CAMBRIDGE SYSTEMATICS

Congestion Management Toolbox Update

final

toolbox

prepared for

Mid-America Regional Council

prepared by

Cambridge Systematics, Inc.

with

Shockey Consulting Services
Olsson Associates

December 31, 2013
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2023 Revisions

Table 2.5 Land Use Strategies	Per feedback received from workgroup, added one (1) strategy: Last-Mile Delivery/Fulfillment Centers
Table 2.8 TDM Strategies	Per feedback received from workgroup, added one (1) strategy: Alternative Truck Freight Delivery Hours to

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1.0 Introduction: History of the MARC Congestion Management Process

Federal regulation requires that a congestion management process shall be developed, established, and implemented as part of the metropolitan transportation planning process. The development of a congestion management process should result in multimodal system performance measures and strategies that can be reflected in the metropolitan transportation plan (MTP) and transportation improvement program (TIP).

On December 18, 2001, the MARC Board of Directors adopted a Congestion Management System (CMS) policy to be compliant with the Federal regulations adopted as part of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). In 2005, the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) transportation bill was signed into law. Along with this, various changes were made to the Federal regulations pertaining to metropolitan planning, including a change in requirements from MPOs having a CMS to having a Congestion Management Process (CMP). In MARC's 2009 Triennial Certification Review, the U.S. Department of Transportation (USDOT) identified the need for MARC to update the region's CMP. As a result, MARC adopted a new CMP policy on May 24, 2011.

The 2011 CMP policy provides a framework for how MARC will address the Federal CMP requirements and meet the unique needs of the Kansas City metropolitan area. It defines the relationship of CMP to the regional LRTP, TIP, corridor studies, and regional Intelligent Transportation Systems (ITS) architecture. As part of the regional architecture development process, and subsequent updates, outreach is conducted to a range of agencies in the region. These include state, regional and local transportation agencies as well as first responders and emergency management agencies. This provides an opportunity to identify projects for the CMP that may not otherwise be included. In addition ITS projects must be included in the regional architecture in order to be eligible for Federal funding.

The MARC CMP describes an eight-step regional CMP framework consistent with the official guidance issued by the USDOT:

1. Develop congestion management objectives
2. Identify area of application
3. Define system/network of interest

4. Develop performance measures
5. Institute system performance monitoring plan
6. Identify and evaluate strategies
7. Implement selected strategies and manage transportation system
8. Monitor strategy effectiveness

Figure 1.1 presents a broader look at how the CMP fits into the transportation planning process.

To go along with this updated CMP, MARC prepared this update Congestion Management Toolbox in 2013. This Toolbox builds on the one previously created in 2001. That original Toolbox was developed as a component of the CMS to provide a reference of alternative strategies to consider in corridor studies and NEPA documents. A wide range of congestion reduction strategies applicable to the Kansas City region was documented in the toolbox, organized into eight categories. This updated Toolbox expands the number of categories; adds more contemporary strategies; and includes additional information of relevance to practitioners.

Figure 1.1 CMP and the Overall Planning Process

Source: FHWA

2.0 Congestion Management Toolbox

2.1 USING THE TOOLBOX

When local agencies in the region find themselves considering roadway capacity projects, they can use the Toolbox like a checklist. They will consider each item in the Toolbox and, in turn determine whether a strategy (or package of strategies) and the relevant actions/projects have a reasonable potential for providing benefit to the corridor or study area being evaluated. If a strategy shows promise, it can be evaluated in detail using the regional model and applicable post-processing tools suggested in the toolbox.

To select the right types of strategies, an agency must have an understanding of the nature of the need. Figure 2.2 identifies the different dimensions of congestion: what is the issue that needs to be solved? Next, what is the agency trying to accomplish through a strategy: what are the goals and objectives? What would be the measure of success after the strategy has been implemented? Is the focus of the agency long or short term in relation to the need being addressed?

As shown in Figure 1.1 previously, the CMP is integrated into the establishment of goals and objectives, identification and evaluation of alternative strategies, and then developing the LRTP and TIP. The CMT can be used to support this process.

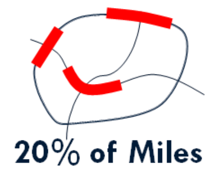
However, there are other ways in which the CMT can be used by agencies in the Kansas City region at a more localized level:

- Identify alternative strategies for addressing local congestion issues, and select the most appropriate of these strategies for the specific issues based on the information in the toolbox;
- After identifying the best strategies for a particular need based on this initial screen, perform more analysis using some of the tools identified; and
- Present national best practices and typical outcomes experienced in other cities to stakeholders, the public, government officials, developers, and others.

Figure 2.1 Different Dimensions of Congestion

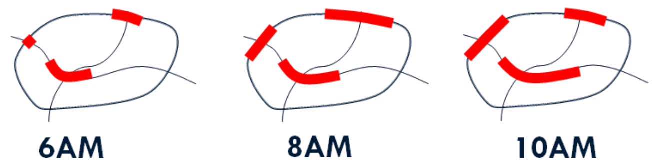
Spatial

How much of the system is congested? The image presents an example of a metropolitan highway network with 20 percent of all miles congested.



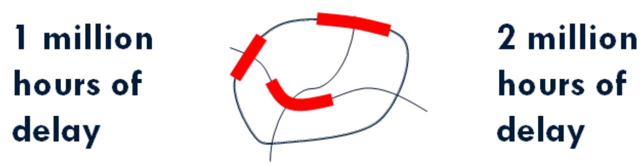
Temporal

How long does congestion last? The image presents an example of a metropolitan highway network with congestion from 6:00 a.m. through 10:00 a.m.



Severity

How much delay is there or how low are travel speeds? The image shows that for the same percentage of miles congested, the number of vehicles and total hours of vehicular delay can be different.



Variability

How does congestion change from day to day? The image shows how the severity and location of congestion can change from day to day. More variation in travel time indicates less reliable travel. A reliable system would have consistent levels of congestion from hour to hour and day to day.

2.2 Strategies

Table 2.1 provides a summary of the types of strategies described in the toolbox. Each strategy type is described in greater detail below, and the strategies themselves are detailed in Tables 2.2 through 2.10.

In these tables, readers will find:

- A list of the projects and strategies;
- How they reduce congestion and how they should be analyzed in specific locations;
- Tools that can be used to do this evaluation;
- Order-of-magnitude cost estimates to assist in selecting the best strategy; and

- Suggestions regarding which strategies are complementary and in what situations they are best used together.

For each of the projects and strategies, the potential for congestion reduction benefits is indicated, along with a recommended analysis method to help with location-specific assessment and prioritization. This includes the tools needed to evaluate the congestion reduction potential of each strategy or project. Tools include the Travel Demand Management (TDM) Evaluation Model, ITS Deployment Analysis System (IDAS), Tool for Operations Benefit/Cost (TOPS-BC), the MARC regional travel model, and others. In some cases, benefits may be more qualitative for selected strategies.

The congestion reduction impacts are defined qualitatively by indicators such as the potential reduction of single occupant vehicles (SOV), improved travel times, and reduced delay. This includes both recurring delay – delay that occurs on a regular basis, such as that due to daily peak congestion – and non-recurring delay – delay that occurs unexpectedly, such as due to crashes or special events. About half of all congestion is non-recurring.

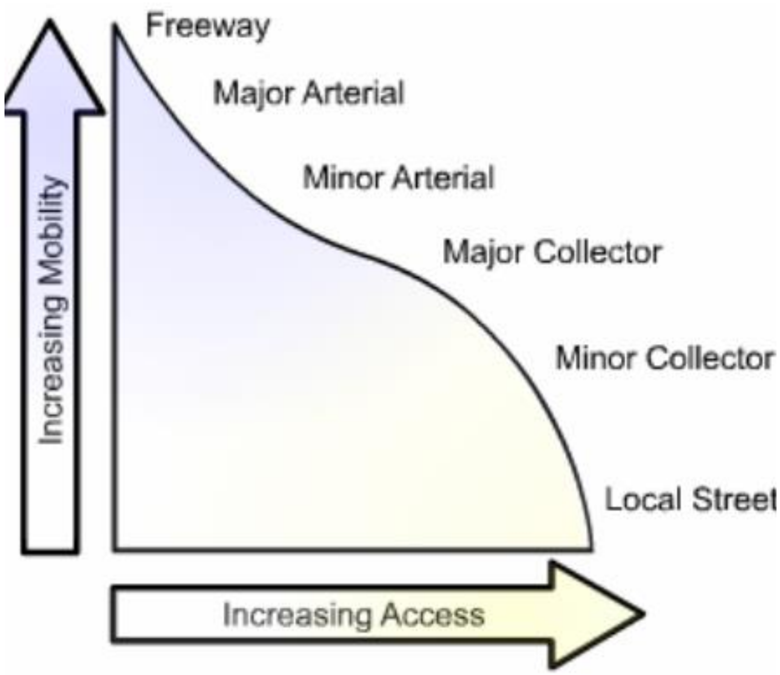
Order-of-magnitude cost estimates also help in selecting between strategies. National cost data built into the TOPS-BC software, IDAS, and other national practices are used to provide this estimate. Therefore, these costs may vary for the Kansas City region. The implementation costs and schedules consider design and maintenance costs, interjurisdictional agreements, and implementation timing over short-term (one to five years), medium-term (five to 10 years), and long-term (over 10 years).

Finally, the Toolbox indicates strategies that are complementary, and in what situations they are best used together.

Access Management Strategies

Access management is a broad concept that can include everything from curb cut restrictions on local arterials to minimum interchange spacing on freeways. Restricting turning movements on local arterials can reduce crashes and prevent turning vehicles from impeding traffic flow; this can then make it easier to effectively apply ITS and transportation system management (TSM) strategies in the Transportation Operations and Management category. Similarly, eliminating merge points and weaving sections at freeway interchanges increases the capacity of the facility. Tradeoffs exist in limiting access to individual properties and increasing system mobility, and many communities assign different access restrictions to different functional classifications of roadway (Figure 2.3). The access management strategies listed in Table 2.7 are applicable to Kansas City, and can be used in either the modification or original design of a facility.

Figure 2.2 Tradeoffs in Access and Mobility



Source: FHWA, Introduction to Access Management Principles

Active Transportation

Investments in non-motorized modes of transportation, such as biking and walking, can increase safety and mobility in a cost-efficient manner, while providing a zero-emission alternative to motorized modes (Figure 2.4). The strategies listed in Table 2.4 can be implemented in the Kansas City area with relatively little cost, but tend to have local rather than systemwide impacts. The effectiveness of an investment in non-motorized travel depends heavily on coordination with local land use policies and connections with other modes, such as transit, for longer distance travel. Safety and aesthetics should also be emphasized in the design of bicycle and pedestrian facilities in order to increase their attractiveness.

Figure 2.3 Active Transportation: Bicycle Lanes and Sidewalks

Source: www.peopleforbikes.org

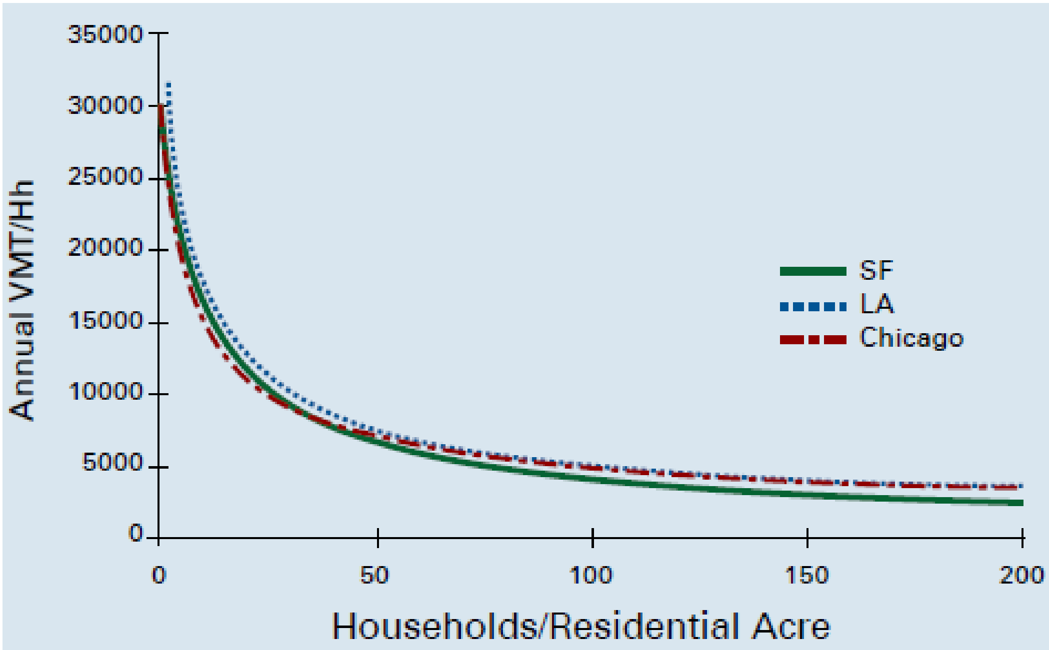
Highway Strategies

Table 2.4 presents the potential highway infrastructure strategies that may be applicable for the Kansas City region. These are often higher-cost strategies that also tend to have larger congestion benefits in the short term. These strategies can sometimes be paired with ITS and transportation system management (TSM) strategies within the Transportation Operations and Management category. Several highway strategies can increase the effectiveness of certain transit strategies: managed lanes can facilitate express buses or bus rapid transit, for example.

Land Use Strategies

Land development strategies have been used in some areas to manage transportation demand on the system, and to help agencies meet air quality conformity standards. Land development strategies can include limits on the amount and location of development until certain service standards are met, or policies that encourage development patterns better served by public transportation and non-motorized modes. These strategies may help decrease the number and length of trips made (Figure 2.5). Table 2.5 presents the land development strategies that may be applicable for the Kansas City region. These are often paired with Parking Strategies and can complement Active Transportation Strategies.

Figure 2.4 Vehicle Miles Traveled versus Residential Density



Source: Best Practices in Transportation Demand Management, Seattle Urban Mobility Plan

Parking Strategies

Parking management is most often used to decrease automobile trips for both work and non-work purposes, although in the context of enforcement it may also be used to improve traffic flow (Table 2.6). Often, policies implemented by local governments and directed towards the private sector must be accompanied by incentives in order to ensure their effectiveness. These are often closely linked with Land Use Strategies and Transportation Demand Management (TDM) Strategies.

Regulatory Strategies

Regulatory Strategies, shown in Table 2.7, are low- or no-cost policy decisions that affect each of the strategy categories above. This could include pricing, vehicle restrictions, insurance schemes, and others.

TDM Strategies

Transportation demand management (TDM) strategies are used to reduce travel during the peak commute period. They are also used to help agencies meet air quality conformity standards, and are intended to provide ways to provide congestion relief and mobility improvements without high cost infrastructure projects by focusing on the demand, rather than supply, side. Pricing strategies, such as congestion pricing, are included in this group (Figure 2.6). Table 2.8 presents the TDM strategies that may be applicable for the Kansas City region.

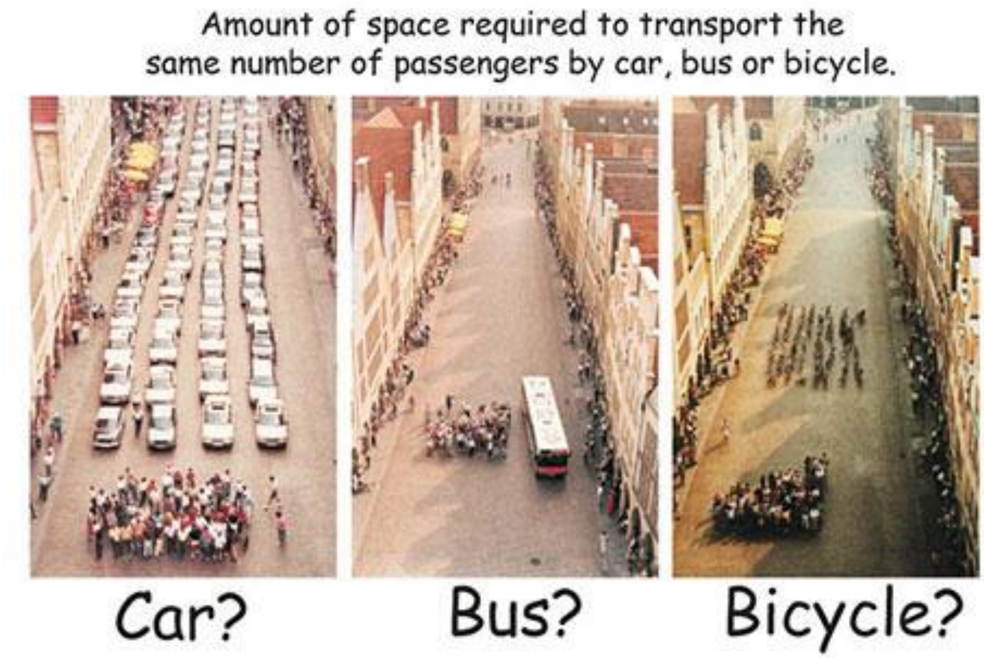
Figure 2.5 TDM Strategies: Congestion Pricing

Source: Minnesota Department of Transportation

Transit Strategies

Transit services and infrastructure projects have traditionally been implemented in regions to provide an alternative to automobile travel potentially reducing peak-period congestion and improving mobility and accessibility for commuters. Table 2.9 presents the transit projects that may be applicable for the Kansas City region. These projects tend to reduce systemwide VMT in relatively small increments but do improve corridor and systemwide accessibility, improve roadway travel times, and decrease congestion on the roadway system: successful treatments can greatly increase the people transported within a given roadway (Figure 2.7). Transit Strategies are more effective when paired with effective transportation system management (TSM) in Transportation Operations and Management Strategies, pedestrian approaches in Active Transportation Strategies, and Land Use Strategies.

Figure 2.6 Impacting Congestion Through Mode Shift

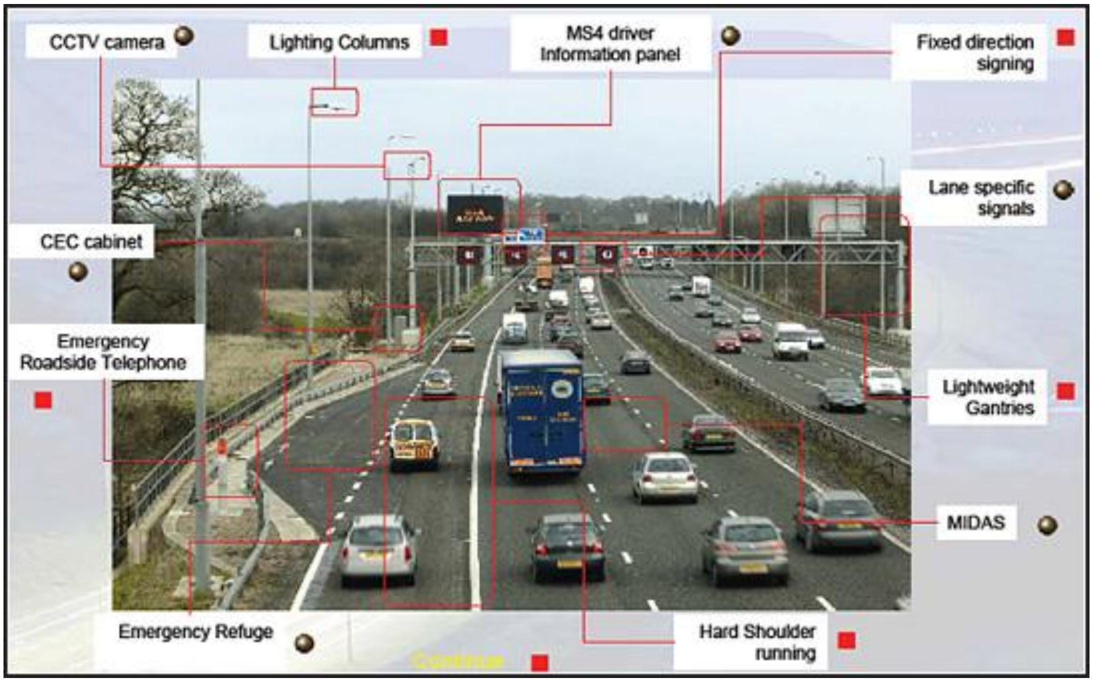


Source: City of Muenster Planning Office, 2001

Transportation Operations and Management

Intelligent transportation system (ITS) and transportation system management (TSM) strategies have traditionally focused on improving the operation of the transportation system without major capital investment and cost. While ITS strategies may be costly compared to more traditional TSM strategies, their relative congestion-reduction impacts can be significant. These strategies also tend to be complementary. Table 2.10 presents the ITS and TSM strategies that may be applicable for the Kansas City region. The strategies can build upon current ITS initiatives in the Kansas City region such as the Kansas City Scout Program and Operation Green Light.

Figure 2.7 Transportation Operations and Management: Sample Active Traffic Management Tools



Source: FHWA, ATDM Program Brief

Table 2.1 Summary of Congestion Management Strategies

Major Categories	Number of Strategies	Benefits	Costs	Examples
Access Management	10 strategies identified	Increase capacity, efficiency, and mobility, reduce travel time	Vary from low to high and include, design, implementation, and maintenance costs	Turn restrictions, turn lanes, frontage roads, roundabout intersections
Active Transportation	8 strategies outlines	Decrease auto mode share, reduce VMT, provide air quality benefits	Low to moderate	New sidewalks and bike lanes, improved facilities near transit stations, bike sharing, and exclusive rights of way
Highway	11 strategies identified	Increase capacity, mobility, and traffic flow	Vary from low to high depending on strategy. Constructing new ROW results in higher cost than design improvements.	HOV lanes, super street arterials, highway widening, acceleration and deceleration lanes, design improvements
Land Use	6 strategies identified	Decrease SOV trips, increase walk trips, increase transit mode share, air quality benefits	Low to moderate and involve establishing ordinances and may require economic incentives to encourage developer buy-in	Infill, TOD development, densification
Parking	8 strategies identified	Increase transit use, reduce VMT, generate revenue	Low to moderate but require economic incentives to encourage developer buy-in	Preferential parking for HOVs, park and ride lots, advanced parking systems
Regulatory	10 strategies identified	Decrease VMT, air quality benefits, increase safety, generate revenue	Vary	Carbon pricing, VMT fee, pay as you drive insurance, auto restriction zones, truck restrictions
TDM	10 strategies identified	Reduce peak period travel, reduce SOV VMT	Low to moderate	Alternative work hours, telecommuting, road pricing, toll roads
Transit	14 strategies identified	Shifting mode share, increasing transit ridership, reduce VMT, provide air quality benefits	Vary from low to high depending on strategy. Constructing new transit travelways is higher cost than improving service frequencies.	Increasing coverages and frequencies, new fixed guideway travelways, employer incentive programs, signal priority, intelligent transit stops (tech improvements)
Transportation Operations and Management	18 strategies identified	Reduce travel time, reduce stops, reduce delays, increase safety	Vary but tend to be low to moderate. Large scale projects involving new infrastructure and devices higher cost.	Signal coordination, ramp metering, highway information systems, service patrols

Table 2.2 Access Management Strategies

Strategies / Projects	Congestion and Mobility Benefits	Cost and Impacts	Implementation Timeframe	Analysis Method	Complementary Strategy	Other Toolbox Examples
Left Turn Restrictions; Curb Cut and Driveway Restrictions						
Turning vehicles can impede traffic flow and are more likely to be involved in crashes.	▪ Increase capacity, efficiency on arterials ▪ Improve mobility on facility ▪ Improve travel times and reduced delay for through traffic ▪ Fewer incidents	$ - $$ Implementation and maintenance costs vary; range from new signage and striping to more costly permanent median barriers and curbs.	Short-Term: 1 to 5 Years Includes planning, engineering, and construction.	▪ Localized Analysis	▪ Operations and Management	▪ NYMTC
Turn Lanes and New or Relocated Driveways and Exit Ramps						
In some situations, increasing or modifying access to a property can be more beneficial than reducing access.	▪ Increase capacity, efficiency ▪ Improve mobility and safety on facility ▪ Improve travel times and reduced delay for all traffic	$ - $$ Additional right-of-way costs, design, construction, and maintenance costs.	Short-Term: 1 to 5 Years Includes planning, engineering, and construction.	▪ Localized Analysis	▪ Operations and Management	▪ NYMTC
Interchange Modification						
Conversion of a full cloverleaf interchange to a partial cloverleaf, for example, reduces weaving sections on a freeway.	▪ Increase capacity, efficiency ▪ Improve mobility on facility ▪ Improve travel times and reduced delay for through traffic ▪ Fewer incidents due to fewer conflict points	$$ Design and construction costs.	Short-to Medium-Term: 1 to 10 Years Includes planning, engineering, and construction.	▪ IDAS ▪ Regional Travel Model ▪ Interchange Management System	▪ Operations and Management	▪ NYMTC
Minimum Intersection / Interchange Spacing						
Reduces number of conflict points and merging areas, which in turn reduces incidents and delays.	▪ Increase capacity, efficiency ▪ Improve mobility on facility ▪ Improve travel times and reduced delay for through traffic ▪ Fewer incidents	$ Part of design costs for new facilities and reconstruction projects.	Medium-Term: 5 to 10 Years Includes planning, engineering, and construction.	▪ Localized Analysis	▪ Operations and Management	▪ NYMTC
Frontage Roads and Collector-Distributor Roads						
Frontage roads can be used to direct local traffic to major intersections on both super arterials and freeways. Collector-distributor roads are used to separate exiting, merging, and weaving traffic from through traffic at closely spaced interchanges.	▪ Increase capacity, efficiency ▪ Improve mobility on facility ▪ Improve travel times and reduced delay for through traffic ▪ Fewer incidents due to fewer conflict points	$$$ Additional rights-of-way costs; design, construction, and maintenance costs.	Medium-Term: 5 to 10 Years Includes planning, engineering, and construction.	▪ IDAS ▪ Regional Travel Model	▪ Operations and Management	▪ NYMTC
Roadway Restrictions						
Closes access during rush hours (AM and PM peak hours) and aids in the increase of safety levels through the prevention of crashes at problem intersections. This measure may be effective along mainline segments of a highway, which operate at poor service levels.	▪ Increase capacity, efficiency on arterials ▪ Improve mobility on facility ▪ Improve travel times and decrease delay for through traffic ▪ Fewer incidents	$ - $$ Additional right-of-way costs, design, construction, and maintenance costs.	Short-Term: 1 to 5 Years Includes planning, engineering, and construction.	▪ Localized Analysis ▪ Simulation Model	▪ Operations and Management	▪ NYMTC
Access Control to Available Development Sites						
Coordination of access points to available development sites allows for less interference in traffic flow during construction and/or operation of new developments.	▪ Increase capacity, efficiency on arterials ▪ Improve mobility on facility ▪ Improve travel times and decrease delay for through traffic ▪ Fewer incidents	$ - $$ Additional right-of-way costs, design, construction, and maintenance costs.	Short-Term: 1 to 5 Years Includes planning, engineering, and construction.	▪ Localized Analysis ▪ Simulation Model	▪ Operations and Management	▪ NYMTC

Intersection Turn Lanes						
Additional left-turn or tight-turn lanes that sperate turning vehicles from through-traffic.	▪ Greater number of vehicles can pass through the intersection in given amount of time, resulting in a lower level of travel delays and stopped time ▪ Can reduce the likelihood of rear-end crashes	$ - $$ Depends on right-of-way needs.	<u>Medium-Term: 5 to 10 Years</u> Agencies must be sure to plan for possible time needed to obtain right-of-way.	▪ Localized Analysis	▪ Operations and Management	▪ DRCOG
Roundabout Intersections						
An intersection modification that does not use traffic signal or stop sign controls. Provides continuous movement via entrance and exit lanes to/from a typically circular distribution roadway.	▪ Greater capacity than traditional 3- or 4-way intersections in many situations ▪ Fewer crashes over time ▪ Lower air pollutant emissions due to fewer stopped vehicles	$$ Cost affected by the amount of right-of-way needed.	<u>Medium-Term: 5 to 10 Years</u> Completion time for a replacement roundabout is related to the amount of planning and public outreach time needed and the right-of-way acquisition process.	▪ Localized Analysis	▪ Access Management (for the approach roadways and adjacent properties should be done) ▪ Operation and Management	▪ DRCOG
New Grade-Separated Intersections						
An overpass or underpass for one roadway to avoid intersecting with a cross street.	▪ Increase capacity, efficiency on arterials ▪ Improve mobility on facility ▪ Improve travel times and decrease delay for through traffic ▪ Fewer incidents	$$$ Cost depends on the amount of right-of-way needed and the scale of construction impediments.	<u>Medium-to Long-Term: 5 to 10+ Years</u> Includes planning, engineering, and construction.	▪ Localized Analysis	▪ Operations and Management	▪ DRCOG

Table 2.3 Active Transportation

Strategies / Projects	Congestion and Mobility Benefits	Cost and Impacts	Implementation Timeframe	Analysis Method	Complementary Strategy	Other Toolbox Examples
New Pedestrian and Bicycle Facilities						
Enhancing the visibility of bicycle and pedestrian facilities increases actual and perceived safety. In many cases, bike lanes can be added to existing roadways through restriping. Use of bicycling and walking is often discouraged by a fragmentary, incomplete network of sidewalks and shared use facilities. Constructing new facilities, such as bike lanes (conventional / separated), shared use paths, and sidewalks will encourage greater use of walking and bicycling.	▪ Increase mobility and access ▪ Increase nonmotorized mode share ▪ Separate slow-moving bicycles from motorized vehicles ▪ Reduce incidents ▪ Increase safety	$ - $$ Implementation and maintenance costs vary; range from new signage and striping to more costly permanent median barriers and curbs.	Short-Term: 1 to 5 Years Includes planning, engineering, and construction.	▪ TDM Evaluation Model	▪ Land Use ▪ Other Active Transportation	▪ NYMTC ▪ MAG ▪ DRCOG
Improved Bicycle Facilities at Transit Stations and Other Trip Destinations						
Bicycle racks and bike lockers at transit stations and other trip destinations increase security. Additional amenities such as locker rooms with showers at workplaces provide further incentives for using bicycles.	▪ Increase bicycle mode share ▪ Reduce motorized vehicle congestion access routes	$ Capital and maintenance costs for bicycle racks and lockers, locker rooms.	Short-Term: 1 to 5 Years Includes planning, engineering, and construction.	▪ TDM Evaluation Model	▪ Land Use ▪ Transit ▪ Other Active Transportation	▪ NYMTC
Design Guidelines for Pedestrian-Oriented Development						
Maximum block lengths, building setback restrictions, and streetscape enhancements are examples of design guidelines that can be codified in zoning ordinances to encourage pedestrian activity.	▪ Increased pedestrian mode share ▪ Discourage motor vehicle use for short trips ▪ Reduce VMT ▪ Reduce emission	$ Capital costs largely borne by private sector; developer incentives may be necessary. Public sector may be responsible for some capital and/or maintenance costs associated with right-of-way improvements. Ordinance development and enforcement costs.	Short-Term: 1 to 10 Years	▪ TDM Evaluation Model ▪ Regional Travel Model	▪ Land Use ▪ Other Active Transportation	▪ NYMTC
Improved Safety of Existing Bicycle and Pedestrian Facilities						
Maintaining lighting, signage, striping, traffic control devices, and pavement quality, and installing curb cuts, curb extensions, median refuges, and raised crosswalks can increase bicycle and pedestrian safety.	▪ Increased nonmotorized mode share ▪ Reduce incidents	$ Increased monitoring and maintenance costs. Capital costs of sidewalk improvements and additional traffic control devices.	Short-Term: 1 to 5 Years	▪ TDM Evaluation Model ▪ Regional Travel Model	▪ Land Use ▪ Other Active Transportation	▪ NYMTC
Exclusive Non-Motorized Rights-of-Way						
Abandoned rail rights-of-way and existing parkland can be used for medium- to long distance bike trails, improving safety and reducing travel times.	▪ Increase mobility ▪ Increased nonmotorized mode share ▪ Reduce congestion on nearby roads ▪ Separate slow-moving bicycles from motorized vehicles ▪ Reduce incidents	$ - $$ Additional rights-of-way costs; construction, engineering, and maintenance costs.	Medium-Term: 5 to 10 Years Includes planning, engineering, and construction.	▪ TDM Evaluation Model ▪ Regional Travel Model	▪ Land Use ▪ Other Active Transportation	▪ DRCOG
Bike Sharing Programs						
Short-term bicycle rental program supported by a network of automated rental stations.	▪ Increased nonmotorized mode share ▪ Discourage motor vehicle use for short trips ▪ Reduce VMT	$ - $$ Capital and maintenance costs for bicycles and rental stations.	Short-Term: 1 to 5 Years		▪ Land Use ▪ Transit ▪ Other Active Transportation	▪ NYMTC

Promoting Bicycle and Pedestrian Use Through Education and Information Dissemination						
Bicycle and pedestrian use can be promoted through educational programs and through distribution of maps of bicycle facility/multi-use path maps. This may be supported by the public sector, but often could be employer-based.	▪ Increased nonmotorized mode share	$ First-year implementation costs for private-sector. Second-year costs tend to decline. Requires public agency support; requires interagency and private-sector coordination.	Short-Term: 1 to 5 Years	▪ EPA Commuter Model	▪ Land Use ▪ Other Active Transportation	▪ MAG
Adopting and Implementing a Complete Streets Policy						
Policy that takes into account all users of streets rather than just autos, with a goal of completing the streets with adequate facilities for all users. A "Complete Street" is one designed and operated to enable safe access for all users including pedestrians, bicyclists, motorists, and transit riders of all ages and abilities.	▪ Increase safety by improving the overall (pedestrian and bicycle) transportation system environment ▪ Reduce congestion ▪ Provide cost savings by reducing longer distance travel and increasing shorter distance travel ▪ Provide travel time savings to users of the system ▪ Increase access to and use of nonmotorized modes ▪ Protect natural environment through sound land use and transportation sustainability policies	$ Policy development. $ - $$ For implementation.	Short-Term: 1 to 5 Years Agencies must be sure to plan for possible time needed to obtain right-of-way.		▪ Land Use ▪ Transportation Demand Management ▪ Operations and Management ▪ Transit	▪ Oregon DOT

Table 2.4 Highway Strategies

Strategies / Projects	Congestion and Mobility Benefits	Cost and Impacts	Implementation Timeframe	Analysis Method	Complementary Strategy	Other Toolbox Examples
Increasing Number of Lanes without Highway Widening						
Takes advantage of "excess" width in the highway cross section used for breakdown lanes or median.	▪ Increase capacity ▪ Reduce congestion in the short-term; long-term effects on congestion depend on local conditions ▪ Reduce traffic and congestion on parallel roads	$ - $$ Capital costs depend on extent of modifications needed; maintenance costs increase.	Short-Term: 1 to 5 Years Includes planning, engineering, and construction.	▪ Regional Travel Model ▪ IDAS	▪ Operations and Management ▪ Active Transportation	▪ NYMTC
Geometric Design Improvements						
Includes widening to provide shoulders, additional turn lanes at intersections, improved sight lines, auxiliary lanes to improve merging and diverging. Interchange modifications to decrease weaving sections on a freeway, paved shoulders, and realignment of intersecting streets. Adding turning lanes or through lanes at an intersection, realignment of intersection streets, intersection channelization, or modifying intersection geometrics to improve overall efficiency and operation.	▪ Increase mobility ▪ Reduce congestion by improving bottlenecks ▪ Increase traffic flow and improve safety ▪ Decrease incidents due to fewer conflict points	$ - $$ Design, construction, operations, and maintenance costs vary by design type.	Short-Term: 1 to 5 Years Includes planning, engineering, and construction.	▪ Regional Travel Model	▪ Other Highway	▪ NYMTC ▪ MAG
HOV Lanes						
Increases corridor capacity while at the same time providing an incentive for single-occupant drivers to shift to ridesharing. These lanes are most effective as part of a comprehensive effort to encourage HOVs, including publicity, outreach, park- and-ride lots, and rideshare matching services.	▪ Reduce regional VMT and trips ▪ Increase vehicle occupancy / reduce SOV's ▪ Improve travel times ▪ Increase transit use and improve bus travel times	$$ - $$$ Costs depend on extent of additional right-of-way, barrier separation costs, operations, and enforcement.	Medium-Term: 5 to 10 Years Includes planning, engineering, and construction.	▪ IDAS ▪ Regional Travel Model ▪ TDM Evaluation Model	▪ Active Transportation ▪ BRT / Express Bus ▪ Congestion Pricing	▪ NYMTC ▪ DRCOG ▪ MAG ▪ SLC WFRC
Super Street Arterials						
Converting existing major arterials with signalized intersections into "super streets" that feature grade-separated intersections.	▪ Increase capacity ▪ Reduce congestion in the short-term; long-term effects on congestion depend on local conditions ▪ Reduce traffic and congestion on parallel roads	$$$ Construction and engineering substantial for grad separation.	Medium-Term: 5 to 10 Years Includes planning, engineering, and construction.	▪ Regional Travel Model	▪ Operations and Management ▪ Access Management	▪ NYMTC
Highway Widening by Adding Lanes						
Traditional adding of lanes by widening roadway surface.	▪ Increase capacity ▪ Reduce congestion in the short-term; long-term effects on congestion depend on local conditions ▪ Reduce traffic and congestion on parallel roads	$$$ Costs vary by type of highway constructed; can be more expensive in dense urban areas. Could create negative environmental and community impacts.	Long-Term: 10+ Years Includes planning, engineering, and construction.	▪ Regional Travel Model	▪ Operations and Management ▪ Access Management	▪ NYMTC ▪ MAG
Acceleration/Deceleration lanes						
Deceleration lane provided on a freeway just before an exit off- ramp allows vehicles to reduce speed outside the through- lanes. Acceleration lane provided as an extension of a freeway on- ramp or an arterial street turn-lane for vehicles to increase speed and merge more smoothly into the through-lane.	▪ Slower-moving turning or exiting vehicles are removed from through-lanes resulting in fewer delays for upstream traffic ▪ Accelerating vehicles are provided more distance to reach the speed of through traffic, resulting in fewer delays caused by merging and weaving vehicles ▪ Could greatly reduce delays (caused by braking) for upstream vehicles during peak traffic flow periods (in certain situations)	$ - $$ Costs relatively low if right-of-way or bridge widening is not required.	Medium-Term: 5 to 10 Years	▪ Regional Travel Model ▪ IDAS	▪ Hill Climbing Lanes	▪ DRCOG

Hill Climbing Lanes						
Additional lanes provided for a short distance to allow slower- moving vehicles (e.g., trucks and recreational vehicles) to move to the right and allow faster-moving vehicles to pass.	▪ Reduce travel time for vehicles on rural highways, especially those with peak levels of recreational traffic ▪ Safety benefits due to fewer frustrated drivers making dangerous passing maneuvers	$ - $$ Costs relatively low if right-of-way, major rock-cuts, or environmental mitigations are not required.	<u>Short-to Medium-Term: 1 to 10 Years</u> Shorter segments with o right-of-way needs could be done in the short-term.	▪ Simulation Model / HCM Software	▪ Acceleration / Deceleration Lanes	▪ DRCOG
Grade Separated Railroad Crossings						
Roadway underpass or overpass of a railroad line.	▪ Reduced travel delays at high volume locations ▪ Reduce vehicle-train incidents	$$$ Requires construction of either a bridge or tunnel.	<u>Medium-to Long-Term: 5 to 10+ Years</u> Implementation requires significant negotiation with railroads and local communities.	▪ Simulation Model	▪ Other Highway	▪ DRCOG
New Freeways						
Construction of new, access-controlled, high-capacity roadways in areas previously not served by freeways.	▪ Reduce congestion on arterial roadway network ▪ Reduce travel times and delay	$$$ Costs vary by type of highway constructed; can be more expensive in dense urban areas. Could create negative environmental and community impacts.	<u>Long-Term: 10+ Years</u> Includes planning, engineering, and construction.	▪ Regional Travel Model ▪ Simulation Model	▪ Operation and Management	▪ MAG
New Arterial Streets						
Construction of new, higher-capacity roads designed to carry large volumes of traffic between areas in urban settings.	▪ Provide connectivity ▪ Carry traffic from local and collectors roads to other areas ▪ Increase capacity ▪ Reduce congestion in the short-term; long-term effects on congestion depend on local conditions	$$ - $$$ Substantial construction and engineering costs; maintenance costs depend on urban region. Could create negative environmental and community impacts.	<u>Medium-Term: 5 to 10 Years</u> Includes planning, engineering, and construction.	▪ Regional Travel Model ▪ Simulation Model	▪ Operations and Management ▪ Access Management ▪ Transit, as appropriate	▪ MAG
New Collectors and Local Streets						
Construction of new roadway along separate right-of-way to serve newer developed or developing areas.	▪ Increase capacity to serve developing areas ▪ Reduce traffic and congestion on parallel roads due to vehicles diverted to the new road ▪ Increase access / connectivity to local destinations	$$ - $$$ Costs depend on right-of-way needed and the scale of construction impediments.	<u>Medium-Term: 5 to 10 Years</u> Includes planning, engineering, and construction.	▪ Regional Travel Model ▪ Simulation Model	▪ Land Use ▪ Access Management ▪ Transit, as appropriate	▪ DRCOG

Table 2.5 Land Use Strategies

Strategies / Projects	Congestion and Mobility Benefits	Cost and Impacts	Implementation Timeframe	Analysis Method	Complementary Strategy	Other Toolbox Examples
Mixed-Use Development						
Allows multiple land use types within a single development or district, rather than completely segregating land uses. It facilitates the reduction of trip length and increase of walking trips.	▪ Increase walk trips ▪ Decrease SOV trips ▪ Decrease VMT and vehicle hours of travel	$ - $$ Public costs to set up and monitor appropriate ordinances. Encourage developer buy-in with economic incentives. Regional savings in reduced new infrastructure development.	Short-to Long-Term: 1 to 10+ Years Requires supporting regulations and zoning for development to begin.	▪ Regional Travel Model ▪ TDM Evaluation Model	▪ Transit ▪ Active Transportation	▪ NYMTC
Infill and Densification						
Takes advantage of existing infrastructure by encouraging development on vacant or underused parcels in already developed areas; this avoids requiring new construction of infrastructure on the fringes of the urban area.	▪ Decrease SOV trips ▪ Increase transit, walk, and bicycle trips ▪ Decrease VMT and vehicle trips ▪ Air quality improvements	$ - $$ Public costs to set up and monitor appropriate ordinances. Encourage developer buy-in with economic incentives. Regional savings in reduced new infrastructure development.	Short-to Long-Term: 1 to 10+ Years Requires supporting regulations and zoning for development to begin.	▪ Regional Travel Model ▪ TDM Evaluation Model	▪ Transit ▪ Active Transportation	▪ NYMTC ▪ SLC WFRC
Transit-Oriented Development						
This clusters housing units and/or businesses near transit stations in walkable communities.	▪ Decrease SOV trips ▪ Increase transit trips ▪ Decrease VMT	$ - $$ Public costs to set up and monitor appropriate ordinances. Encourage developer buy-in with economic incentives. Regional savings in reduced new infrastructure development.	Short-to Long-Term: 1 to 10+ Years Requires supporting regulations and zoning for development to begin.	▪ Regional Travel Model ▪ TDM Evaluation Model	▪ Active Transportation ▪ Transit	▪ NYMTC ▪ MAG ▪ SLC WFRC
Trip Reduction Strategies						
Plans, policies, and regulations instituted to reduce the use of SOVs for commuting; often linked to air quality planning and employer based.	▪ Decrease SOV trips ▪ Increase transit trips and non-motorized mode share ▪ Decrease VMT	$ First-year implementation costs for private sector (per employee equipment). Second-year costs tend to decline. Requires interagency and private sector coordination.	Short-Term: 1 to 5 Years	▪ EPA Commuter Model	▪ Transit ▪ Active Transportation	▪ MAG
Transportation Management Associations						
Nonprofit, member-controlled organizations that provide transportation services in a particular area, such as a commercial district, mall, medical center, or industrial park. They are generally public-private partnerships consisting primarily of area businesses with local government support.	▪ Decrease SOV trips ▪ Increase transit trips and non-motorized mode share ▪ Decrease VMT	$ First-year implementation costs for private sector (per employee equipment). Second-year costs tend to decline. Requires interagency and private sector coordination.	Short-Term: 1 to 5 Years	▪ EPA Commuter Model	▪ Transit ▪ Active Transportation	▪ MAG
Last-Mile Delivery/Fulfillment Centers						
Last-mile delivery centers of micro-fulfilment centers (MFCs) allow inventory to be stored closer to customers. These centers speed up deliveries and can offer in-person pick-up of packages. Governments can support these centers by repurposing urban spaces for the development of MFCs.	▪ Reduce last-mile delivery emissions ▪ Decrease last-mile delivery traffic	$ Encourage developer buy-in with economic incentives. Requires interagency and private sector coordination. Costs for outreach and publicity to encourage customers to use greener methods when picking up packages from MFCs.	Short-to Medium-Term: 1 to 10 Years		▪ Active Transportation ▪ Other Land Use	

Table 2.6 Parking Strategies

Strategies / Projects	Congestion and Mobility Benefits	Cost and Impacts	Implementation Timeframe	Analysis Method	Complementary Strategy	Other Toolbox Examples
On-Street Parking and Standing Restrictions						
Enforcement of existing regulations can substantially improve traffic flow in urban areas. Peak-period parking prohibitions can free up extra general-purpose travel lanes or special use or HOV "diamond" lanes.	▪ Increase peak period capacity ▪ Reduce travel time and congestion on arterials ▪ Increase HOV and bus mode shares	$ Design, construction, and maintenance costs for signage and striping. Rigid enforcement of parking restrictions.	Short-Term: 1 to 5 Years Includes planning, engineering, and construction.	▪ Regional Travel Model ▪ IDAS	▪ Highway	▪ NYMTC
Employer/Landlord Parking Agreements						
Employers can negotiate leases so that they pay only for the number of spaces used by employees. In turn, employers can pass along parking savings by purchasing transit passes or reimbursing non-driving employees with the cash equivalent of a parking space.	▪ Reduce work VMT ▪ Increase non-motorized mode shares	$ Encourage employer and landlord buy-in with economic incentives.	Short-Term: 1 to 5 Years	▪ TDM Evaluation Model	▪ Transit	▪ NYMTC
Preferential or Free Parking for HOVs and Parking Management						
Strategies include reducing the availability of free parking spaces, particularly in congested areas, or providing preferential or free parking for HOVs. This provides an incentive for workers to carpool. A strategy could include a downtown employee parking payroll tax (e.g., all downtown workers pay for parking, $5/day average for users not already paying). Other strategies include dynamic pricing, higher fees on free parking lots, parking permits (see strategies above for Parking Pricing).	▪ Reduce work VMT ▪ Increase vehicle occupancy / reduce SOV's	$ Costs primarily borne by the private sector; include signing, striping, and administrative costs.	Short-Term: 1 to 5 Years Depends on political factors.	▪ TDM Evaluation Model	▪ Land Use ▪ Transportation Demand Management ▪ Operations and Management ▪ Transit ▪ Active Transportation	▪ NYMTC ▪ Oregon DOT
Location-Specific Parking Ordinances						
Parking requirements can be adjusted for factors such as availability of transit, a mix of land uses, or pedestrian-oriented development that may reduce the need for on-site parking. This encourages transit-oriented and mixed-use development.	▪ Increase transit and non-motorized mode shares ▪ Reduce VMT	$ Encourage developer buy-in with economic incentives.	Short-Term: 1 to 5 Years Depends on political factors.	▪ Regional Travel Model ▪ TDM Evaluation Model	▪ Transit ▪ Land Use ▪ Active Transportation	▪ NYMTC
Park and Ride Lots						
Park-and-Ride lots provide parking in areas that are convenient to other modes of transportation, and are commonly located adjacent to train stations, bus lines, or HOV lane facilities.	▪ Increase transit use and ridesharing ▪ Reduce VMT	$ - $$ Land acquisition, construction and maintenance are necessary for park-and-ride lots.	Short-Term: 1 to 5 Years		▪ Transit	▪ NYMTC
Advanced Parking Systems						
Helps drivers find or reserve parking using real-time information about the status of parking availability.	▪ Reduce congestion on local streets ▪ Some peak-period travel and shift to non-motorized modes	$ - $$ Costs vary based on system complexity.	Short-Term: 1 to 5 Years		▪ Transit	▪ NYMTC
Local and Regional Excise Taxes						
A flat fee-per-space on parking spaces provided by businesses designed to discourage automobile-dependent development, encourage more efficient land use, and - to the extent the fees are passed on to parkers - encourage non-motorized and transit choices. The revenue generated by such a tax (on parking spaces, not their use) could be used for transit and other transportation investments not eligible for highway dollars.	▪ Generate revenue to maintain system and address transportation improvements region-wide ▪ Increase non-motorized mode shares ▪ Reduce congestion	$	Short-Term: 1 to 5 Years Depends on political factors.		▪ Land Use ▪ Transportation Demand Management ▪ Operations and Management ▪ Active Transportation ▪ Transit	▪ Oregon DOT

Parking Facility Management Information Signs						
Signage to notify travelers of the remaining number of unoccupied parking spaces at a public (e.g., park-and-ride) or private parking lot, guiding them to available parking.	▪ Decrease travel delay and travel miles ▪ Improve convenience of transit; if used at park-and-ride lots	$ Simple parking management can cost as low as $20,000, whereas more sophisticated programs can exceed $250,000 (cost and implementation).	Short-Term: 1 to 5 Years		▪ Transit ▪ Operations and Management	▪ DRCOG

Table 2.7 Regulatory Strategies

Strategies / Projects	Congestion and Mobility Benefits	Cost and Impacts	Implementation Timeframe	Analysis Method	Complementary Strategy	Other Toolbox Examples
Trip Reduction Ordinance						
Draws commuters to use other ways to travel to work besides driving alone. Requires employers to promote commute alternatives.	▪ Improve air quality ▪ Reduce congestion ▪ Minimize energy consumption	$	Short-Term: 1 to 5 Years		▪ Transit ▪ Active Transportation ▪ Transportation Demand Management	▪ NYMTC
Congestion Pricing						
Controls peak-period use of transportation facilities by charging more for peak-period use than for off-peak. Congestion pricing fees are charged to drivers using congested roadways during specific times of the day. This strategy is evaluated in order to maintain a specific level of service on a given road or all roads (areawide systems) in a region. For example, an average fee of $0.65 cents/mile could be applied to 29 percent of urban and 7 percent of rural vehicle miles traveled (VMT) to better manage travel demand and the resulting congestion for a roadway.	▪ Increase transit and non-motorized mode shares ▪ Decrease VMT	$ - $$ Implementation and maintenance costs vary.	Medium-Term: 5 to 10 Years		▪ Land Use ▪ Operations and Management ▪ Transit ▪ Transportation Demand Management	▪ NYMTC ▪ Oregon DOT
Auto Restriction Zones (Pedestrian Malls)						
The most common form of an auto-restriction zone (pedestrian zones) in large cities is the pedestrian mall. Pedestrian malls generally consist of a storefront-lined street that is closed off to most automobile traffic. Emergency vehicles always have access, while delivery vehicles may be restricted to limited delivery hours or entrances on adjacent back streets. Provides commercial access for pedestrians and non-car users.	▪ Increase capacity ▪ Decrease travel times ▪ Increase safety ▪ Improve bicycle and pedestrian friendly roadways	$ - $$ Design, construction, and maintenance costs.	Short-to Medium- Term: 1 to 10 Years		▪ Active Transportation	▪ NYMTC
Truck Restrictions						
Aims to separate trucks from passenger vehicles and pedestrians. Prohibits trucks from traveling on certain roadways and may call for weight restrictions on certain bridges.	▪ Increase capacity ▪ Decrease travel times ▪ Increase safety ▪ Improve bicycle and pedestrian friendly roadways	$ Implementation and maintenance costs vary.	Short-Term: 1 to 5 Years			▪ NYMTC
Arterial Access Management						
Involves the application of local and state planning, and regulatory tools in efforts to preserve and/or enhance the transportation functions of roadways. Includes land use ordinances and techniques, corridor preservation, transportation improvements, and techniques in finance. Actual implementation of physical access management improvements are in Table 4.2 above.	▪ Increase capacity ▪ Decrease travel times ▪ Increase safety ▪ Improve bicycle and pedestrian friendly roadways	$ Implementation and maintenance costs vary.	Medium-Term: 5 to 10 Years		▪ Operations and Management ▪ Land Use ▪ Access Management	▪ NYMTC

Carbon Pricing /Motor Fuel Tax						
Carbon pricing considers an economy wide or system strategy set either as a fuel tax or as a result of a cap-and-trade system. Motor fuel taxes, currently the primary source of revenue for highways, would increase to higher levels to generate more revenue for highways. Very high levels of either carbon prices or motor fuel taxes may affect fuel efficiency or fuel types, as well as travel demand. Carbon pricing strategies, while not implemented, consider: ▪ Environmental levy on the carbon content of fuels; and ▪ Dedicated fuel consumption tax to support development and maintenance of new and existing transportation systems. State DOTs with federal (U.S. DOT, FHWA) agency support have been assessing the potential for implementing carbon pricing strategies. An example pricing strategy could include an allowance price of $30-50 per ton in 2030, or similar carbon tax.	▪ Generate revenue to maintain the system and to address transportation improvements region-wide ▪ Reduce congestion on corridors and throughout the system ▪ Provide incentive to use transit, bike, and/or walk	$	<u>Long-Term: 10+ Years</u>		▪ Land Use ▪ Transportation Demand Management ▪ Operations and Management ▪ Transit ▪ Active Transportation	▪ Oregon DOT
Emission-Based Vehicle Registration Fees						
Fees are levied based on the carbon dioxide emission levels of a car while it is operating.	▪ Generate revenue to maintain the system and to address transportation improvements region-wide ▪ Reduce congestion on corridors and throughout the system ▪ Provide incentive to use transit, bike, and/or walk ▪ Provide incentive to purchase and use efficient vehicles	$	<u>Medium-Term: 5 to 10 Years</u>		▪ Land Use ▪ Transportation Demand Management ▪ Operations and Management ▪ Transit	▪ Oregon DOT
Vehicle Miles Travelled (VMT) Fee						
A VMT Fee is charged based on how many miles a car is driven. Odometer readings determine the exact fee charged. A city or county could modify the structure of the fee to include a carbon fee (see Carbon Pricing/Motor Fuel Tax). VMT fees can be layered to be higher or lower based on the fuel economy of cars and layered based on urban and rural usage. Specific VMT fees of 2 to 5 cents per mile have been tested. VMT Fees consider distance-traveled charges levied to users based on the amount a vehicle uses a road system, while Congestion Pricing/Road User fees are levied to system users during congested periods of the day.	▪ Generate revenue to maintain the system and to address transportation improvements region-wide ▪ Reduce congestion on corridors and throughout the system ▪ Provide incentive to use transit, bike, and/or walk ▪ Provide incentive to purchase and use efficient vehicles	$	<u>Medium-Term: 5 to 10 Years</u>		▪ Land Use ▪ Transportation Demand Management ▪ Operations and Management ▪ Transit	▪ Oregon DOT
Traffic Impact Fee						
A charge on new development to cover the full cost of the additional transportation capacity, including transit, required to serve the development. While fee strategies may vary, in most cases, only those new developments that result in an increase in vehicle trips would be charged. Traffic impact fees can be structured as a single fee for the entire region, multiple fees for individual geographic areas, or multiple fees for specific corridors. Traffic impact fees vary based on the expected new development impact on the transportation system and are often structured with lower fees for developments that promote mixed use development, reduce single occupant vehicle use, and encourage transit and non-motorized travel use.	▪ Generate revenue to maintain the system and to address transportation improvements region-wide ▪ Provide incentive to purchase and use efficient vehicles	$	<u>Short-Term: 1 to 5 Years</u>		▪ Land Use ▪ Transportation Demand Management ▪ Operations and Management ▪ Transit ▪ Active Transportation	▪ Oregon DOT
Pay-As-You-Drive (PAYD) Insurance (State Level)						
PAYD insurance considers charging drivers insurance premium costs based in part on annual vehicle miles travelled. Other insurance rating factors still apply to insurance rates, so high risk drivers pay more than lower risk drivers. All drivers have the opportunity to save money (reduced insurance fees) by driving fewer miles. The state could require insurance companies to offer PAYD insurance at lower rates and require companies to offer higher rates to encourage fewer vehicle miles travelled.	▪ Promote transit, biking, and walking ▪ Reduce congestion in corridors and on transportation system	$	<u>Short-Term: 1 to 5 Years</u>			▪ Oregon DOT

Table 2.8 Transportation Demand Management (TDM) Strategies

Strategies / Projects	Congestion and Mobility Benefits	Cost and Impacts	Implementation Timeframe	Analysis Method	Complementary Strategy	Other Toolbox Examples
Alternative Work Hours						
Allows workers to arrive and leave work outside of the traditional commute period. It can be on a scheduled basis or a true flex-time arrangement. Can also include a compressed work week.	▪ Improve travel time ▪ Reduce peak period VMT ▪ Reduce peak period SOV trips	$ No capital costs. Agency costs for outreach and publicity. Employer costs associated with accommodating alternative work schedules.	Short-Term: 1 to 5 Years	▪ Regional Travel Model ▪ TDM Evaluation Model	Other Transportation Demand Management	▪ NYMTC ▪ MAG
Telecommuting						
Involves employees to work at home or regional telecommuting center instead of going into the office. They might do this all the time, or only one or more days per week. Also include teleconferencing and videoconferencing: the live exchange of information among several persons and machines linked by telecommunications; includes telephone conferencing and videoconferencing.	▪ Reduce SOV trips ▪ Reduce VMT ▪ Decrease commuting costs	$ First year implementation costs for employee equipment from private sector. Costs tend to decline in second year.	Short-Term: 1 to 5 Years	▪ Regional Travel Model ▪ TDM Evaluation Model	▪ Other Transportation Demand Management	▪ NYMTC ▪ DRCOG ▪ MAG ▪ SLC WFRC
Ridesharing						
This is typically arranged/encouraged through employers or transportation management agencies (TMA), which provides ride-matching services. Programs to promote carpooling and vanpooling, including ridematching services and policies that give ridesharing vehicles priority in traffic and parking.	▪ Reduce work VMT ▪ Reduce SOV trips ▪ Decrease commuting costs	$ Administrative costs. Costs per year per free parking space provided.	Short-Term: 1 to 5 Years	▪ Regional Travel Model ▪ TDM Evaluation Model	▪ Active Transportation ▪ Transit ▪ Highway ▪ Other Transportation Demand Management	▪ NYMTC ▪ DRCOG ▪ MAG ▪ SLC WFRC
Guaranteed Ride Home Policies						
Provides a guaranteed ride home at no cost to the employee in the event an employee or a member of their immediate family becomes ill or injured, requiring the employee to leave work.	▪ Reduce work VMT ▪ Reduce SOV trips	$ Costs vary; requires administrative support from employers.	Short-Term: 1 to 5 Years		▪ Active Transportation ▪ Transit ▪ Other Transportation Demand Management	▪ NYMTC
Alternative Travel Mode Events and Assistance						
A variety of events that promote, encourage and educate people about alternative travel modes (e.g., Bike to Work Day, RideSmart Thursdays and employer transportation fairs). Can include programs that provide free or low-cost transit services (e.g., EcoPass) or other incentives.	▪ Reduce SOV trips ▪ Decrease commuting costs	$ Costs vary; depends on the level of participation from employers and sponsors	Short-Term: 1 to 5 Years		▪ Active Transportation ▪ Transit ▪ Highway ▪ Other Transportation Demand Management	▪ DRCOG
Public Education Campaigns						
Education related to driving habits, trip chaining, idle reduction, jackrabbit starts, Clean the Air Challenges, and others.	▪ Various, depending on campaign	$	Short-Term: 1 to 5 Years		▪ Highway ▪ Other Transportation Demand Management ▪ Transit ▪ Active Transportation	▪ SLC WFRC

Traditional Toll Roads						
Payment charged for passage on roads, bridges or ferries that carry cars. Primary use as a revenue generator to help pay for building new facilities and maintaining infrastructure. Often associated with bonding for infrastructure.	▪ Reduce SOV trips ▪ Reduce trips ▪ Generate revenue to maintain the system and to address transportation improvements region-wide	$$$ High capital costs for construction of new facility; lower costs if converting an existing facility. Operating and maintenance costs may partially be recovered through toll revenue.	Medium-to Long-Term: 5 to 10+ Years	▪ Regional Travel Model ▪ TDM Evaluation Model	▪ Operations and Management	▪ Oregon DOT
Non-Traditional Toll Roads						
Usually these roads, or portions of roads, are referred to as "Managed Lanes" – A toll lane or lanes designed to increase freeway efficiency through a combination of operational and design actions. This may include High Occupancy Vehicle (HOV) toll (HOT) lanes that allow a limited number of low- occupancy vehicles to use the lane if a fee is paid.	▪ Reduce SOV trips ▪ Increase reliability ▪ Shift traffic to off-peak period times ▪ Generate revenue to maintain the system and to address transportation improvements region-wide	$$$ High capital costs for construction of new facility; lower costs if converting an existing facility. Operating and maintenance costs may partially be recovered through toll revenue.	Medium-to Long-Term: 5 to 10+ Years	▪ Regional Travel Model	▪ Operations and Management ▪ Transit	▪ Oregon DOT
Car Sharing						
Program in which automobile rental services are used to substitute private vehicle use and ownership. Programs are designed to be accessible to residences, affordable, follow easy check-in/out processes, and reliable. Peer to peer car sharing, also known as Personal Vehicle Car-Sharing (PVCS) enables private car owners to make their vehicle available on a temporary basis to a private carsharing company for rental. In return, the vehicle owner gets a substantial portion of the rental revenue from the carsharing company. When not rented, the vehicle owner can continue to use their car as before. Commercial Car Sharing, run by private firms, maintain a fleet of vehicles that are deployed regionally (neighborhoods) for rental and use.	▪ May increase non-motorized mode share ▪ Provide cost savings to users	$$$ Costs may be privately funded. Revenues may recover costs over time.	Short-to Medium-Term: 1 to 10 Years Implementation time depends on the level of service changes and magnitude of project.		▪ Land Use ▪ Transportation Demand Management ▪ Transit ▪ Active Transportation	▪ Oregon DOT
Alternative Truck Freight Delivery Hours						
Urban businesses schedule freight truck delivery hours in the evening off-peak hours. This strategy reduces large truck freights from traveling through and parking in denser urban areas during peak business hours.	▪ Reduce peak period congestion in urban areas ▪ Decrease fuel consumption	$ Depending on surrounding land uses potential need to mitigate noises that may bother neighbors.	Short-Term: 1 to 5 Years			

Table 2.9 Transit Strategies

Strategies / Projects	Congestion and Mobility Benefits	Cost and Impacts	Implementation Timeframe	Analysis Method	Complementary Strategy	Other Toolbox Examples
Reducing Transit Fares						
Encourages additional transit use, to the extent that high fares are a barrier to transit.	▪ Increase transit ridership ▪ Reduce VMT ▪ Reduce congestion	$ - $$ Total operating costs may increase if ridership increases. Operating subsidies needed to replace lost fare revenues.	Short-Term: 1 to 5 Years	▪ Regional Travel Model ▪ TDM Evaluation Model	▪ Land Use ▪ Other Transit	▪ NYMTC
Increasing Bus Route Coverage / Frequencies						
Provides better accessibility to transit to a greater share of the population. Increasing frequency makes transit more attractive to use. May require investment in new buses which would create a capital cost per passenger trip. May also include new routes or extensions to existing routes.	▪ Increase transit ridership ▪ Reduce VMT ▪ Decrease travel time ▪ Improve convenience and travel reliability ▪ Reduce traffic congestions due to trips switching from driving to taking transit	$ - $$ Likely requires new bus purchases; increased operating costs.	Short-Term: 1 to 5 Years Includes planning, engineering, and construction.	▪ Regional Travel Model ▪ TDM Evaluation Model	▪ Other Transit ▪ Land Use	▪ NYMTC ▪ DRCOG ▪ MAG
Park-and-Ride Lots						
Provides a location for individuals to park their vehicles to join carpools or access transit. Can be used in conjunction with HOV lanes and/or express bus services. They are particularly helpful for encouraging HOV use for longer distance commute trips.	▪ Reduce regional VMT ▪ Reduce SOV trips ▪ Increase mobility and transit efficiency ▪ Increase transit boardings and mode share ▪ Decrease congestion	$ - $$ Costs for transit stations and land acquisition.	Medium-Term: 5 to 10 Years Includes planning, engineering, and construction.	▪ Regional Travel Model ▪ TDM Evaluation Model	▪ Active Transportation ▪ Other Transit ▪ Highway	▪ SLC WFRC
Light, Heavy, and Commuter Rail						
Exclusive guideways (e.g., light rail, heavy/commuter rail) and street travelways (e.g., 16th Street Mall, bus rapid transit (BRT)) devoted to increasing the person-carrying capacity within a travel corridor.	▪ Reduce VMT ▪ Reliable (and sometimes faster than driving) travel times ▪ Reduce SOV trips ▪ Increase person throughput capacity within a corridor due to people switching from SOV to transit ▪ Encourages efficient mixed-use or higher-density development	$ - $$ Costs vary; could be high due to right-of-way acquisition, materials, and infrastructure. New systems require large upfront capital and ongoing operation costs.	Medium-to Long-Term: 5 to 10+ Years A rail project is a major undertaking that can take 10 plus years from initial planning phases, through NEPA studies, to opening day.	▪ Regional Travel Model	▪ Active Transportation ▪ Other Transit ▪ Land Use ▪ Highway ▪ Transportation Demand Management	▪ DRCOG ▪ MAG
Employer Incentive Programs						
Encourages additional transit use through transit subsidies of mass transit fares provided by employers.	▪ Increase transit ridership ▪ Decrease travel time ▪ Reduce VMT	$ - $$ Costs for employers to offer incentives to employee benefits for transit use.	Short-Term: 1 to 5 Years		▪ Other Transit ▪ Transportation Demand Management	▪ NYMTC
Electronic Payment Systems and Universal Farecards						
Equipment that allows riders to electronically pay a transit fare by using credit, debit and magnetic fare cards. Interchangeable smartcard payment system (including RFID) can be used as a fare payment method for multiple transit agencies throughout the region.	▪ Increase transit ridership ▪ Decrease travel time ▪ Decrease operating costs	$$ - $$$ Costs to implement electronic fare collection equipment can be high; costs vary based on system design, functionality, and technology. An initial surge in the maintenance and repair of electronic fare equipment can be expected due to the need for highly trained personnel.	Short-Term: 1 to 5 Years		▪ Other Transit	▪ NYMTC ▪ DRCOG

Realigned Transit Service Schedules and Stop Locations						
Service adjustments to better align transit service with ridership markets.	▪ Increase transit ridership ▪ Reduce VMT	$	Short-Term: 1 to 5 Years	▪ Regional Travel Model	▪ Other Transit	▪ NYMTC
Intelligent Transit Stops						
Ranges from kiosks, which show static transit schedules, to real-time information on schedules, locations of transit vehicles, arrival time of the vehicle, and alternative routes and modes.	▪ Reduce VMT ▪ Increase transit ridership ▪ Decrease congestion	$ - $$ Capital and operating costs for new infrastructure and technology.	Medium-Term: 5 to 10 Years Includes planning, engineering, and construction.		▪ Other Transit	▪ NYMTC
Transit Intersection Queue Jump Lanes and Signal Priority						
Additional travel lane at a signalized intersection that allows buses to proceed via their own "green time" before other vehicles. Done by restriping within existing road footprint or may require construction.	▪ Reduce bus travel delays and improve reliability ▪ Improved operational efficiency of transit service ▪ Increase transit ridership ▪ Safer driving conditions for all road users	$ - $$ Implementation costs vary based on system design, functionality, and type of equipment. Higher costs for constructing a new designated transit lane. Installation and operation costs of equipment is low.	Short-Term: 1 to 5 Years Planning, engineering, and implementation can reasonably completed in less than one year; longer time is needed if new lane must be constructed.	▪ Localized Analysis ▪ Simulation Model	▪ Highway ▪ Other Transit	▪ DRCOG ▪ NYMTC
Enhanced Transit Amenities						
Includes vehicle replacement/upgrades and better shelters or stations, which furthers the benefits of increased transit use.	▪ Reduce VMT ▪ Decrease congestion ▪ Increase transit ridership	$ - $$	Short-Term: 1 to 5 Years Includes planning, engineering, and construction.		▪ Other Transit	▪ NYMTC
Dedicated Rights-of-Way for Transit						
Reserved travel lanes or rights-of-way for transit operations, including use of shoulders during peak periods.	▪ Decrease travel time ▪ Increase transit ridership	$ - $$	Medium-Term: 5 to 10 Years Includes planning, engineering, and construction.	▪ Simulation Model	▪ Highway ▪ Other Transit	▪ NYMTC
Bus Rapid Transit (BRT)						
High-capacity, highly efficient bus service designed to compete with rail in terms of quality of service.	▪ Reduce VMT ▪ Reduce SOV trips ▪ Increase transit ridership and mode share	$$ - $$$	Long-Term: 10+ Years Includes planning, engineering, and construction.	▪ Regional Travel Model ▪ EPA Commuter Model	▪ Highway ▪ Other Transit ▪ Operations and Management	▪ MAG
Express Bus Service						
Bus service with high-speed operations, usually between two commuter points.	▪ Reduce VMT ▪ Reduce SOV trips ▪ Increase transit ridership and mode share	$ - $$	Short-Term: 1 to 5 Years Includes planning, engineering, and construction.	▪ Regional Travel Model ▪ EPA Commuter Model	▪ Other Transit ▪ Operations and Management	▪ MAG
Local Circulator						
Fixed-route service within an activity area, such as a CBD or campus, designed to reduce short trips by car.	▪ Reduce VMT ▪ Reduce SOV trips ▪ Increase transit ridership and boardings	$ - $$ May require purchase of new buses.	Short-Term: 1 to 5 Years Includes planning, engineering, and construction.	▪ Regional Travel Model ▪ EPA Commuter Model	▪ Other Transit	▪ MAG

Table 2.10 Transportation Operations and Management Strategies

Strategies / Projects	Congestion and Mobility Benefits	Cost and Impacts	Implementation Timeframe	Analysis Method	Complementary Strategy	Other Toolbox Examples
Traffic Signal Coordination and Modernization						
Improves traffic flow and reduces emissions by minimizing stops on arterial streets. Enhancements to timing/coordination plans and equipment to improve traffic flow and decrease the number of vehicle stops. May include: ▪ Modern technology that provides for real-time traffic and transit management ▪ Equipment that may permit immediate knowledge of malfunctions ▪ Responsive control that allows traffic signals to alter timing in response to immediate traffic flow conditions, rather than at predetermined times ▪ Transit signal priority system that can extend "green-time" a few seconds to allow buses to progress through an intersection	▪ Improve travel times ▪ Reduced number of stops ▪ Reduce VMT ▪ Reduce vehicle hours travelled ▪ Reduce air pollution and fuel consumption	$ - $$ Varied depending on required equipment. Costs include initial investment of equipment, software, communication network and connections, and O&M costs per signal.	Short-Term: 1 to 5 Years Includes planning, engineering, and construction.	▪ Regional Travel Model ▪ Microsimulation Model ▪ TOPS-BC	▪ Transit ▪ Other Operations and Management	▪ NYMTC ▪ DRCOG ▪ MAG ▪ SLC WFRC
Reversible Traffic Lanes						
These are appropriate where traffic flow is highly directional. Can entail a variety of different types of movable barriers, signage, and signaling.	▪ Increase peak direction capacity ▪ Reduce peak travel times ▪ Decrease vehicle hours traveled	$$ - $$$ Costs depend on barrier separation type and operation per mile.	Short-Term: 1 to 5 Years	▪ Regional Travel Model ▪ Microsimulation Model	▪ Other Operations and Management	▪ NYMTC
Freeway Incident Detection and Management Systems						
This is an effective way to alleviate non-recurring congestion. Systems typically include video monitoring, dispatch systems, and sometimes roving service patrol vehicles.	▪ Reduce accident delay ▪ Reduce travel time ▪ Decrease vehicle hours traveled	$$ - $$$ Annual operating and maintenance costs.	Medium-to Long-Term: 5 to 10+ Years	▪ Regional Travel Model	▪ Other Operations and Management	▪ NYMTC ▪ DRCOG
Ramp Metering						
Allows freeways to operate at their optimal flow rates, thereby speeding travel and reducing collisions. May include bus or high-occupancy vehicle bypass lanes. May require ramp widening to avoid extensive vehicle queuing.	▪ Decrease travel time ▪ Decrease crashes related to merging and weaving ▪ Improve traffic flow	$$ Costs vary; potential significant costs associated with enhancements to centralized control system. Annual operating and maintenance costs.	Medium-Term: 5 to 10 Years	▪ Regional Travel Model ▪ TOPS-BC ▪ Freeval ▪ Microsimulation	▪ Other Operations and Management	▪ DRCOG ▪ MAG ▪ NYMTC
Highway Information Systems						
These systems provide travelers with real-time information that can be used to make trip and route choice decisions.	▪ Some shift from peak-period travel to off-peak ▪ Reduce travel times ▪ Reduce travel delay	$$ Capital, operating, and maintenance costs.	Medium -Term: 5 to 10 Years	▪ Regional Travel Model ▪ TOPS-BC ▪ User Surveys	▪ Other Operations and Management	▪ MARC
Advanced Traveler Information Systems						
This provides an extensive amount of data to travelers, such as real time speed estimates on the web or over wireless devices, and transit vehicle schedule progress. Provides travelers with real-time information that can be used to make trip and route choice decisions. Information accessible on the web, dynamic message signs, 511 systems, Highway Advisory Radio (HAR), or handheld wireless devices.	▪ Some shift from peak-period travel to off-peak ▪ Reduce travel times ▪ Reduce travel delay	$$ Capital, operating, and maintenance costs. Private sector data available for purchase.	Medium -Term: 5 to 10 Years	▪ Regional Travel Model ▪ TOPS-BC ▪ User Surveys	▪ Other Operations and Management	▪ NYMTC ▪ DRCOG ▪ MAG
Service Patrols						
Service vehicles patrol heavily traveled segments and congested sections of the freeways that are prone to incidents to provide faster and anticipatory responses to traffic incidents and disabled vehicles.	▪ Reduce incident duration time ▪ Reduce full freeway capacity ▪ Reduce the risks of secondary crashes to motorists	$ - $$ Costs vary based on number of vehicles used by the patrol, number of routes that the patrol operates, and the population of the area in which the program operates.	Short-Term: 1 to 5 Years	▪ Regional Travel Model ▪ TOPS-BC	▪ Other Operations and Management	▪ NYMTC ▪ DRCOG

Restricting Turns at Key Intersections						
Limits turning vehicles, which can impede traffic flow and are more likely to be involved in crashes.	▪ Improve mobility ▪ Increase capacity / efficiency on arterials ▪ Decrease traffic delay ▪ Improve travel times ▪ Decrease incidents	$ Implementation and maintenance costs vary; range from new signage and striping to more costly permanent median barriers and curbs.	Short-Term: 1 to 5 Years Includes planning, engineering, and construction.	▪ Localized Analysis		▪ NYMTC
Converting Streets to One-Way Operations						
Establishes pairs of one-way streets in place of two-way operations. Most effective in downtown or very heavily congested areas.	▪ Increase traffic flow	$ Conversion costs include adjustments to traffic signals, striping, signing, and parking meters.	Short-Term: 1 to 5 Years Includes planning, engineering, and construction.	▪ Regional Travel Model ▪ Microsimulation Model		▪ NYMTC
Targeted and Sustained Enforcement of Traffic Regulations						
Improves traffic flow by reducing violations that cause delays; Includes automated enforcement (e.g., red light cameras).	▪ Improve travel times ▪ Decrease the number of stops	$ Increased labor costs per officer.	Short-Term: 1 to 5 Years	▪ TOPS-BC ▪ Microsimulation Model		▪ NYMTC
Special Events and Work Zone Management						
Includes a suite of strategies including temporary traffic control, public awareness and motorist information, and traffic operations.	▪ Decrease traffic delays ▪ Improve mobility ▪ Maintain access for businesses and residents	$ - $$	Short-Term: 1 to 5 Years	▪ TOPS-BC ▪ Microsimulation Model		▪ NYMTC
Road Weather Management						
Identifying weather and road surface problems and rapidly targeting responses including advisory information, control measures, and treatment strategies.	▪ Increase safety ▪ Improve mobility	$ - $$	Short-Term: 1 to 5 Years	▪ Maintenance Decision Support System (MDSS) Software		▪ NYMTC
Traffic Surveillance and Control Systems						
Often housed within a Traffic Management Center (TMC), monitors volume and flow of traffic by a system of sensors, and further analyzes traffic conditions to flag developing problems, and implement adjustments to traffic signal timing sequences, in order to optimize traffic flow estimating traffic parameters in real-time. Currently, the dominant technology traffic surveillance is that of magnetic loop detectors, which are buried underneath roadways and count automobiles passing over them. Video monitoring systems for traffic surveillance may provide vehicle classifications, travel times, lane changes, rapid accelerations or decelerations, and length queues at urban intersections, in addition to vehicle counts and speeds.	▪ Decrease travel times ▪ Decrease travel delay ▪ Some peak-period travel and mode shift	$$ Installation of video surveillance cameras may be less expensive than magnetic loop detectors, which require disruption and digging of the road surface.	Medium-Term: 5 to 10 Years	▪ Regional Travel Model ▪ TOPS-BC		▪ NYMTC
Electronic Toll Collection (ETC)						
Equipment that electronically collects tolls from users without requiring vehicles to stop at a toll booth.	▪ Fewer vehicle stops and less traveler delay at toll stations ▪ Cost savings due to no (or fewer) toll booth facilities or lanes ▪ Decrease in pollutant emissions from stop-and-go traffic at toll booths/plazas	$$ - $$$ Initial investment in electronic toll collection technology can be substantial, for overhead transponder readers, surveillance and enforcement equipment; estimated annual maintenance and operational costs for an electronic toll lane are less than $20,000, whereas a staffed toll booth lane can cost nearly $200,000 annually.	Short-to Medium-Term: 1 to 10 Years Physical implementation of electronic toll collection equipment can be completed in a short time period, unless additional right-of-way is needed.	▪ Regional Travel Model	▪ Transit ▪ Highway	▪ DRCOG

Cordon Area Congestion Fees						
An established cordon area or zone in which vehicles are charged a fee to enter. Such a fee can be variable (by time of day) or dynamic (based on real-time congestion conditions). Should include electronic payment/collection methods using cameras or transponders.	▪ Reduce air pollution and congestion within the cordon area ▪ Revenue for roadway maintenance, new transit, and bicycle and pedestrian facilities ▪ Decrease congestion ▪ Reduce VMT ▪ Shift to non-motorized modes	$$$	Medium-to Long-Term: 5 to 10+ Years Extensive time required for political and public discussions, possible ballot measures, construction, and implementation.	▪ Regional or Subareas Travel Demand Models	▪ Regulatory ▪ Transit ▪ Active Transportation ▪ Other Operations and Management	▪ Oregon DOT ▪ DRCOG
Roadway Signage Improvements						
Adequate or additional signage that facilitates route-finding and the decision-making ability of roadway users. Signs with clearer/larger lettering that can be read from a greater distance. Design of signs should follow the guidance of the Manual on Uniform Traffic Control Devices (MUTCD).	▪ Increase safety ▪ Decrease travel delay, for upstream approaching vehicles	$	Short-Term: 1 to 5 Years Production of signs and installation can occur shortly after site visits and design of new signing plans.			▪ DRCOG
Communications Networks and Roadway Surveillance Coverage						
Base infrastructure (fiber, cameras, etc.) required to support all operational activities; Communications networks that allow remote roadway surveillance and system control from a TMC and provision of data for immediate management of transportation operations and distribution of information. Communication networks are essential to get the most efficiency and capacity out of the existing transportation system.	▪ Increase capability for regional-level coordination of operations and traveler information.	$$ Cost can be reduced when done in conjunction with a larger scale construction project.	Medium-to Long-Term: 5 to 10+ Years Large-scale regional network components require more time for planning and funding.		▪ Other Operations and Management	▪ DRCOG
Transit Vehicle Travel Information						
Communications infrastructure, GPS technology, vehicle detection/monitoring devices and signs/media/Internet sites for providing information to the public such as the arrival times of the next vehicles.	▪ Improve operations and management of transit service ▪ Increase ridership ▪ More satisfied road users due to enhanced and reliable information sources	$$ Costs depend upon communication networks, changing technologies, and the number of fleet vehicles to be equipped.	Medium--Term: 5 to 10 Years Time required for detailed planning, design, and funding procurement.		▪ Transit	▪ DRCOG