio, TX	Transportation Management Centers (1-54), Express Lanes (4-68), Compressed Work Week (6-8)
2,638	1,016	411,480	666,957	Tucson, AZ	Intersection Improvements (4-54), Compressed Work Week (6-4)

City Population Density		Population			
person/ sq. mi.	person/ sq. km.	City	MSA	City/Area	Techniques
2,632	1,021	50,008	73,142	Cheyenne, WY	Variable Message Signs (1-32)
2,627	1,003	110,330	2,410,668[2]	Irvine, CA	Access Management (4-18), Telecommuting (6-12)
2,557	968	35,800	2,033,128[2]	Redmond, WA	Telecommuting (6-16)
2,411	930	419,539	1,162,140	Charlotte, NC	Freeway Service Patrols (1-10), Incident Management (1-38)
2,410	930	212,092	858,485	Raleigh, NC	Construction and Public Awareness/Relations (3-12)
2,344	905	984,310	2,238,498	Phoenix, AZ	Incident Management (1-34), High Occupancy Vehicle Lanes (2-4)
2,178	841	2,609,212[1]	2,609,212[2]	Long Island, NY	High Occupancy Vehicle Lanes (2-8)
2,165	837	472,020	846,227	Austin TX	Rideshare (2-35), Bicycle/Pedestrian Paths (4-36), Express Lanes (4-67)
2,103	810	515,342	591,610	El Paso, TX	Border Crossings (4-80)
2,070	811	60,034	398,978	Melbourne, FL	Access Management (4-20)
2,020	780	731,278	1,380,491	Indianapolis, IN	Incident Management (1-36)
1,996	776	111,790	1,582,874	Overland Park, KS	Access Management (4-25)
1,981	761	124,773	233,609	Tallahassee, FL	Lane Closures (3-20)
1,938	744	127,885	2,676,248	Plano, TX	Access Management (4-26)
1,907	734	38,142	189,731[2]	Bremerton, WA	Rideshare (2-36), Bus (5-10)
1,907	736	257,453	349,894	Corpus Christi, TX	Intersection Improvements (4-59)
1,791	691	157,571	187,514	Amarillo, TX	Intersection Improvements (4-58), Added Single Occupant Vehicle Lanes (4-88)
1,785	714	7,141	n/a	Detroit Lakes, MN	Construction and Public Awareness/Relations (3-11)
1,742	661	19,157	n/a	Gallup, NM	Multimodal Facilities (5-34)
1,706	661	175,727	513,117	Little Rock, AR	Lane Closures (3-19)
1,593	615	447,619	1,361,034[2]	Ft. Worth, TX	Construction and Public Awareness/Relations (3-14), Traffic Calming (4-10)
1,529	591	757,027[1]	4,222,830[2]	Montgomery Co., MD	Rideshare (2-32), Traffic Signalization (4-46)
1,467	567	159,928	1,072,227	Salt Lake City, UT	Ramp Meters (1-24)
1,410	544	190,350	292,517	Montgomery, AL	Construction and Public Awareness/Relations (3-10)
1,363	529	103,590	189,123	Waco, TX	Added Single Occupant Vehicle Lanes (4-90)
1,245	482	53,516	429,453	Battle Creek, MI	Multimodal Facilities (5-30)
1,140	446	41,036	n/a	Meridian, MS	Multimodal Facilities (5-32)
946	365	110,734	453,932	Columbia, SC	Construction and Public Awareness/Relations (3-13)
928	361	19,489	n/a	Nogales, AZ	Border Crossings (4-74)

City Population Density		Population			
person/ sq. mi.	person/ sq. km.	City	MSA	City/Area	Techniques
728	280	45,857	101,760	Flagstaff, AZ	Added Single Occupant Vehicle Lanes (4-86)
417	161	335,113[1]	335,113	Lee Co., FL	High Occupancy Toll Lanes and Congestion Pricing (2-22

Notes: Populations are for City Proper and MSA unless otherwise noted.
n/a - not applicable
[1] County
[2] PMSA
[3] CMSA