TCRP

SYNTHESIS 83

TRANSIT
COOPERATIVE
RESEARCH
PROGRAM

Bus and Rail Transit Preferential Treatments in Mixed Traffic

Sponsored by
the Federal
Transit Administration

A Synthesis of Transit Practice

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

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Bus and Rail Transit Preferential Treatments in Mixed Traffic

A Synthesis of Transit Practice

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TRANSPORTATION RESEARCH BOARD

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TRANSIT COOPERATIVE RESEARCH PROGRAM

The nation's growth and the need to meet mobility, environmental, and energy objectives place demands on public transit systems. Current systems, some of which are old and in need of upgrading, must expand service area, increase service frequency, and improve efficiency to serve these demands. Research is necessary to solve operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the transit industry. The Transit Cooperative Research Program (TCRP) serves as one of the principal means by which the transit industry can develop innovative near-term solutions to meet demands placed on it.

The need for TCRP was originally identified in *TRB Special Report 213—Research for Public Transit: New Directions,* published in 1987 and based on a study sponsored by the Federal Transit Administration (FTA). A report by the American Public Transportation Association (APTA), *Transportation 2000*, also recognized the need for local, problem-solving research. TCRP, modeled after the longstanding and successful National Cooperative Highway Research Program, undertakes research and other technical activities in response to the needs of transit service providers. The scope of TCRP includes a variety of transit research fields including planning, service configuration, equipment, facilities, operations, human resources, maintenance, policy, and administrative practices.

TCRP was established under FTA sponsorship in July 1992. Proposed by the U.S. Department of Transportation, TCRP was authorized as part of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). On May 13, 1992, a memorandum agreement outlining TCRP operating procedures was executed by the three cooperating organizations: FTA, the National Academy of Sciences, acting through the Transportation Research Board (TRB); and the Transit Development Corporation, Inc. (TDC), a nonprofit educational and research organization established by APTA. TDC is responsible for forming the independent governing board, designated as the TCRP Oversight and Project Selection (TOPS) Committee.

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Because research cannot have the desired impact if products fail to reach the intended audience, special emphasis is placed on disseminating TCRP results to the intended end users of the research: transit agencies, service providers, and suppliers. TRB provides a series of research reports, syntheses of transit practice, and other supporting material developed by TCRP research. APTA will arrange for workshops, training aids, field visits, and other activities to ensure that results are implemented by urban and rural transit industry practitioners.

The TCRP provides a forum where transit agencies can cooperatively address common operational problems. The TCRP results support and complement other ongoing transit research and training programs.

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The members of the technical panel selected to monitor this project and to review this report were chosen for their special competencies and with regard for appropriate balance. The report was reviewed by the technical panel and accepted for publication according to procedures established and overseen by the Transportation Research Board and approved by the Governing Board of the National Research Council.

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FOREWORD

Transit administrators, engineers, and researchers often face problems for which information already exists, either in documented form or as undocumented experience and practice. This information may be fragmented, scattered, and unevaluated. As a consequence, full knowledge of what has been learned about a problem may not be brought to bear on its solution. Costly research findings may go unused, valuable experience may be overlooked, and due consideration may not be given to recommended practices for solving or alleviating the problem.

There is information on nearly every subject of concern to the transit industry. Much of it derives from research or from the work of practitioners faced with problems in their day-to-day work. To provide a systematic means for assembling and evaluating such useful information and to make it available to the entire transit community, the Transit Cooperative Research Program Oversight and Project Selection (TOPS) Committee authorized the Transportation Research Board to undertake a continuing study. This study, TCRP Project J-7, "Synthesis of Information Related to Transit Problems," searches out and synthesizes useful knowledge from all available sources and prepares concise, documented reports on specific topics. Reports from this endeavor constitute a TCRP report series, *Synthesis of Transit Practice.*

This synthesis series reports on current knowledge and practice, in a compact format, without the detailed directions usually found in handbooks or design manuals. Each report in the series provides a compendium of the best knowledge available on those measures found to be the most successful in resolving specific problems.

PREFACE

By Donna L. Vlasak
Senior Program Officer
Transportation Research Board

This synthesis provides a review of the application of a number of different transit preferential treatments in mixed traffic and offers insights into the decision-making process that can be applied in deciding which preferential treatment might be the most applicable in a particular location. The synthesis is offered as a primer on the topic area for use by transit agencies, as well as state, local, and metropolitan transportation, traffic, and planning agency staffs.

This synthesis is based on the results from a survey of transit and traffic agencies related to transit preferential treatments on urban streets. Survey results were supplemented by a literature review of 23 documents and in-depth case studies of preferential treatments in four cities—San Francisco, Seattle, Portland (Oregon), and Denver. Eighty urban area transit agencies and traffic engineering jurisdictions in the United States and Canada were contacted for survey information and 64 (80%) responded. One hundred and ninety-seven individual preferential treatments were reported on survey forms. In addition, San Francisco Muni identified 400 treatments just in its jurisdiction.

Alan R. Danaher, PB Americas, Inc., Orlando, Florida, collected and synthesized the information and wrote the report, under the guidance of a panel of experts in the subject area. The members of the topic panel are acknowledged on the preceding page. This synthesis is an immediately useful document that records the practices that were acceptable within the limitations of the knowledge available at the time of its preparation. As progress in research and practice continues, new knowledge will be added to that now at hand.

CONTENTS

BUS AND RAIL TRANSIT PREFERENTIAL TREATMENTS IN MIXED TRAFFIC

SUMMARY

Transit preferential treatments are a key component to the provision of travel time savings and improved on-time performance for bus and rail systems operating in mixed traffic on urban streets. Rail systems operating on-street include both light rail transit and streetcar. Enhanced bus operations where transit preferential treatments are particularly critical include bus rapid transit and express bus.

Although transit preferential treatments on urban streets have been presented and reviewed with respect to their application and impact in several documents over the years there has not been a single, recent document that has addressed all of the potential treatments that have been or could be applied. This synthesis report provides such a document. Treatments that are addressed relate to both roadway segments and spot locations (intersections) and include the following:

- Roadway Segments
  - Median transitway,
  - Exclusive lanes outside the median area, and
  - Limited stop spacing/stop consolidation.
- Spot Locations (Intersections)
  - Transit signal priority (TSP),
  - Special signal phasing,
  - Queue jump and bypass lanes, and
  - Curb extensions.

This synthesis report describes these different treatments and reviews their application, costs, and impacts. Three sources of information have been used: (1) a literature review (more than 20 documents), (2) a transit and traffic agency survey, and (3) selected case studies in four urban areas [San Francisco, Seattle, Portland (Oregon), and Denver].

The transit/traffic agency survey was sent to organizations contacted in 80 urban areas in the United States and Canada, 30 systems operating bus and light rail and/or streetcars on urban streets, and another 50 systems with just bus operations. Fifty-two agencies responded to the survey and provided the following insights:

- TSP is the most popular preferential treatment on urban streets.
- There are no standard warrants being applied to identify the need for particular treatments.
- Most transit agencies do not have formal comprehensive transit preferential treatment programs.
- Only a slight majority of transit agencies have intergovernmental agreements with traffic engineering jurisdictions in their service area related to developing and operating preferential treatments.
- Transit agency involvement in preferential treatments has focused on identifying, locating, and designing treatments, with construction and maintenance primarily left to the roadway/traffic jurisdictions.

Twelve traffic engineering jurisdictions provided added insights from their perspective related to transit preferential treatments. These agencies confirmed a focus on constructing and maintaining transit preferential treatments. They also noted that they were most supportive of TSP, queue jump/bypass lanes, exclusive lanes and limited transit stops, and least supportive of median transitways, special signal phasing, and curb extensions.

Including the transit and traffic agency responses (64 total), an 80% survey response rate was achieved related to the 80 urban areas contacted. In addition, insights were obtained from agency staff participating in the follow-up case studies.

The four case studies reviewed present a variety of transit preferential treatment applications on urban streets. This included a comprehensive treatment program that has been in place for more than 30 years in San Francisco, related to both bus and light rail and streetcar operations, where TSP, exclusive lanes, boarding islands, and curb extensions have been applied at more than 400 locations in the city, and where the implementation process has been simplified over the years with the merger of transit operations and traffic engineering into the same agency. In Seattle, a similar comprehensive transit preferential treatment program has been implemented, but is just related to bus operations. King County Metro, the major bus transit operator in the Seattle area, has entered into multiple intergovernmental agreements with local cities to implement its TSP program. In Portland, the focus has also been on TSP applications with an intergovernmental agreement between Tri-Met, the public transit agency, and the city of Portland. In Denver, the cornerstone transit preferential treatment has been the development of the 16th Street Transit Mall, with associated limited stop improvements on adjacent downtown streets.

From a review of the literature, responses to the transit and traffic agency surveys, and the case studies, the capital and operating costs of different transit preferential treatments have been identified, including a set of unit costs, where possible, including appropriate ranges. The impact of different treatments on transit travel savings and improved on-time performance has also been identified. The analysis revealed that the greatest positive impact on transit operations is achieved through a systematic application of one or more preferential treatments along a corridor, with median transitways, exclusive lanes, and TSP having the greatest benefit.

The synthesis report also presents a set of analysis methods to evaluate the travel time impacts of exclusive transit lanes, TSP, and queue jump/bypass lanes. This includes the use of field surveys, analytical models (including a set of simplified nomographs), and simulation. A potential methodology to assess the cumulative impacts of a set of transit preferential treatments in a corridor is also presented. Finally, decision frameworks are presented related to exclusive lanes, TSP, queue jump/bypass lanes, and curb extensions, to provide guidance to agencies on which preferential treatment might be most applicable in a particular location.

In concluding the synthesis assessment, five major areas for potential added research have been identified:

1. Limited stop/stop consolidation impacts.
2. Warrants for transit preferential treatment application.
3. Benefits of multiple transit preferential treatment application.
4. Tradeoffs on intersection-based transit preferential treatments.
5. Intergovernmental relationships in transit preferential treatment development.

CHAPTER ONE

INTRODUCTION

BACKGROUND

Transit preferential treatments are not new, having been around for about 70 years for buses and longer for on-street rail systems. However, in recent years there has been increasing interest in the development of preferential treatments where bus or rail vehicles operate in a mixed-traffic environment, in particular on arterial streets in urban and suburban areas. Most bus routes, outside of exclusive busway applications, operate on streets in the general traffic flow alongside general traffic. Streetcar lines and many light rail systems also operate on streets with general traffic. The inherent congestion on many streets, particularly during peak periods, often results in substantial delays to transit operation that increase travel time and degrade on-time performance. In certain situations this can lead to the requirement for added transit vehicles (and thus added capital and operating cost) to provide the same service frequency.

The implementation of new bus rapid transit (BRT) systems has renewed interest in preferential treatments, critical to keeping the “rapid” in such services.

Transit preferential (or priority) treatments range from exclusive transitways and transit lanes applied along certain roadway segments to spot improvements typically applied at intersections, such as transit signal priority (TSP), queue jump signals, bus bypass lanes, and curb extensions (also known as bulbouts).

SCOPE

Objective

Although there have been several research projects and project studies in certain urban areas that have addressed transit preferential treatments in mixed-traffic environments, including warrants for their application and costs and impacts of different treatments, most notably *NCHRP Reports 143* and *155* (*1*,*2*) from the 1970s, there has not been a recent document that focuses just on this subject. The TCRP J-7/SA-22 project was intended to provide such a document. The initial problem statement for this project was developed by the TRB Committee on Transit Capacity and Quality of Service, which recognized the importance that transit preferential treatments could provide with respect to increasing capacity and improving quality of service for transit operations in mixed-traffic environments.

Methodology

This report focused on three components:

1. A review of past literature that addressed transit preferential treatments, both in terms of their features and application warrants, but also their impact on both transit and general traffic operations in different cities across North America.
2. A representative survey of transit agencies that operate streetcar/light rail and/or bus service on city streets, and a parallel survey of traffic engineering jurisdictions that work with transit agencies to implement transit preferential treatments.
3. A review of specific cities where more extensive, organized transit preferential programs have been developed, and specific information about how these came about and the successful partnerships involved.

The literature review (a total of 23 documents were reviewed) was intended to obtain added documentation of transit preferential treatments beyond the three current sources, where some organized presentation of overall preferential treatments has existed in recent years: *TCRP Report 100: Transit Capacity and Quality of Service Manual* (*3*), *TCRP Report 90: Bus Rapid Transit Volume 2: Implementation Guidelines* (*4*), and *TCRP Report 118: Bus Rapid Transit Practitioner’s Guide* (*5*). Through the transit agency survey conducted, added documentation of transit preferential treatment programs and assessments were obtained.

The transit agency survey was designed to obtain insights on the types of preferential treatments that were implemented in their service areas, under what conditions, and what the impacts were on transit operations. Also of interest were the partnerships in place with the traffic engineering jurisdictions in their area to plan, design, implement, operate, and maintain treatments. The following information was sought:

- Type and location of different treatments;
- Characteristics of transit service using preferential treatments—peak versus off-peak transit volumes and operating periods of treatments;
- Characteristics of streets where treatments are located—traffic volumes and level of service;
- Costs of different treatments—capital and operations and maintenance (O&M);

- Funding sources of different treatments;
- Design and operational criteria for different treatments;
- Impacts of different treatments on transit operations—travel time savings, improved service reliability, reduction in number of operating vehicles—specific performance measures applied;
- Factors that led to the decision to apply certain preferential treatments; and
- Agreements in place with local traffic agencies related to preferential treatment application.

The intent was to have the survey completed by the transit agency staff responsible for the development and monitoring of transit preferential treatments within the agency. The transit agencies surveyed were asked for copies of reports documenting their preferential treatment programs and the costs and impacts of different treatments.

The traffic agency survey provided an opportunity to ask questions of traffic engineers on their perceptions on the applicability and success of transit preferential treatments on the street system under their jurisdiction. This survey was structured to obtain some added data related to the impact of transit preferential treatments; particularly those related to O&M costs and general traffic impacts, and to assess overall traffic agency acceptance of such treatments.

The survey was intended to be comprehensive—a total of 80 urban areas in the United States and Canada were targeted—including 50 transit agencies operating just bus and another 30 operating bus and streetcar and/or light rail. The transit survey responses received (a total of 52) were helpful in identifying overall trends with respect to transit preferential treatment application. As part of the survey, a supplemental survey of traffic engineering jurisdictions in these urban areas was conducted to obtain traffic engineers' insights on transit preferential treatments. An added 12 jurisdictions responded to this survey. A total of 64 responses were received, an 80% response rate.

In addition, to probe further into the issues, opportunities, and constraints associated with the development of transit preferential treatments, selected urban areas known to have established transit preferential treatment programs were further studied. In these cases, the transit agency already had an established working relationship with the traffic engineering jurisdiction, and the level and type of partnering between the two agencies could be probed in more detail.

REPORT ORGANIZATION

This report is divided into six remaining chapters:

- Chapter two—Types of Transit Preferential Treatments
- Chapter three—Literature Review
- Chapter four—Survey Responses
- Chapter five—Case Studies
- Chapter six—Warrants, Costs, and Impacts of Transit Preferential Treatments
- Chapter seven—Conclusions.

Three appendices are also provided: Appendix A presents the transit agency survey questionnaire and responses, Appendix B presents the traffic agency survey questionnaire and responses, and Appendix C includes sample intergovernmental agreements that agencies have developed to implement transit preferential treatments.

CHAPTER TWO

TYPES OF TRANSIT PREFERENTIAL TREATMENTS

OVERVIEW

There are several different types of transit preferential treatments that can be applied on urban streets. These can be divided into treatments applied over a given roadway segment or at a specific location (typically at an intersection). Two basic types of treatments have been identified, three related to roadway segments and four to spot locations.

Roadway Segments

- Median transitways,
- Exclusive transit lanes outside a median area (concurrent-flow, contraflow, bi-directional, intermittent lanes), and
- Stop modifications (limited stop spacing/stop consolidation).

Spot Locations (Intersections)

- TSP,
- Special signal phasing,
- Queue jump and bypass lanes, and
- Curb extensions.

The extent of the preferential treatment (e.g., longer length of exclusive transit lane or more green time for signal priority), along with traffic conditions along the roadway, will determine the impact on both transit and traffic operations. Treatments can be applied at isolated locations where there is a particularly high delay to transit vehicles or as a series of treatments strung together in a corridor of some length to have a greater impact on travel time savings and improved reliability.

This chapter presents the basic characteristics of the different transit preferential treatments addressed in this report.

MEDIAN TRANSITWAYS

Median transitways are exclusive transit facilities developed in the median of an urban street. Most applications in North America to date have been associated with light rail transit (LRT) lines, although there are a few median busways emerging. These facilities typically have one lane in each direction, with a dedicated right-of-way (ROW) for the running way and stations. With the development of median transitways, minor unsignalized street intersections and local access driveways with the transit corridor are typically converted to right-in, right-out operation. Transitways interface with general traffic at signalized intersections, where cross streets remain and both left turns on the street the transitway is operating on and cross street traffic typically is accommodated at-grade. To accommodate left turns and U-turns for general traffic on the transitway street, dedicated left-turn lanes are provided to allow protected left-turn phasing to be provided, given the median separation and presence of the transitway.

Median transitways typically have stations at signalized intersections, where pedestrians can access the station platforms using crosswalks and pedestrian signal phasing. Generally, far-side stations are provided to facilitate the provision of signal priority for transit vehicles. Typically, side platforms have been applied for median busways and streetcar lines because of right side running and doors on the right side of the vehicle. However, there have been some recent applications (in Cleveland and Eugene–Springfield, Oregon) of single center platforms and left side doors (doors on both sides of a bus).

Because of the typical limited width of median areas and the overall roadway ROW, most median busways do not incorporate passing lanes, with added width only provided for stations.

Examples of a median transitway for LRT operations in Phoenix are shown in Figure 1, and the former bus median transitway in Richmond, British Columbia, in Figure 2 (Richmond's busway was recently replaced by an aerial rail rapid transit line).

To keep general traffic and pedestrians out of a median transitway, some physical separation between the transitway and the adjacent general traffic lanes is provided, ranging from the use of jersey barriers and raised pavement markers, where limited ROW exists, to wider landscaped median treatments where more space is available. Added signing at intersections designating "Do Not Enter" and "Pedestrians/Bicycles Prohibited" are typically provided.

EXCLUSIVE TRANSIT LANES

Exclusive lanes used by transit on urban streets include new lanes developed along a roadway through widening or dedication of one or more existing general traffic or parking lanes for

FIGURE 1 Median LRT transitway in Phoenix, Arizona (*Source:* Valley Metro Rail).

transit use. These lanes can be designated for transit use during peak periods only, or all day. These lanes typically allow use by general traffic, for left- or right-turn movements, and local access driveway in and out movements. Most exclusive lane treatments are used by buses and streetcars, given that these vehicles better mix with general traffic and the vehicle lengths are relatively short, thus not blocking local access driveways. There are four kinds of exclusive lanes:

- Concurrent-flow,
- Contraflow,
- Bi-directional, and
- Intermittent.

Concurrent-Flow Lane

A concurrent-flow lane is a designated lane for transit vehicles moving in the same direction as general traffic. This lane is typically developed on the right side, adjacent to the curb or shoulder. The lane is typically developed either by (1) removing on-street parking and having transit vehicles operate in the parking lane, (2) using a general traffic lane if there is no parking, or (3) using the general traffic lane outside (or left) of a parking lane. With this treatment, right-turn and local access driveway traffic are allowed to use the lane over short distances. In some cases, such as in Toronto and Vancouver, carpools and vanpools are allowed to use exclusive bus lanes as a through route as a high-occupancy vehicle (HOV) lane. In a few cases, such as on Madison Avenue in New York City, dual concurrent-flow bus lanes are included to provide added capacity and bus bypass capability.

FIGURE 2 Former median bus transitway in Richmond, British Columbia (*Source:* Alan Danaher).

Concurrent-flow lanes can be developed in different operating configurations:

- A lane in each direction of travel operating at the same time over a designated time period;
- A single lane operating in the peak traffic direction during one peak period, with a lane developed in the opposite direction during the opposite peak traffic period; and
- A single lane operating in one direction during one time period, then reversed to operate in the opposite direction during another time period (also referred to as a reversible lane).

The most common form of a concurrent-flow transit lane is one located at the right side of the street, adjacent to the curb or the shoulder. Although this layout is common throughout North America, simply installing a curbside transit lane does not imply the creation of an exclusive transitway, because curb transit lanes are subject to a variety of interference and conflicts, including right-turning vehicles, vehicles seeking to park or load at the curb, and vehicles entering or exiting at local driveways. In this context, maintaining the integrity of the transit lane through signs, markings, education, and ongoing enforcement is critical to ensuring the speed and reliability of bus service in these lanes.

A variation of the curb transit lane that addresses some of these conflicts is an "interior" or "offset" bus lane, which operates in the lane adjacent to the curb lane. This configuration leaves the curb lane available for other uses, including direct curb access for loading and parking and right-turn lanes. The negative aspect of an interior or "offset" transit lane is that it has a significant impact on the travel capacity of the street, whereas the installation of a curb bus lane on a street by replacing on-street parking will not change capacity. However, in some locations there may be less concern about eliminating roadway capacity, particularly if there are good alternative routes, as compared with eliminating parking or loading that may have a greater impact on the viability of local businesses.

Figure 3 illustrates concurrent-flow bus lanes in operation in Boston, London, and New York. Figure 4 shows similar lanes for streetcars in Portland (Oregon) and Toronto.

(a) **(b)**

(c)

FIGURE 3 Exclusive concurrent-flow bus lane applications: (*a*) Washington Street, Boston, Massachusetts (offset bus lane) [*Source:* APTA *BRT Guideways Guidelines* (*6*)]; (*b*) London, United Kingdom (curb bus lane) [*Source:* APTA *BRT Guideways Guidelines* (*6*)]; (*c*) Madison Avenue, New York City (dual bus lanes) [*Source: TCRP Report 118* (*5*)].

(a) **(b)**

FIGURE 4 Alternate streetcar running way configurations: (*a*) Portland, Oregon—one-way shared with traffic; (*b*) Toronto—two-way shared with traffic (*Source:* www.lightrail.com).

FIGURE 5 Contraflow bus lane on 4th Street, St. Petersburg, Florida (*Source:* Kittelson & Associates, Inc.).

Contraflow Lane

Contraflow transit lanes involve designating a lane for exclusive transit use in the direction opposite that of general traffic. Contraflow lanes are applied almost exclusively on one-way streets, with bus lanes typically being no more than one to two blocks in length, with longer segments for LRT. With longer segments, lane use control signals need to be applied to properly alert general traffic and transit operators of the direction of use of the lane.

Figure 5 illustrates a bus contraflow lane in downtown St. Petersburg, Florida, and Figure 6 illustrates a contraflow LRT lane in downtown Denver.

Bi-Directional Lane

A bi-directional transit lane is an exclusive lane that allows a transit vehicle (typically a bus or streetcar) to pass in one direction through a constrained section while a transit vehicle waits or dwells at a station or bypass area until it can be given the green signal to pass though the section in the other direction. This strategy is used when there is only enough room to install a single transit lane of restricted length to traverse through no more than two to three signalized intersections, and with longer service headways. It is noted that the signal system needs to have safeguards that "block out" the section so that only one transit vehicle can be in the section at a time. It is worth noting that when comparing the operations of a bi-directional lane with a transit vehicle traversing the section in question in mixed-use lanes, the bi-directional lane exclusivity can provide some level of reliability over a congested mixed-traffic scenario. Figure 7 provides an example of a bi-directional lane applied on the Eugene–Springfield, Oregon, BRT line.

FIGURE 6 Downtown Denver LRT operation in curb lane (southbound on Stout Street) (*Source:* Denver Regional Transportation District).

Intermittent Lane

An intermittent bus lane or IBL, which can also be called a moving bus lane, is a restricted lane for short time duration only. This concept consists of using the general-purpose lane that can be changed to a bus-only lane only for the time needed for the bus to pass, after which the lane reverts back to a general-purpose lane until another approaching bus needs the lane for its movement.

FIGURE 7 Bi-directional bus lane—Eugene–Springfield, Oregon, BRT (*Source:* Lane Transit District)

From an operational protocol standpoint, the IBL system is to be activated only when the flow of the general traffic is operating below a speed that inhibits bus transit speeds. When that threshold is reached—through the technologies of computers and sensors that can provide knowledge of real-time traffic conditions—longitudinal flashing lights embedded in the roadway lane divider are activated to warn general-purpose drivers that they cannot enter that lane and a bus is approaching. Vehicles already in the lane are allowed to continue. This leaves a moving gap or moving time window for the bus to travel through. For this treatment to be effective, driver education and enforcement is paramount.

When the traffic conditions are not expected to cause delays to the bus movement, the IBL should not be activated.

Figure 8 shows the signalization/signage for an intermittent lane demonstration project in Lisbon, Portugal. There currently is no application of intermittent lanes in North America.

STOP MODIFICATIONS

Modifications to stop placement can create some travel time savings for transit operations along urban areas or allow another preferential treatment (such as signal priority) to be more effectively applied. Given the relative inexpense of moving bus stops versus full LRT stations, modifications to stop placement are typically focused on bus operations, particularly new BRT or express bus services.

There are two types of stop modifications associated with the implementation of TSP: (1) stop relocation and/or consolidation along a corridor, and (2) moving specific stops to enhance another priority treatment.

Corridor Stop Relocation and/or Consolidation

This strategy is applied when a new BRT or express bus service is implemented along a corridor. By having such services make fewer stops, travel time savings and improved on-time performance for the service as a whole can be achieved irrespective of any added preferential treatments being applied. Where an average stop spacing might be two to three blocks for local bus service (800–1,200 ft), for new BRT service minimum stop spacing is typically 0.5 to 1 mile. The 0.5 mile stop spacing is typically associated with 0.25 to 0.5 mile being an acceptable walking distance to such a premium bus service. For express bus service, stop spacing is even greater, with typically just a couple of intermediate stops between the outer stop of a line (in many cases associated with a park-n-ride facility) and downtown. It should be noted, however, that there are many cases where the existing local bus service alone has too many stops, and there are benefits of eliminating or moving stops to go from a one- to two-block stop pattern to a three- to four-block stop pattern and provide some travel time savings and adequate accessibility to adjoining neighborhoods.

In downtown areas, the concept of skip-stop operation is sometimes applied for bus operations. This concept

(a)

(b)

FIGURE 8 Intermittent lane application—Lisbon, Portugal: (*a*) Vertical signalization—Variable message sign, (*b*) Horizontal signalization—Pavement light-emitting diodes [*Source:* "The Intermittent Bus Lane System: Demonstration in Lisbon" (*7*)].

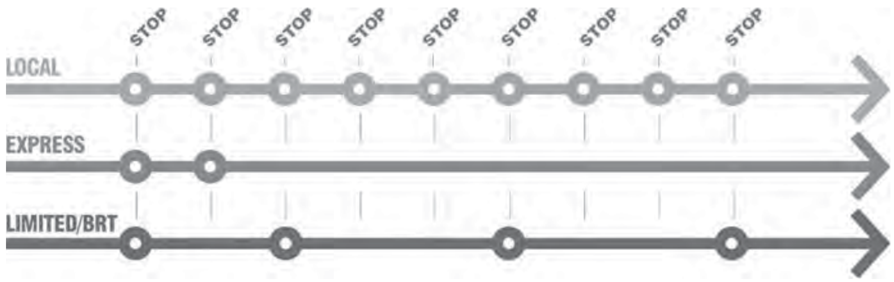


FIGURE 9 Bus stop spacing alternatives (*Source:* PB Americas, Inc.).

involves having bus routes stop at every second or third stop, thereby reducing the dwell time for buses at a stop and facilitating passenger boarding. This is not unlike the concept of having dedicated bus bays at a bus terminal. Critical to the success of skip-stop operations is the availability of a passing lane that allows buses to pass one another.

Figure 9 illustrates the relationship between local, limited and BRT, and express bus stop spacing patterns in a transit corridor. Figure 10 shows the existing skip-stop bus operation on 17th Street in downtown Denver.

This strategy is applied at a specific location, typically an intersection, where moving a stop (from near side to far side,

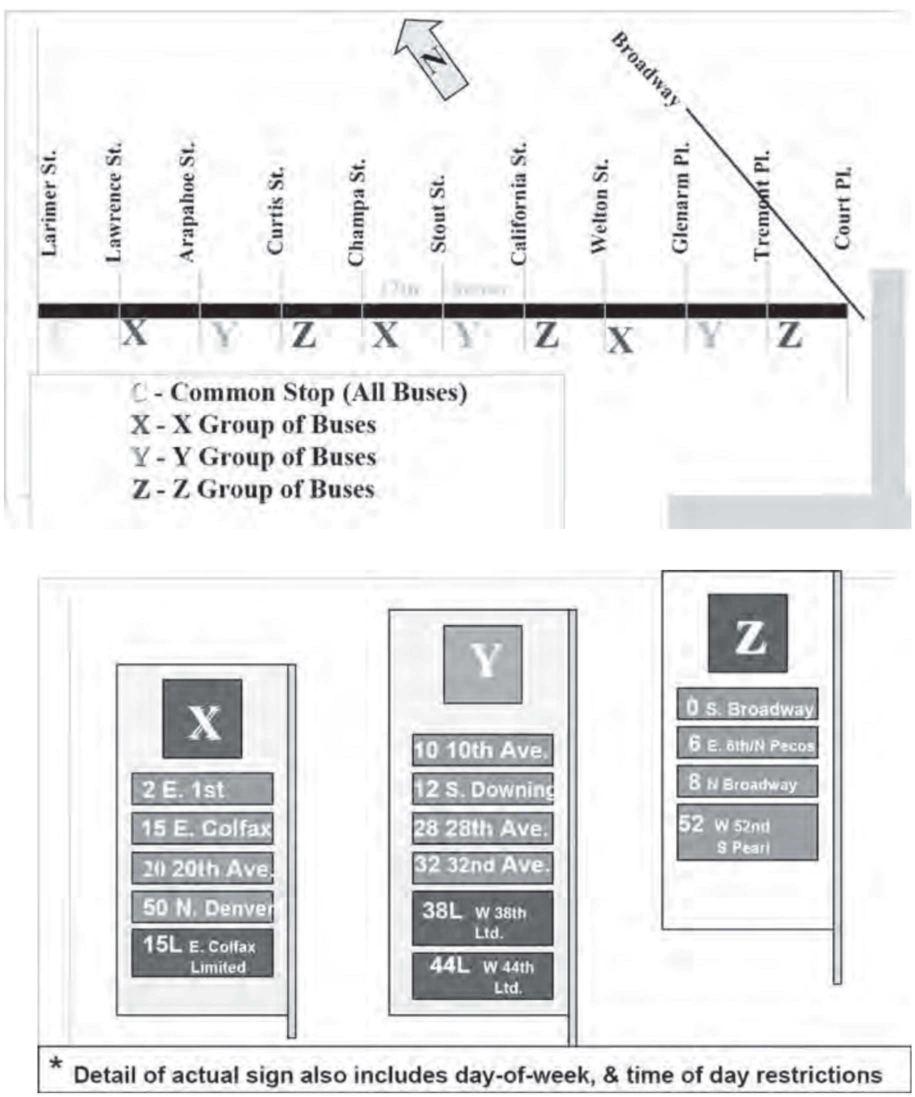


FIGURE 10 Example of bus skip-stop pattern—17th Street, Denver, Colorado, *Moving Specific Stops* (*Source:* Denver Regional Transportation District).

or far side to near side) can allow another preferential treatment to be applied or improve the performance of another preferential treatment. For TSP, having the transit stop far side at a signalized intersection will optimize the effectiveness of TSP, because transit vehicles can move through an intersection without stopping to pick up or discharge passengers near side. Far-side stops are also preferred where buses use a bypass lane near side to go through an intersection into a far-side stop, with or without supplemental signal priority. To implement a queue jump signal, having a near-side transit stop allows passengers to board and deboard before the signal is triggered.

TRANSIT SIGNAL PRIORITY

TSP alters traffic signal timing at intersections to give priority to transit operating in a median transitway, in exclusive bus lanes, or in mixed traffic. TSP modifies the normal signal operation to better accommodate transit vehicles while maintaining the coordinated operation and overall signal cycle length. TSP is different from signal preemption (typically applied for emergency vehicles), where the normal signal operation is interrupted through changing of the signal cycle length, thus taking the general traffic progression out of coordination associated with the preemption call. Signal preemption is used by LRT trains when they operate in a separate ROW and cross an urban street; however, the priority concept is applied when LRT trains travel along a street and cross an intersecting street.

The usual TSP treatment is a minor adjustment in signal phase split times. The green phase serving an approaching transit vehicle may stay longer or start sooner, so that delay for a transit vehicle approaching an intersection can be reduced or eliminated. This is referred to as the "green extension/red truncation" concept. The expanded transit phase split time is recovered during the following signal cycle so that a corridor signal timing coordination plan can be maintained. This concept is illustrated in Figure 11.

TSP can be activated either manually by the transit operator or automatically using on-board technology. The automated procedure is preferred because it eliminates the requirement for an operator to activate the emitter on the vehicle. In many cases, the automated TSP will be tied to an automatic vehicle location (AVL) or automatic passenger counter (APC) system that can determine if priority should only be given if a certain condition in the transit operation is being met—such as if the vehicle/train is behind schedule or if there are a certain number of passengers on board the vehicle/train.

TSP detection can be identified by different means. In past years, many U.S. and Canadian agencies used optical detection for transit priority requests from buses to signal controllers (see Figure 12). Inductive loop systems have also been applied, involving the use of an inductive loop embedded in the pavement and a transponder mounted on the underside of the transit vehicle. Another system includes use

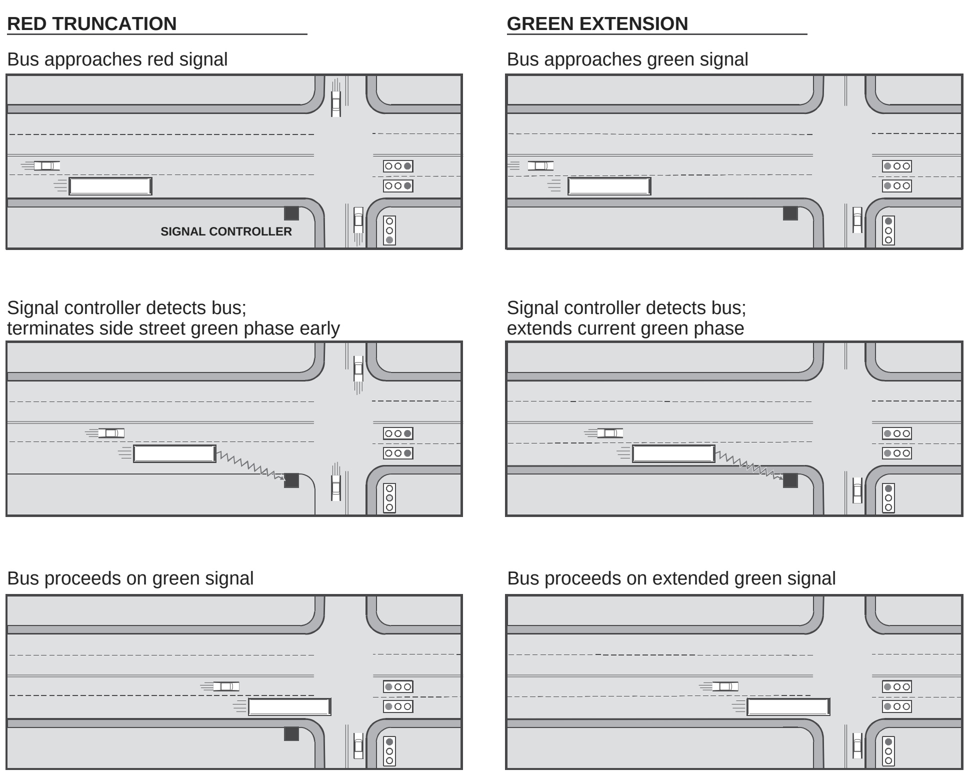


FIGURE 11 Red truncation/green extension TSP concept [*Source: TCRP Report 118* (*5*)].

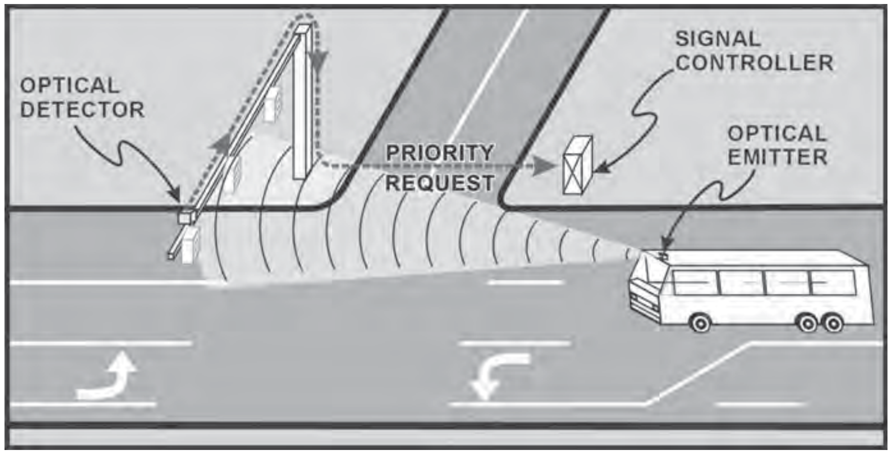


FIGURE 12 TSP bus detection concept—Optical system (*Source:* Kittelson & Associates, Inc.).

of radio frequency tags mounted on the vehicles that interact with wayside reader stations (see Figure 13). New detection systems involving the use of global positioning systems (GPS) and wireless technology are emerging.

There are three types of TSP strategies: passive, active, and real-time priority. *Passive* strategies provide some level of transit priority through the use of pre-timed modifications to the signal system that occur whether or not a bus is present. Applications could range from just one signal to an entire signal system in a corridor. *Active* strategies adjust the signal timing after a transit vehicle is detected approaching an intersection. Either unconditional or conditional priority can be applied as an active strategy. Unconditional priority provides priority for all transit vehicles equipped with detection, whereas conditional priority only provides priority if a transit vehicle meets some condition based on AVL and/or APC data—such as if the transit vehicle is behind schedule or there are a certain number of passengers on-board. *Real-time* or adaptive strategies account for both transit vehicle and general traffic arrivals at an intersection or system of intersections and require specialized equipment capable of optimizing signal timings in the field to respond to current traffic conditions and transit vehicle location.

TSP can be activated at either a distributed or centralized level. At the *distributed* level, decisions on TSP activation at an intersection are dependent on both the transit vehicle and signal controller. At the *centralized* level, the decision to activate TSP is made by a centralized traffic management system.

TSP is typically applied when there is significant traffic congestion and hence bus delays along a roadway. Studies have found that TSP is most effective at signalized intersections operating under level of service "F" conditions, with a volume-to-capacity of ratio between 0.80 and 1.00. A basic guideline is to apply TSP when there is an estimated reduction in bus delay with negligible change in general traffic delay. Given this condition, the total person delay (on both buses and general traffic) would decrease with the application of TSP at a particular intersection or along an extended corridor. TSP also has a positive impact in reducing travel time variability and hence keeping transit vehicles on schedule.

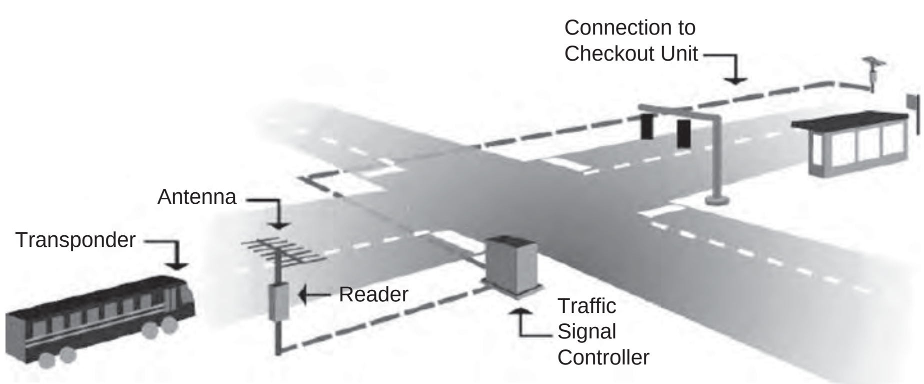


FIGURE 13 TSP bus detection concept—Wayside reader system (*Source:* King County Metro).

For mainline TSP to be most effective, it is important that transit stops be located on the far side of signalized intersections so that a bus activates the priority call and travels through the intersection and then makes a stop. For queue jump signal treatments where there is a designated transit stop at an intersection, the stop could be located either near side or far side. With a transit stop near side of the intersection, the operator can trigger the priority call while passengers board and deboard.

SPECIAL SIGNAL PHASING

Another signal preferential treatment strategy is to introduce a transit-only signal or added signal phase into an intersection. This typically would involve provision for a special left-turn signal at a particular location to allow transit vehicles to make turns onto a cross street. Figure 14 shows a special bus left-turn signal implemented in Portland, Oregon.

QUEUE JUMP LANE

A queue jump lane is a relatively short lane that is available for transit vehicles to bypass general traffic at an intersection. It is typically associated with bus operations. The transit vehicle would enter into a right- or left-turn lane (the right lane being most common), or a new exclusive transit lane developed on the intersection approach. The lane must be sufficiently long enough to allow transit vehicles to effectively access the lane without blockage if there is an adjoining through traffic queue. There are two types of queue jump lanes, depending on whether or not signal priority is provided with the bypass maneuver (see Figure 15).

FIGURE 14 Special left-turn signal for buses—Portland, Oregon (*Source:* Kittelson & Associates, Inc.).

With Signal Priority

With this queue jump treatment, a separate, short signal phase is provided to allow the transit vehicle an early green indication to move into the through lane or bus loading area far side of the intersection, ahead of through traffic. Typically, green time from parallel general traffic movement is reduced to accommodate the special bus signal phase, typically only 3 to 4 s. If there is an optional transit stop at an intersection, it typically would be located near side. With a near-side stop, passenger deboarding and boarding could occur during a red signal indication. In this situation, a signal priority call would be sent to the controller to activate the special signal phase immediately after the closure of vehicle doors. Figure 16 shows a queue jump signal in Portland, Oregon.

Without Signal Priority

If signal priority is not provided, a transit vehicle could still use a right-turn lane or right-side separate lane to bypass a general traffic queue, but then proceed under the normal through signal phase into a far-side bus zone or bus pullout. In this case, the bus stop would typically be far side of the intersection. Figure 17 shows typical "Except Buses" signage associated with a bus bypass lane application.

CURB EXTENSIONS

Curb extensions (also known as bus bulbs) can serve as transit preferential treatments on urban streets. This concept, typically applied with bus and streetcar operations, involves extending the sidewalk area into the street so that transit vehicles do not have to pull out of the travel lane to serve passengers at a stop. This eliminates the "clearance" time associated with transit vehicles at the curb at a stop waiting for a gap in the general traffic stream to pull back into the through lane. There can be significant travel time savings to transit when applied over a series of transit stops along a route.

Curb extensions can be applied far side or near side of intersections (see Figure 18 for near-side treatments), or at midblock (see Figure 19). To develop a curb extension, either a parking lane or loading zone must be available to develop the expanded passenger waiting area. This treatment typically requires the removal of two or more parking spaces or a loading zone to provide sufficient length to develop the curb extension. Curb extensions can also provide space for landscaping and passenger amenities such as benches and pedestrian scale

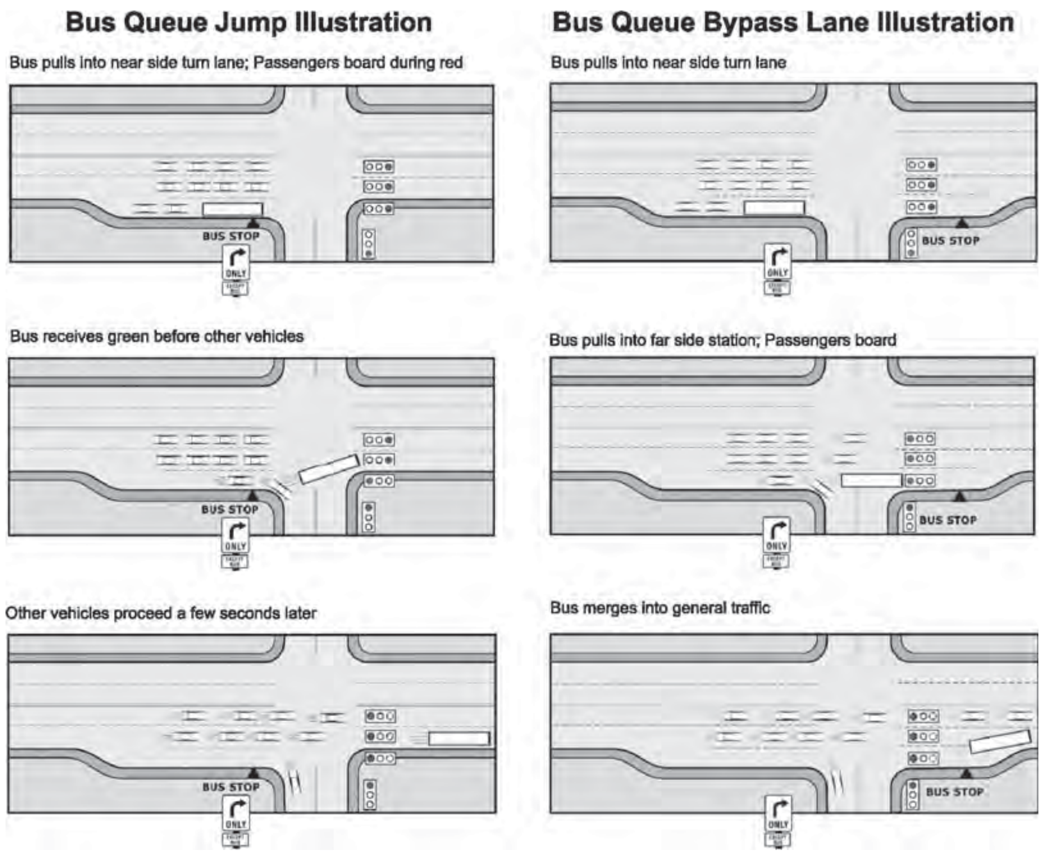


FIGURE 15 Bus queue jump signal/bypass lane concept [*Source: TCRP Report 118* (*5*)].

FIGURE 16 Queue jump signal—Portland, Oregon [*Source: TCRP Report 118* (*5*)].

FIGURE 17 “Except bus” signage used in bypass lane operations [*Source: TCRP Report 118* (*5*)].

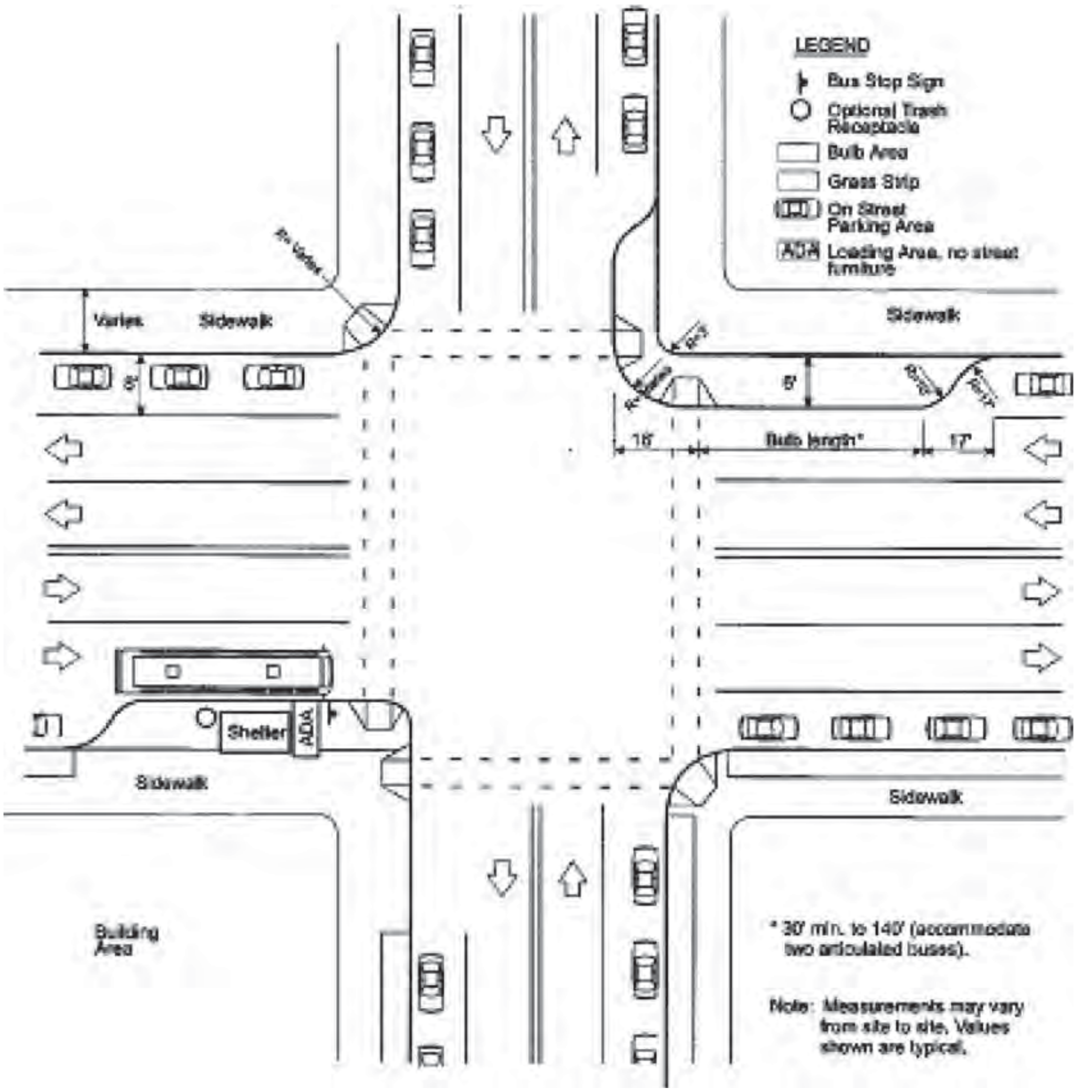


FIGURE 18 Near side curb extension placement [*Source: TCRP Report 65* (*8*)].

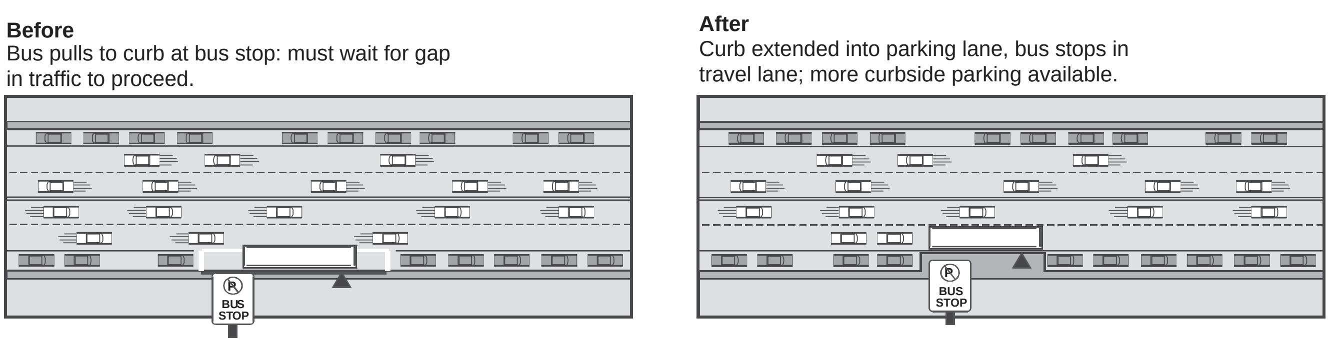


FIGURE 19 Mid-block curb extension concept [*Source: TCRP Report 118* (*5*)].

lighting, assuming such features do not restrict intersection sight distance for traffic. Curb extensions also reduce the pedestrian crossing distance across the street on which the transit vehicle is operating.

Curb extensions are normally applied when traffic volumes on an urban street are relatively low (up to 500 vehicles per lane), there are low-to-moderate right-turn volumes, and there are at least two lanes in the particular direction, which would allow general traffic to circumvent a stopped transit vehicle. This is particularly important with any far-side extensions, such that general traffic would not back up into the prior intersection. Curb extensions typically would not be located where there are high right-turn volumes, particularly truck movements, given the relatively tight curb radius associated with such treatments. Figure 20 shows a curb extension treatment developed in Portland, Oregon.

FIGURE 20 Curb extension treatment—Portland, Oregon [*Source: TCRP Report 118* (*5*)].

CHAPTER THREE

LITERATURE REVIEW

Several studies and research efforts have been completed describing the application of different transit preferential treatments in urban areas in North America. This includes various TCRP reports, reports documenting studies conducted and plans developed for transit agencies, and original research. A total of 20 documents were reviewed in this synthesis. Brief summaries of the content and major findings from these different reports are presented in this chapter. The review is grouped by type of transit preferential treatment.

GENERAL

NCHRP Report 143: Bus Use of Highways—State of the Art, 1973 (*1*)

This report was the first comprehensive documentation of bus operations and priority treatments on urban freeways and arterial streets in the United States and internationally as of the early 1970s. More than 115 different concurrent-flow, curb side bus lane applications and 13 contraflow lane applications in the United States and Canada were identified, with respect to their operating characteristics and signing and pavement markings provided. Another 86 concurrent-flow and 37 contraflow bus lane applications in other countries (particularly Great Britain, France, and Spain) were also profiled.

In several cases, benefits to bus riders and motorists associated with bus lane applications were identified. At the time, most systematic measurements of bus lane effectiveness were limited to studies in European cities. The benefits associated with bus lanes were related to "bus service dependability." There was no conclusive evidence at the time that there were transit ridership gains specifically associated with transit priority treatments or of bus operators being able to reduce the number of buses in service as a result of increased bus speeds and operating effectiveness. However, studies did show modest time savings associated with bus lane application, with generally the larger the treatment the greater the benefit. In certain U.S. cities, travel time savings were found to permit reductions in number of buses operating along specific routes.

Reported benefits of bus lanes in the United States included the following:

1. The bus lane on Washington Street in Chicago (2 miles in length) saved one bus run during peak periods. At the time, this corresponded to an operating cost savings of $25,000 per year to the Chicago Transit Authority.
2. The contraflow bus lanes on 2nd and 3rd Streets in Louisville (each 1.5 miles in length) reduced travel times by about 25%.
3. The Madison Avenue bus lanes in New York City between 86th and 135th Streets reduced midday bus travel times from 11 to 6.5 min.

The report identified a minimum of 60 transit vehicles per peak hour using an exclusive bus lane to justify its designation. Also the number of transit riders using transit vehicles in an exclusive lane should equal or exceed 1.5 times the number of drivers and passengers carried by other vehicles in a single lane during the peak hour. From the standpoint of lane enforcement, the report indicated 40 to 60 buses per hour should use an exclusive lane (resulting in about one bus in each block at any time on an urban street).

NCHRP Report 155: Bus Use of Highways: Planning and Design Guidelines, 1975 (*2*)

This report built on *NCHRP Report 143* in presenting planning and design guidelines for bus operations and priority treatments on highways. This included for the first time presenting a set of warrants for the application of different bus priority treatments. The underlying principle in identifying warrants for priority treatments is whether an exclusive bus lane or other priority treatment would potentially benefit more transit riders than if the treatment were not provided and added general traffic capacity were available.

Suggested values in peak-hour (one-way) bus volumes for exclusive bus lane facilities on arterials were identified as follows:

- Curb bus lanes—within central business district (CBD)—20–30.
- Curb bus lanes—outside CBD—30–40.
- Median bus lanes/transitway—60–90.
- Contraflow bus lanes—extended length—40–60.
- Contraflow bus lanes—short segment—20–30.

These warrants reflect design-year conditions, with existing conditions identified to be at least 75% of these volumes. Contraflow bus lane application was identified to be dependent on a significant directional imbalance of traffic volumes or application on a one-way street. Where arterial bus volumes of less than 60 per hour are present, the report identified taxis being able to use designated bus lanes.

Warrants were also identified for bus "preemption" (10 to 15 buses per peak hour) and special bus signal provisions (5 to 10 buses per peak hour).

A broad set of planning and design guidelines were identified related to different bus priority treatments. Some of the more pertinent guidelines included:

- The prohibition of curb parking, at least during peak hours, should be a requirement to establishing bus lanes. This results in overall increased street capacity, reduces delays and marginal friction associated with parking maneuvers, and allows buses easier access to stops.
- Bus routes should be restructured as needed to make full use of exclusive lanes or transitways.
- Bus priority should reduce both mean and the variance in bus travel time. A 10% to 15% decrease in bus running times in a bus priority area was identified as a desirable objective.
- An extended application of bus lanes in a corridor is required before bus speeds can increase significantly to produce a significant operating cost savings and/or have an impact on transit ridership.
- Bus lanes should recognize the service needs of adjacent land uses, including truck deliveries and passenger drop-off/pickup needs.
- Bus lanes should be provided wherever possible without reducing the lanes available to through traffic in the prevailing direction of general traffic.
- Effective enforcement of bus lanes is essential.

Roadway plan and cross-section diagrams for different bus lane treatments were identified in the report, with guidelines related to bus stop placement and signing and pavement markings.

Guidelines were also identified for bus priority treatments in mixed traffic (identified in the report where buses share a lane with general traffic—in particular TSP, special turn phases, and curb extensions). The following conditions were identified to warrant such treatments:

- Corridor capacity is extremely limited by topographical or other constraints.
- Only one or two continuous streets exist in a corridor.
- There are fewer than 20 buses in the peak direction in the peak hour.
- Allocating an exclusive lane for buses would reduce total corridor capacity to general traffic to an unacceptable level, particularly if oversaturated conditions were to arise.
- Roadway widening is not feasible.

The information in this document served as an input into *NCHRP Report 155.*

***TCRP Report 118: Bus Rapid Transit Practitioner's Guide*, 2007 (*5*)**

This report summarizes research to assess the costs and impacts of different BRT components, including a variety of transit preferential treatments. Treatments along urban streets, including exclusive bus lanes, TSP, queue jump/bypass lanes, and curb extensions, are addressed. For each type of treatment, the following information is provided:

- Basic description,
- Scale of application (relative size, extent of treatment),
- Conditions of application (physical environment, warrants),
- Selected typical examples,
- Estimated costs,
- Likely impacts (on bus travel time, service reliability, operating costs, general traffic), and
- Analysis tools.

The report also identifies a "bottom-up" approach to ridership estimation for BRT in a corridor that accounts for travel time savings associated with transit preferential treatments and other factors. The report also presents examples of how to assess ridership, and the costs and impacts of different BRT scenarios, including four related to the packaging of different transit preferential treatments:

1. At-grade busway with median busway,
2. Bus lanes and TSP,
3. Bus lanes only,
4. TSP only.

***TCRP Report 90: Bus Rapid Transit—Volume 1: Case Studies in Bus Rapid Transit*, 2003 (*9*)**

This report describes the range of BRT applications and provides planning and implementation background through the assessment of 26 BRT projects throughout North America, Australia, Europe, and South America,.

A common thread throughout all the case studies that was the main reason for implementing BRT systems rather than rail were their lower development costs and greater operating flexibility (p. 2).

The evaluated performance of each BRT system varied because of the differing configurations of each system. The case studies measured performance by the number of passengers carried, travel speeds, and land development changes. Basically, ridership increases on BRT systems were sited to be attributable to expanded service, reduced travel times, improved identity, and population growth. BRT systems within exclusive ROW saw the most benefit. However, in general, non-exclusive BRT systems save about 1 to 2 min per mile and exclusive BRT systems save about 2 to 3 min per mile when compared with pre-BRT conditions (p. 6). Further, the land development benefits experience around BRT systems were similar to those experienced with rail transit investments.

The case studies revealed key lessons learned (p. 7):

- Early and continuous community support from elected leaders and citizens is essential.
- It is important that state, regional, and local agencies work together in planning, designing, and implementing BRT.
- Incremental development of BRT will often be desirable.
- Parking facilities should often complement, not undercut, BRT.
- BRT and land use planning in station areas should be integrated as early as possible.
- BRT should serve demonstrated transit markets.
- It is essential to match markets with ROWs.
- The key attributes of rail transit should be transferred to BRT, whenever possible.
- BRT should be rapid.
- Separate ROWs can enhance speed, reliability, safety, and identity.
- Vehicle design, station design, and fare collection procedures should be well coordinated.
- Coordinated traffic engineering and transit service planning is essential for BRT system design.
- BRT services should be keyed to markets.

Bus Rapid Transit Options for Densely Developed Areas, 1975 (*10*)

This document provides guidelines for establishing BRT in densely developed areas without freeways. It includes an extensive discussion of the application of on-street bus lanes (curb lanes versus median lanes, concurrent-flow versus contraflow), including planning and design guidelines. Specific conditions of application in CBD and non-CBD areas are identified, including peak hour bus volume warrants and estimated travel time savings. Travel time savings ranging from 0.4 to 11.4 min per mile were identified associated with bus lane applications in 12 North American and eight European cities. The impact of stop spacing on bus travel time savings and thus the impact of limited stop provision is also assessed.

TCRP Report 100: Transit Capacity and Quality of Service Manual, 2nd ed., 2003 (*3*)

This document presents a comprehensive overview of the transit capacity and operating characteristics of different transit modes. Included in the report is information about bus operations on urban streets, including travel time impacts associated with different transit preferential treatments, and clearance times associated with bus zone areas.

"Bus Semi-Rapid Transit Mode Development and Evaluation," *Journal of Public Transportation*, Vol. 5, No. 2, 2002, pp. 71–95 (*11*)

Upgrading from mixed-traffic bus service to priority treatment at intersections and/or providing buses in exclusive ROWs are cost-effective methods to increasing transit usage. Furthermore, the upgrading or introduction of BRT in exclusive ROWs should have an overall benefit to other bus and rail lines. According to this report, there are three categories of transit ROWs:

1. ROW category C—urban streets with mixed traffic;
2. ROW category B—partially separated from traffic with at-grade intersection crossings; and
3. ROW category A—fully controlled and used exclusively by transit vehicles.

The concept of bus semi-rapid transit was introduced in the 1970s, and has since gone through development that has met success and obstacles. Successes include its introduction as a system concept, running on exclusive lanes and busways, the definition through use of differentiating bus design, and applications of Intelligent Transportation Systems (ITS). Setbacks to learn from are the combination of transit with HOV lanes because of the congestion and degradation of service; bus lanes on streets have experienced the same degradation of service as HOV lanes because the lack of separation offers ease of introducing non-transit vehicles to the lane; and the dilution or elimination of priority measures that, again, degrade the performance of the transit system.

The individual systems of the family have service overlap that builds off of each other to provide a balanced transportation system. The successful application of bus semi-rapid transit includes "corridors with many overlapping bus lines; streets and avenues where separated bus lanes can be introduced; and political and civic support for transit in traffic regulations are sufficiently strong that the bus priority measures can be introduced and maintained" (p. 93).

"Toward a Systems Level Approach to Sustainable Urban Arterial Revitalization: A Case Study of San Pablo Avenue," TRB 2006 (*12*)

A sustainable corridor implies "developing a system that is economically viable, environmentally friendly, and equitable across income and racial spectrums, now and in the future" (p. 3). Principles of urban arterial revitalization and redevelopment can be achieved through land use and transportation coordination, multimodal transportation operations, and street design within decision-making processes that rely on community involvement. Applying these principles to San Pablo Avenue in San Francisco, California, provides insight on how to encourage sustainable urban arterial revitalization.

San Pablo Avenue operates seven bus routes along at least part of the segment and during peak periods there are about

20 buses per hour. The need to integrate land use and transportation planning along this corridor is essential to achieving the sustainable characteristics described. The study included an evaluation of the existing impediments to development and recommends improvements to the Oakland city code to alleviate land-use issues in context of the existing transportation system. Another factor recommended to encourage revitalization is sustainable street design that increases transit use through improvement of pedestrian access to transit stops and enhanced pedestrian amenities at stops. Also addressed is the calming of high-speed traffic, the implementation of priority treatments for transit to reduce the impacts of congestion, and the optimization of signal timing for transit vehicles.

"Characteristics of Bus Rapid Transit Projects: An Overview," *Journal of Public Transportation*, Vol. 5, No. 2, 2002, pp. 31–46 (*13*)

BRT has been implemented in numerous cities throughout North America. This article provides a review of BRT projects and a comparison of BRT to LRT to gain insight and provide definition to BRT. As discussed in this article, key characteristics of BRT systems are running ways, stations, vehicles, service, fare collection, and ITS; however, these are not exhaustive and not exclusive features to BRT. Many cities, such as Miami, Pittsburgh, and Ottawa, Ontario, use abandoned freight rail lines to provide exclusive busways. Although efficiencies are found when buses run in exclusive ROWs, it is not always financially feasible and BRT can function within mixed-traffic operation and experience similar efficiencies through the proper execution of, for example, AVL and traffic signal technology. Furthermore, with proper marketing and branding, the use of several of these elements can set BRT apart from other transit systems. This was found to be true through the review of implemented BRT projects, specifically the Los Angeles County Metropolitan Transportation Authority (MTA) Metro Rapid BRT system. Efforts to distinguish BRT lines do not always accompany ROWs; however, the use of other distinguishing features such as simple routes throughout the area, frequent service, separated and differentiating stations, and color-coded buses help create pseudo-rail operations in mixed traffic.

"Transit Corridor Evaluation and Prioritization Framework," TRB 2006 (*14*)

This report presents the evaluation methodology that was developed and used by Hillsborough Area Regional Transit (HART) (Tampa, Florida) to evaluate and prioritize key transit corridors, or *T*ransit *E*mphasis *C*orridors (TECs). This methodology is a planning-level tool to verify if specific improvements relating to bus service, preferential treatment, and/or facilities are warranted. Although it requires tailoring, the methodology developed is intended to be applied by any community establishing priority corridors.

The methodology focuses on three categories of improvements: service improvements, bus preferential treatments, and facility improvements. The authors created a series of worksheets that list potential improvements that can be applied to, for example, a corridor, bus stop, or intersection. The worksheets are intended to be used to determine if a certain location meets the thresholds to warrant the improvement(s). If it is determined that all the thresholds are met, then the improvements for the corridor are weighted and summed for all evaluated corridors; the totals for the corridors provide prioritization of the corridors for needed improvement.

The application of this tool to HART's TECs was found to be "a technically sound, flexible, and objective evaluation methodology for prioritizing transit improvements and can serve as the foundation for subsequent policy discussions and decision-making" that can be applied to the planning-level evaluation and prioritization of corridors in any community (p. 9).

TCRP Report 17: Integration of Light Rail Transit into City Streets, 1996 (*15*)

This report addresses the operating characteristics and safety experience associated with light rail transit operating in shared (on-street or mall) ROWs, under slower speed conditions (under 35 mph). Nine LRT systems were surveyed (Baltimore, Boston, Buffalo, Calgary, Los Angeles, Portland, Sacramento, San Diego, and San Francisco) to obtain information on their operating practices, safety concerns, accident experiences, innovative features, and enforcement and safety education programs.

For LRT operations that physically operate on-street, both semi-exclusive and nonexclusive alignments are defined. Semi-exclusive alignments are characterized with limited grade crossings, and some physical separation of the LRT alignment from motor vehicle traffic is provided, ranging from raised curbs and fencing to mountable curbs, raised pavement markers, and/or striping. This concept is similar to the median transitway defined in chapter two. Operating speeds are typically governed by vehicle speed limits where automatic crossing gates are not provided. Nonexclusive alignments allow for mixed traffic flow with motor vehicles or pedestrians, resulting in a higher level of operating conflict and slower operating speeds. Nonexclusive alignments are typically applied in downtown areas and for most streetcar applications.

The research identified several problems associated with on-street operation of light rail, and identified potential solutions. The problems and solutions addressed include:

- Pedestrian safety (trespass on tracks, jaywalk, station, and/or cross-street access)
- Side-running alignment
- Vehicles operating parallel to LRT ROW, turning left across tracks (illegal left turns, protected left-turn lanes with signal phases)
- Traffic control observance (passive and active turn restriction sign violations, confusing traffic signal displays, poor delineation of dynamic envelope)

- Motor vehicles on tracks
- Crossing safety (right-angle accidents)
- Poor intersection geometry.

A set of planning guidelines are identified related to designing roadway geometry and traffic control devices for on-street LRT:

- Attempt to maintain existing traffic and travel patterns.
- Locate the LRT trackway in the median of a two-way street, if possible.
- If operating on a one-way street, LRT should operate in the direction of motor vehicle traffic, with all unsignalized midblock access points closed if possible.
- Two-way LRT operations on one-way streets should be avoided.
- If LRT operates within the street ROW, separate LRT operations from motor vehicles by some physical device (e.g., raised pavement markets, rumble strips, contrasting pavement texture, or mountable curbs).
- Provide LRT signals that are clearly different from motor vehicle traffic signals in their design and placement.
- Coordinate traffic signal phasing and timing to preclude cross-street traffic stopping on and blocking tracks.
- Apply traffic signal turn arrows to control left- and right-turn movements for motor vehicle traffic that might conflict with LRT operations.
- Provide adequate storage lengths for left- and right-turn lanes for motor vehicle traffic, and provide separate turn phases. The motor vehicle left-turn phase should follow the LRT phase.
- Use supplemental interior illuminated signs to supplement traffic signals to warn motorists making conflicting turns with LRT operations.
- Properly channelize pedestrian crossings to minimize conflicts with LRT operations, using gates and/or barriers where appropriate.
- For on-street operations, load or unload LRT passengers from or onto the sidewalk or a protected raised median platform and not into the roadway.

EXCLUSIVE LANES

***TCRP Report 26: Operational Analysis of Bus Lanes on Arterials,* 1997 (*16*)**

This research assessed the operation of buses in arterial street bus lanes. The focus was on identifying operating conditions in which buses have complete or partial use of adjacent lanes, estimating the impacts of adjacent lanes on bus speeds and capacities, and establishing relationships and procedures for assessing impacts. The research verified how increasing bus volumes in exclusive lanes can reduce speeds and how right turns from or across bus lanes can affect operations.

Three types of bus lanes were analyzed:

1. Curb bus lane where passing is impossible or prohibited and where right turns are permitted or prohibited. The lane could operate either in concurrent flow or contra flow.
2. Curb bus lane where buses can use the adjacent general traffic lane for passing around stopped buses. Right turns by general traffic may or may not be prohibited from the curb bus lane.
3. Dual bus lanes with general traffic right turns prohibited.

Adjustment factors were developed to reflect capacity increases resulting from skip stop operations and capacity losses from right-turn traffic conflicts.

The relationship between bus speeds in the different bus lane configurations with stop frequency, stop duration, and traffic signal timing were addressed by use of both field observations and the TRAF-NETSIM model. A look-up table is presented identifying bus lane speeds for various stop frequencies and dwell times. Speed reduction factors based on the critical bus berth volume/capacity ratio is also presented.

***TCRP Research Results Digest 38: Operational Analysis of Bus Lanes on Arterials: Application and Refinement,* Sep. 2000 (*17*)**

This digest presents the results of TCRP Project A-74, which used the bus operational analysis methodology presented in *TCRP Report 26* to analyze the performance of six existing arterial bus lanes and recommends refinements to the method. The methodology of *TCRP Report 26* (*16*) was incorporated into *TCRP Web Document 6: Transit Capacity and Quality of Service Manual* (*18*), and the 2000 edition of the *Highway Capacity Manual* (*19*).

For this research, data gathered included bus speeds, physical site conditions, traffic signal timing, and videotaping of bus travel along the arterial, from the following bus lane locations:

1. Fifth Avenue, Portland, Oregon—Dual bus lanes on bus-only street.
2. Sixth Avenue, Portland, Oregon—Dual bus lanes on bus-only street.
3. Second Avenue, New York City, New York—Curb bus lane.
4. Albert Street, Ottawa, Ontario—Curb bus lane.
5. Commerce Street, San Antonio, Texas—Curb bus lane.
6. Market Street, San Antonio, Texas—Curb bus lane.

From the observed data the authors were able to suggest several refinements to the parameters and default values defined in *TCRP Report 26* to produce estimates closer to actual bus operations. The authors found that the bus speeds fell within 20% of the estimated speeds. Slight modifications to the speed assumptions resulted in more accurate speed estimations. On Portland's Fifth and Sixth Avenues, delays caused by intermediate traffic signals warranted increasing the incremental traffic delay from 1.2 to 2.0 min/mi; to account for blocking of the bus lanes, Second Avenue's incremental traffic delay was increased from 2.0 to 3.0 min/mi; an adjusted decrease from 1.2 to 0.6 min/mi was provided for Ottawa's Albert Street to reflect the preferential traffic signal timing for buses; and to reflect the platooning effect from an upstream bus stop, the berth efficiency factor was increased from 2.50 to 2.75 on Albert Street.

From this analysis, the authors suggest several refinements to the parameters and default values used in *TCRP Report 26.*

1. Consideration should be given to increasing the efficiency of multiple, on-line berths and recognizing the increased efficiency of platooned operations.
2. Single values of incremental traffic delay for various types and locations of bus lanes, as presented in Table 3-3 of *TCRP Report 26*, may not fully reflect specific operating conditions. Further latitude is suggested to better reflect the effects of (1) traffic signals set to favor buses, (2) traffic signals located between (as well as at) bus stops, and (3) bus lane blockage.

"A New Methodology for Optimizing Transit Priority at the Network Level," TRB 2008 (*20*)

This report proposes a methodology to defining the optimal number of exclusive lanes in an existing operational transport network. This study found that most other similar studies focus only on select arterials when analyzing exclusive lane integration and that there is no approach that addresses a network-level analysis. Using bi-level programming that minimizes the total travel time, the optimal solution for exclusive lanes within a transportation network can be found.

TRANSIT SIGNAL PRIORITY AND SPECIAL SIGNAL PHASING

An Overview of Transit Signal Priority, ITS America, 2002 (*21*)

This report was the first comprehensive documentation on what is transit signal priority (TSP), its different components and applications, and the costs and benefits associated with TSP. Strategies for planning for deployment of TSP and addressing TSP design, operations, and maintenance issues are included. Case studies in eight North American cities [Chicago, Los Angeles, Minneapolis, Pierce County (Washington), Portland, (Oregon), San Francisco, Seattle, and Toronto] and cities in Europe and Japan were analyzed to identify the benefit and impact of TSP on both transit and traffic operations. The results of these case studies are presented in chapter six.

Improving Transportation Mobility, Safety, and Efficiency: Guidelines for Planning and Deploying Traffic Signal Priority Strategies, 2007 (*22*)

This report was assembled to assist local, regional, and state jurisdictions in Vermont when considering the use of traffic signal systems and technologies to implement TSP strategies for buses. Through a literature review and case studies a greater understanding of the state of TSP and how it is employed was gained.

In addition, a VISSIM (VISual SIMulation) analysis was undertaken to evaluate alternative transit priority strategies along two major bus routes in Burlington, Vermont: Route 15 and the Old North Route.

VISSIM Results: Route 15

The following evaluation measures were employed in the Route 15 simulation analysis: bus and car travel time, delay, outbound bus waiting time, and side street queue length. Two TSP scenarios were evaluated: (1) under existing conditions with a 10-s green extension for the inbound 30 min headway a.m. buses, and (2) the headways were changed to 15 min.

Travel time for both buses and autos improved with the simulated implementation of TSP, as did delay. However, the bus travel time and auto delay reductions did not prove to be statistically significant. Bus waiting time represents all the times that a bus vehicle is stopped in traffic delay. Outbound buses travel in the non-peak direction and do not get priority. Although increases in stopped time were seen with the implementation of TSP, it was not found to be significant. The inbound buses are in the peak direction and receive priority treatment. There were significant reductions in the bus waiting time, in the inbound direction, with the implementation of TSP. The analysis of the side-street queue length showed that there was no significant difference with the implementation of TSP.

The authors arrived at the following conclusions based on these results (p. 28):

- A 10-s green extension may reduce bus travel time along Route 15 from 4.6% to 5.8%.
- A 10-s green extension may also reduce bus delay along Route 15 from 14.2% to 16.5%.
- A 10-s extension may also reduce bus waiting time ranging from 27.3% to 27.9%.
- The other vehicular traffic that moves in the same direction as the buses may also experience travel time savings from 0.3% to 6.3% and a reduction in delay from 1.1% to 9.5%.
- These reductions in bus travel time, bus delay, and bus waiting time may occur without adversely affecting other traffic.

VISSIM Results: Old North Route

The following evaluation measures were employed in the Old North Route simulation analysis: bus travel time and delay to non-transit vehicles. Two TSP scenarios were evaluated: (1) under existing conditions with a 10-s green extension for the inbound a.m. buses; and (2) all near-side bus stops were relocated to the far side.

Both scenarios provided reduced travel time as compared with the base scenario; however, the reduction found between Scenarios 1 and 2 was not statistically significant. Although slight delay decreases were incurred, they also were not found to be significant.

The authors report the following conclusions based on these results (p. 33):

- A 10-s green extension may reduce bus travel time along the Old North Route by up to 7%.
- A 10-s green extension coupled with the relocation of all near-side bus stops to the far side suggests that travel time may diminish, although the results did not prove to be significant.

Comprehensive Evaluation of Transit Signal Priority System Impacts Using Field Observed Traffic Data, June 2008 (_23_)

This study discusses the impacts of the South Snohomish Regional Transit Signal Priority (SS-RTSP) project on transit and local traffic operations by evaluating quantitative field-observed data and simulation models used to compute measures of effectiveness that could not be obtained from the field-observed data. The study was conducted on two corridors with the TSP hardware and software already installed. Early green and extended green active TSP strategies are used in the SS-RTSP system. To measure the effectiveness of the TSP system, primary data were gathered on the following criteria: transit time match, transit travel time, traffic queue length, signal cycle failures, and frequency of TSP "calls"; secondary measures included average person delay and vehicle delays and stops. Data were collected by means of TSP logs, GPS data, traffic controller logs, traffic video data, and a transit driver log to record reasons for unusual delays; however, the transit driver logs were found to not be accurate in Phase One and eliminated from Phase Two testing. The study used Structured Query Language (SQL) for data management and was implemented in Microsoft SQL Server 2000. VISSIM Version 4.30 was utilized to simulate traffic operations along both corridors. It was an essential tool used to measure average person and vehicle delays and stops that were not calculable from the field-observed data.

Two tests were conducted where TSP was turned off during week one and on during week two. Phase One was preformed on a test corridor approximately 3,600 ft long with three transit routes, four signalized intersections, and seven bus stops including three near-side stops. The Phase Two corridor was approximately 5.3 miles long with 2 transit routes, 13 signalized intersections, and 33 far-side bus stops (none were near side). The Phase One and Two tests found that transit bus stop arrival was more reliable with less variability with the use of the TSP system.

Transit Travel Time

In Phase One, eastbound trips experienced shorter travel times when TSP was operational, whereas westbound trips experienced longer travel times. This was contributed to by the near-side bus stops, which may have had negative impacts on trips with granted priority. In Phase Two, on average, TSP saved transit travel time per trip; however, the average transit travel time was longer when TSP was turned off. This is explained because TSP is only granted for late trips.

Average Person Delay

Average person delay was reduced by the SS-RTSP system during Phase One and Two.

Vehicle Delays and Stops

In Phase One, the TSP system was found to decrease average intersection control delay and number of stops at three of the four intersections; the fourth intersection, although it experienced a negative impact, was not found to be significant and did not offset the benefits of the positive impacts at the other intersections. In Phase Two, the *t*-test concluded that with TSP implementation there were no significant changes to average vehicle delay or number of vehicle stops.

Traffic Queue Length

In Phase One, the traffic queue length increased in vehicles per cycle; however, the median value remained constant. In Phase Two, the average queue lengths with TSP implemented was not significantly changed.

Signal Cycle Failure

Implementation of TSP did not have a significant impact on signal cycle failure in either phase.

The authors found that the SS-RTSP system provided significant benefits to transit vehicles, whereas the impacts to local traffic were not significant. The study revealed that with the TSP on, transit vehicles had a higher adherence to their established schedules and the TSP corridors provided decreased overall person delays. The authors assert that "Given that the negative impacts of the SS-RTSP system on local traffic was not statistically significant, more transit trips could be given proper TSP treatment, and the frequency of TSP requests could be increased to generate more benefits from the SS-RTSP system" (p. 79).

"Active Transit Signal Priority for Streetcars—Experience in Melbourne and Toronto," Nov. 2007 (*24*)

This report discusses the application of TSP to streetcar systems in Toronto, Canada, and Melbourne, Australia. (Because Synthesis Report J-7/SA-22 focuses on preferential treatments in North America, this report relied on the application of TSP in Toronto.) The Toronto streetcar system utilizes a detection system consisting of vehicle-mounted transponders and two pavement-embedded detector loops, one for "requests" and another to "cancel." There are two types of signal priority request that are initiated depending on the timing of the request. They are either transit-corridor green extension or side-street green truncation.

The Toronto streetcar system with TSP experienced "delay reduction of 12 to 16 seconds per intersection and streetcar travel time savings of 7 to 11 minutes per route" (p. 9). These travel time savings provide the Toronto Transportation Commission (TTC) with a "reported annual operating cost savings of more than $200,000 CAD per route per year, which is the direct result of lower fleet requirements (1 to 2 streetcars) and the associated reduction in hours of labor and mileage. The TTC found the payback on TSP investments to be achieved in less than 5 years" (p. 9). Although the benefits were noted from the implementation of TSP, other issues were not resolved owing to the characteristics of the streetcar system, its riders, and its operational characteristics. These issues included frequent bunching of the streetcars or excessive gaps, overcrowding of streetcars, and instances where passengers were left behind owing to inadequate capacity, and the worst conditions occurred at stops along high-frequency routes that were located on the nearside of the signalized intersections without dedicated ROW that had varying passenger demand.

"Evaluation of Transit Signal Priority Benefits Along a Fixed-Time Signalized Arterial," 2002 (*25*)

This report looks at implementing TSP along an arterial with a coordinated signalized system. Using the INTEGRATION microscopic traffic simulation model, five alternative priority strategies were evaluated on prioritized buses and general traffic during the a.m. peak and midday traffic periods along Columbia Pike in Arlington, Virginia.

The Columbia Pike corridor is a relatively straight, hilly four-mile alignment comprised of 20 signalized intersections, a pedestrian crossing and a freeway-type interchange; 6 of the 22 intersections are with major cross streets. Observations revealed that the corridor has directional flow in the a.m. and p.m. peaks, which are between 6:30 and 9:00 a.m. and 4:00 and 6:00 p.m., respectively, and maintains more balanced traffic during the midday. For evaluation, fixed-time operation was assumed for the length of the corridor, although there is a short length that is normally controlled by a SCOOT System.

Evaluation of simple green extensions and green recalls on a 5-s-increment basis within a fixed-time traffic signal control environment were conducted on the following transit priority strategies. Transit operations within the corridor were modeled to keep as close to the published schedules as possible.

- Base Scenario: No priority.
- Scenario 1: Priority to express buses traveling along Columbia Pike between Dinwiddie and Quinn Streets (Route 16J).
- Scenario 2: Priority to regular buses traveling along Columbia Pike between Dinwiddie and Quinn Streets (Routes 16 and 24, except route 16J).
- Scenario 3: Priority to all buses traveling along Columbia Pike between Dinwiddie and Quinn Streets (Routes 16 and 24).
- Scenario 4: Priority to buses traveling along cross streets between Dinwiddie and Quinn Streets (Routes 10, 22, 25, and 28).
- Scenario 5: Priority to all buses traveling between Dinwiddie and Quinn Streets (p. 8).

This study concluded that, depending on the specific characteristics of each transportation network, transit priority systems can provide significant benefits to transit vehicles while not significantly impacting traffic in the network. However, in most cases in this simulation the benefits did not offset the negative impacts to the general traffic. The most benefit was found during the midday period and was attributable to lower volumes of traffic and reduced number of buses requesting fewer priority calls.

"Critical Factors Affecting Transit Signal Priority," TRB 2004 (*26*)

This article presents a framework for an ideal TSP system and reviews its impact on traffic operations. Through interviews of transit engineers and planners and examination of different transit operating conditions, including congestion levels, bus stop location, and bus service level, the different techniques of TSP required under each condition were revealed. These TSP techniques are real-time or fixed-time based control, which used control strategies such as phase suppression, synchronization, compensation, and green recall.

Basic findings of this research were that a real-time control strategy has the most potential to reduce delays to non-transit traffic and is the preferable TSP system treatment. Furthermore, constraints to minimum and maximum greens at the intersection level, using software with a weighing system, and the implementation of priority to late buses only have the potential to minimize delay to non-transit vehicles. Also, using AVL technology to anticipate bus arrival time at intersections and extend green time can help to clear congestion before bus arrival.

Chada proposes the following as some of the ideal elements of a priority system:

- Ability to track bus movements accurately;
- Ability to measure and record statistics on the bus routes to form transit plans based on statistical analysis. Also consider traffic volume, passenger occupancy, and other related figures;
- Ability to offer a wide variety of priority techniques for different situations;
- Ability to minimize delay to non-transit traffic; and
- Ability to estimate cost to both passenger and transit agency (based on average delay) associated with enacting any given priority method.

Chada designed a "Pre-Implementation Checklist" to help local transit agencies find the optimal locations for TSP implementation within the transportation network. Furthermore, the "Operational and Design Guidelines" provides strategies for choosing the most appropriate TSP method for any given area. These guidelines include a series of yes or no questions about TSP characteristics that would require possibly changing the current operating characteristics of a transit system. Dependent on the yes or no answer, a recommendation is given for how to proceed under the current or proposed condition.

QUEUE JUMP/BYPASS LANES

The Tail of Seven Queue Jumps, 2004 (*27*)

The effectiveness of TSP is reduced when traffic congestion increases. In this report, *The Tail of Seven Queue Jumps,* the implementation and operation of seven different queue jumps built within the existing ROWs in the city of Ottawa, Ontario, is discussed.

Queue Jump #1: Queue Jump at "T" Intersection Without Special Transit Signal Display

This queue jump was implemented because the left-turning vehicles would delay transit vehicles. Implementation required signage and driver training (see Figure 21).

Queue Jump #2: Queue Jumps at "T" Intersection with Transit Priority Signal Indication (*TPSI*)

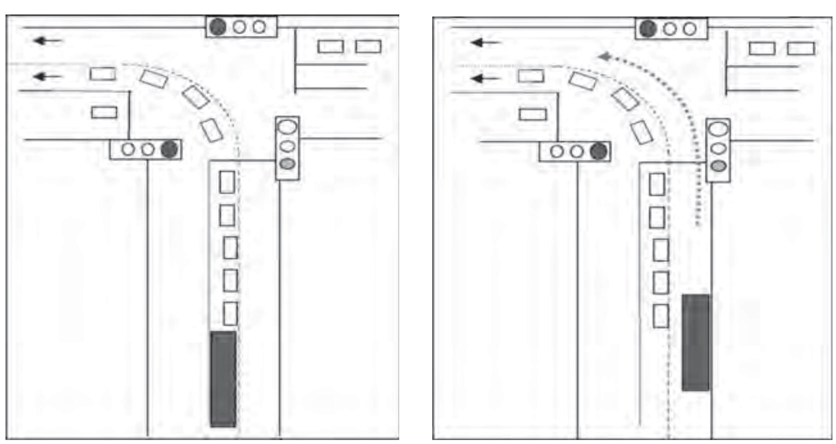
This queue jump was complex because of the short receiving lane at the far side of the intersection, which requires more separation time between when the transit vehicle enters the intersection and when general traffic receives the green light (see Figure 22).

Queue Jumps #3 and #4: Multiple Queue Jumps at a Four-Legged Intersection

This example implemented queue jumps at the left-turning and straight-through intersection approach. The left turn is a regular actuated phase without timing priority. By changing the lane designations both queue jumps were implemented within the existing ROW (see Figure 23).

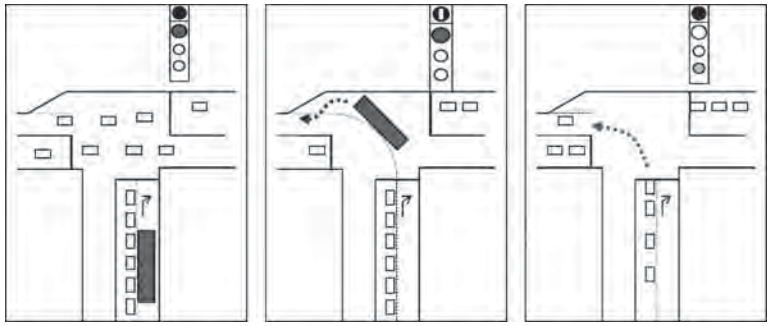
Queue Jump #5: Queue Jump with Advance Stop Bar

This queue jump was implemented at an intersection leaving the Ottawa CBD. Approximately 20 buses each hour move straight through the intersection during the peak period, whereas another 160 buses use the dedicated bus lane to turn right. Before implementation, the buses that would move straight through the intersection would have



No Queue Jump (*Figure 1, page 2*) **With Transit Queue Jump (*Figure 2, page 2*)**

FIGURE 21 Queue jump at "T" intersection without special transit signal display (*27*).



A: Nobody moves at the side street

B: Bus enters intersection

C: General traffic enters intersection

FIGURE 22 Operation of a queue jump with TPSI (*27*).

to merge into heavy traffic, which would often block right-turning buses as a result of merging congestion. The implementation of this queue jump moved the stop bar back by 25 m, allowing transit vehicles that needed to proceed straight through the intersection to enter the “restricted space” in front of the vehicular queue (see Figure 24).

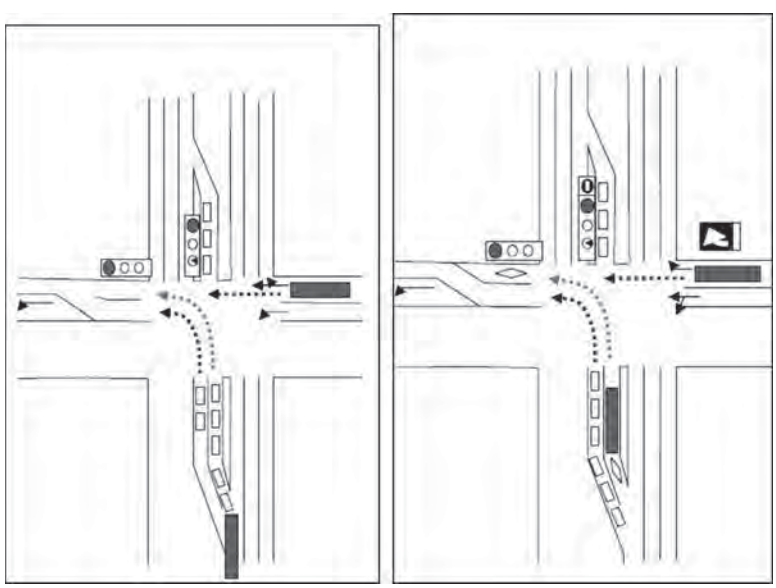
Queue Jump #6: Queue Jump with Queue Relocation to the Adjacent Lane

To better use the ROW at this bottleneck intersection, up to the near-side bus stop, the curb side lane was converted from mixed-traffic to an exclusive bus lane. The bus stop was converted to a bulb out to provide merging for the bus and lane definition of the right-turning vehicles. This change reduced variability and transit travel times along the corridor (see Figure 25).

***Queue Jump #7: Queue Jump with Lane Control Signals* (*Heron/Bronson Type*)**

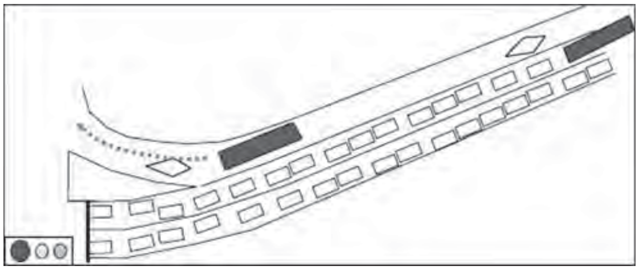
This queue jump was installed to provide a strategic transit stop that would allow for transfers between buses and a grade-separated light rail line; the location would have been unsafe without the queue jump because of the highly utilized right-turn lane. With this queue jump, the transit vehicle movement through the intersection is protected through the use of special TSP (see Figure 26).

Although the seven queue jumps were implemented under differing conditions, they all resulted in a more efficient TSP system and transit travel time savings with relatively inexpensive capital improvement costs. The author notes that because of the transportation policy in the city of Ottawa that supports measures that selectively improve transit operations (i.e., policy and planning objectives are focused on increasing future transit modal share rather than moving vehicles), the imple-

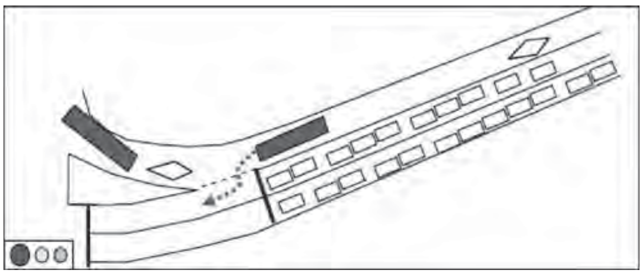


No Queue Jumps (*Figure 5, page 5*) **Double Queue Jumps (*Figure 6, page 5*)**

FIGURE 23 Multiple queue jumps at a four-legged intersection (*27*).



Operation with Buses Using Mixed Flow Lane Approaching Intersection (*Figure 7, page 6*)



Operation with Buses using the Bus-Only Lane to Approach the Intersection (*Figure 9, page 7*)

FIGURE 24 Queue jump with advance stop bar (*27*).

mentation of the presented and other queue jumps were feasible (p. 12).

"Design of Transit Signal Priority at Intersections with Queue Jumper Lanes," TRB 2008 (*28*)

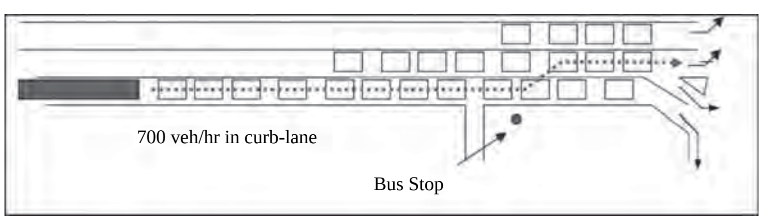
This article evaluates the effectiveness of TSP on transit vehicles in mixed traffic versus the utilization of queue jumper lanes. Design alternatives were studied using the VISSIM simulation tool. Under high traffic volumes, the use of queue jumper lanes with TSP reduced bus delays more so than mixed-lane TSP. A queue jumper lane acts as an exclusive bus lane in the vicinity of an intersection. This design promotes the ease of transit movement through congested intersections without affecting general traffic lanes because it makes full use of existing right-turn bays that often operate under low-saturation conditions, even during the most congested traffic periods.

The VISSIM simulation was preformed with near-side and far-side bus stops under both mixed-lane TSP and jump-lane TSP. All scenarios were evaluated under varying traffic volume levels, from low to high. It was found that the most beneficial and optimally performing alternative included jump-lane TSP and near-side bus stops that reduced bus delay by up to 25% when compared with far-side bus stops with jump-lane TSP. It was also found that "jump-lane TSP with a near-side bus stop can reduce bus delay by 3% to 17% when compared with mixed-lane TSP with a far-side bus stop" (p. 14). Furthermore, in high traffic volumes, the benefits of queue jump lanes with TSP are more pronounced.

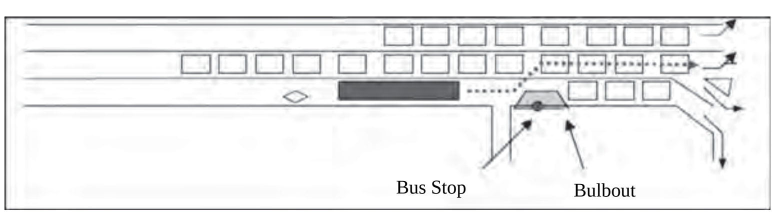
CURB EXTENSIONS

TCRP Report 65: *Evaluation of Bus Bulbs*, 2001 (*8*).

TCRP Report 65 is a continuation of TCRP Project A-10, which culminated with *TCRP Report 19: Guidelines for the Location and Design of Bus Stops* (*29*). This report evaluated bus bulbs in several North American cities to determine the effect of bus bulbs on transit operations, vehicular traffic, and nearby pedestrian movements. The report presents information about when bus bulbs should be considered and lessons learned from bus bulbs implemented in other cities. Using traffic simulation, vehicular and bus operations for bus bulbs located near side and far side along a corridor are identified. Lastly, it provides information regarding the conditions in which the installation and use of bus bulbs is advisable.

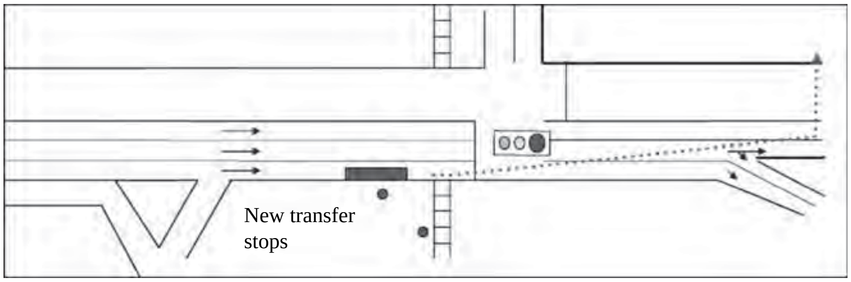


Uneven Lane Utilization at a Congested Intersection Approach (*Figure 12, page 8*)

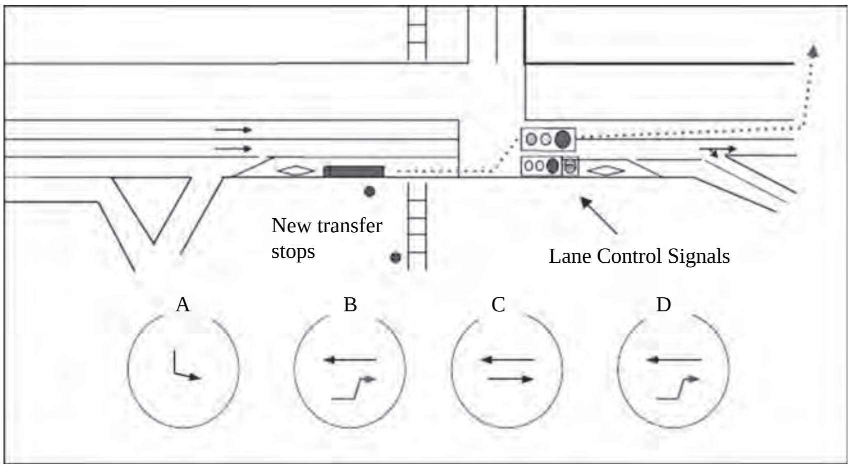


Queue Relocation to Adjacent Lanes (*Figure 12, page 8*)

FIGURE 25 Queue jump with queue relocation to the adjacent lane (*27*).



Operational Issues with the Installation of the New Transfer Stop (*Figure 18, page 10*)



Queue Jump Operation with Lane Control Signals (*Figure 19, page 11*)

FIGURE 26 Queue jump with lane control signals (Heron/Bronson Type) (*27*).

Data were collected including pedestrian volumes, bus dwell times, bus and vehicle speeds near a bus stop, bus and vehicle speeds for the corridor, the length of queue behind a bus, and driver behavior near the bus stop.

As part of this research, two before-and-after studies were conducted. The first was curbside analysis to determine if there were improvements to pedestrian mobility and operations around a newly installed bus bulb. The second was a roadway analysis to determine the advantages or disadvantages to traffic and bus operations from the implementation of bus bulbs at far-side and near-side bus stops. In general, pedestrians benefited from the additional sidewalk capacity by providing additional room for queuing, which reduced conflicts between waiting and walking pedestrians. It was found that the additional space provided by the bus bulb improved pedestrian flow along the adjacent sidewalk by 11%. The roadway before-and-after study determined that the average vehicle and bus speed along the corridor and the block increased when the bus bulbs were installed. Specifically, in studying San Francisco's replacement of several bus bays with bus bulbs, it was found that vehicle and bus speeds on the block and corridor increased between 7% and 46%. Before installation of the bus bulb, buses would often stop partially or fully within the travel lane and would also use both travel lanes when maneuvering away from the bay stop. Once the bus bulbs were installed, buses reduced their use of both travel lanes to leave the bus bulb stop, resulting in the increased bus and vehicle speeds.

In conclusion, this report found that bus bulbs are appropriate in areas with high-density developments and in which the percentage of people moving through the corridor as pedestrians or in transit vehicles is relatively high in comparison with the percentage of people moving in automobiles. Furthermore, the average flow rate of pedestrians traveling along the sidewalk adjacent to the bus stop improved when the bus bay was replaced with a bus bulb.

SUMMARY

Table 1 highlights the major features and conclusions of the documents related to transit preferential treatments reviewed in this literature search.

TABLE 1
SUMMARY FEATURES AND CONCLUSIONS FROM DOCUMENTS IN LITERATURE REVIEW

Document	Focus/Objectives	Major Findings/Conclusions
General		
NCHRP Report 143—Bus Use of Highways—State of the Art (1973)	First comprehensive documentation of bus operations and priority treatments in U.S. and internationally. 165 treatments evaluated. Identified bus travel time savings with different treatments.	Minimum of 60 buses per peak hour to justify use of exclusive bus lane, and lane should carry at least 1.5 times the number of general traffic vehicle occupants.
NCHRP Report 155—Bus Use of Highways: Planning and Design Guidelines (1975)	Extension of *NCHRP Report 143*. Presents planning and design guidelines for bus operations and priority treatments.	Suggested values for one-way peak hour volumes for priority treatments: curb bus lanes (within CBD)—20–30, curb bus lanes—outside CBD—40–60, median bus lanes/transitway—60–90, contraflow lanes—extended length—40–60, short segment—20–30, bus “preemption”—10–15, special bus signal—5–10
TCRP Report 100: *Transit Capacity and Quality of Service Manual*—2nd ed. (2003)	First comprehensive manual documenting transit capacity and quality of service principles and procedures.	Presents bus capacity calculation procedures for mixed traffic and bus lane applications (integrating results documented in *TCRP Report 26*).
TCRP Report 118: BRT Practitioner’s Guide (2007)	Information on different bus priority treatments including exclusive lanes, signal priority, curb extensions, and limited stop spacing on arterial streets.	Presents examples of calculations to identify the cost and impact of different BRT component packages associated with a route or corridor, including integration of bus priority treatments.
TCRP Report 90: Bus Rapid Transit—Volume 1: Case Studies in Bus Rapid Transit (2003)	Assessment of 26 BRT projects throughout the world.	Identified travel time, on-time performance, and other benefits associated with bus priority treatments.
Bus Rapid Transit Options in Densely Developed Areas (1975)	Guidelines for providing BRT in densely developed areas without freeways, focusing on arterial bus lanes. Input to *NCHRP Report 155*.	Identified travel time savings ranging from 0.4 to 11.4 min per mile for 20 North American and European bus lane applications.
B us Semi-Rapid Transit Mode Development and Evaluation” (2002)	Presentation of “semi-rapid” concept for BRT.	Identification of three right-of-way categories (A, B, C) for BRT operation on urban streets.
“Bus Semi-Rapid Transit Mode Development and Evaluation” (2002)	Presentation of “semi-rapid” concept for BRT.	Identification of three right-of-way categories (A, B, C) for BRT operation on urban streets.
“Toward a Systems Level Approach to Sustainable Urban Arterial Revitalization: a Case Study of San Pablo Avenue” (2006)	A review of the operation of the San Pablo Avenue BRT line in Oakland.	Identified effectiveness of bus priority treatments and signal timing optimization.
“Characteristics of Bus Rapid Transit Projects: an Overview” (2002)	Description of BRT characteristics, including priority treatments, and comparison with LRT.	Tradeoffs identified between investing in bus priority treatments vs. other BRT features.
Characteristics of Bus Rapid Transit Projects: An Overview (2002)	Description of BRT characteristics, including priority treatments, and comparison with LRT.	Tradeoffs identified between investing in bus priority treatments vs. other BRT features.
TCRP Report 17: Integration of Light Rail Transit into City Streets (1996)	Assessment of operating characteristics and accident experience for different LRT alignment options on urban streets.	Set of solutions to address potential conflicts between LRT and general traffic and pedestrians. Location criteria identified for placement/design of LRT alignments along urban streets.
Exclusive Lanes		
TCRP Report 26: Operational Analysis of Bus Lanes on Arterials (1997)	Guidelines for calculating the capacity and bus speeds for different bus lane configurations in urban areas.	Look-up tables and adjustment factors to account for different bus and adjacent traffic volumes, stop frequency, and dwell times, for single and dual bus lanes.

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TABLE 1
(*continued*)

Document	Focus/Objectives	Major Findings/Conclusions
TCRP Research Results Digest 38: *Operational Analysis of Bus Lanes on Arterials: Application and Refinement* (2000)	Applied methodologies from *TCRP Report* 26 to evaluate the performance of six existing arterial bus lanes in Portland (OR); New York City; Ottawa, (ON); and San Antonio	Data collected on bus speeds, site conditions, and traffic signal timing. Adjustments in procedures from *TCRP Report 26* to reflect bus platooned operations and incremental traffic delay.
"A New Methodology for Optimizing Transit Priority at the Network Level" (2007)	Methodology for defining optimal number of exclusive transit lanes in transport network.	Use of bi-level programming to minimize total travel time in assessment.
	Transit Signal Priority/Special Signal Phasing	
"An Overview of Transit Signal Priority" (2002)	First comprehensive document describing the transit signal priority concept and applications, benefits, and costs.	Provided strategies for deployment of TSP, including desired intergovernmental arrangements, and addressing TSP design and operations/maintenance issues. Case studies of TSP impact in eight North American cities.
Improving Transportation Mobility, Safety, and Efficiency: Guidelines for Planning and Deploying Traffic Signal Priority Strategies (2008)	VISSIM simulation analysis to evaluate alternate transit signal priority strategies along two bus routes in Montpelier, VT.	A 10-s green extension was evaluated for headways of 15 and 30 min. Bus travel times were found to be reduced by up to 5.8%, bus delays reduced by up to 16.5%, and on-time performance improved by up to 27.9%.
Comprehensive Evaluation of Transit Signal Priority System Impacts Using Field Observed Traffic Data (2008)	Study to assess the impacts of a regional TSP strategy in South Snohomish County, WA. Two corridors evaluated.	TSP effectiveness measures applied included transit time match, transit travel time, traffic queue length, signal cycle failures, and frequency of TSP calls. Evaluation found improved on-time performance and less total person trip delay with TSP implementation.
"Active Transit Signal Priority for Streetcars—Experience in Toronto and Melbourne" (2007)	Reviews the application of TSP to streetcar systems in Toronto and Melbourne, Australia.	Toronto streetcar system has seen dalay reduction of 12 to 16 s per intersection and travel tiume savings of 7 to 11 min per route.
"Evaluation of Transit Signal Priority Benefits along a Fixed-Time Signalized Arterial" (2001)	Presents results of simulation analysis of implementing five alternative TSP strategies along Columbia Pike in Northern Virginia.	Evaluation of green extensions and recalls on a 5-s-increment basis within a fixed-time traffic control environment. Greatest benefit associated with TSP was found during mid-day period owing to lower traffic volumes and fewer TSP calls.
"Critical Factors Affecting Transit Signal Priority" (2003)	Presents framework for an ideal transit signal priority system and its impact on traffic operations.	A real-time control strategy has the most potential to reduce delays to non-transit traffic
	Queue Jump/Bypass Lanes	
The Tail of Seven Queue Jumps (2008)	Describes seven different types of queue jump treatments at intersections	Al identified queue jump treatments resulted in more efficient TSP operation and transit travel time savings.
"Design of Transit Signal Priority at Intersections with Queue Jumper Lanes" (2007)	Comparison of the effectiveness of TSP in mixed traffic vs. use of queue jump lanes.	VISSIM simulation was performed for near and far side bus tops under both mixed-lane TSP and jump-lane TSP. Analysis showed the greatest bus delay reduction (3% to 17%) with jump-lane TSP and near-side stops.
	Curb Extensions	
TCRP Report 65: Evaluation of Bus Bulbs (2001)	Evaluated bus bulbs in several North American cities to estimate the effect of such treatments on transit operations, vehicular traffic, and pedestrian movements.	Two before-and-after studies conducted in San Francisco involving curbside and roadway analysis. With bus bulbs, pedestrian flow adjacent to stops improved by 11%.

CBD = central business district; HART = Hillsborough Area Regional Transit; VISSIM = VISual SIMulation model.

CHAPTER FOUR

SURVEY RESPONSES

INTRODUCTION

A cornerstone of this synthesis report was a comprehensive survey of urban areas in North America. Information was sought on agency perceptions, policies, and characteristics of different transit preferential treatments that they have applied to their bus and light rail/streetcar systems. This has been the first known systematic survey of transit agencies conducted on this topic to date. In addition, a parallel survey was sent to traffic engineering jurisdictions that the transit agencies typically work with to plan, design, construct, operate, and maintain transit preferential treatments. The intent was to obtain insights from traffic engineers on their perceptions and policies related to transit preferential treatment development.

The mechanism chosen for agency input was a web survey. The survey was initially sent to transit agencies, which then identified one or more appropriate contacts in the traffic engineering jurisdiction they deal with, and these individuals were sent a separate survey. The traffic engineers were also asked to add data on traffic conditions in the tabular summary of individual preferential treatment characteristics provided by the transit agencies.

A total of 80 urban areas in the United States and Canada were included in the transit/traffic survey effort—including 50 transit agencies operating just bus and another 30 operating bus and streetcar and/or light rail. The transit survey responses received (52) were helpful in identifying overall trends with respect to transit preferential treatment application. The supplemental survey of traffic engineering jurisdictions in these urban areas was conducted to obtain traffic engineers' insights on transit preferential treatments. An added 12 jurisdictions responded to this survey. The total of 64 responses were received, an 80% response rate.

TRANSIT AGENCY SURVEY

This chapter summarizes the responses of the transit agency survey covering transit preferential treatments. The transit/traffic survey questionnaires and agency responses are included in Appendix A. Between December 20, 2008, and February 20, 2009, a total of 80 urban areas in the United States and Canada were invited to respond to the survey. This included all 30 urban areas that today have both fixed-route bus and light rail and/or streetcar service, and another 50 agencies that provide only bus service. These were most of the larger urban areas in the United States and Canada. Of those transit agencies that were sent the survey, 52 responded; while an additional three agencies indicated that they do not currently have any transit preferential treatments. This response level was achieved following three separate solicitations to respond to the survey. For those 30 systems that operate both bus and light rail and/or streetcar systems, 21 responded. For the 50 bus-only agencies surveyed, 31 responded.

The 52 responding agencies are indicated on the map shown as Figure 27 and in Tables 2 and 3, grouped by transit service type—bus and light rail/streetcar systems versus bus-only systems. These tables also show the Vehicles Operated in Maximum Service, obtained from the 2007 edition of the National Transit Database. Note that Vehicles Operated in Maximum Service were not available for Canadian transit agencies.

Figure 28 provides information on the types of transit preferential treatments (bus and LRT/streetcar) that have been implemented by the responding transit agencies. Percentages are calculated with respect to the number of responding agencies. The most popular treatment is TSP, which has been implemented by two of every three respondents. Limited stops and queue jump/bypass lanes have also been implemented by more than half of the responding agencies.

Table 4 summarizes the type and number of transit preferential treatments in different urban areas where specific treatment information was provided from the survey. It should be noted that the list is not all inclusive, as some transit agencies did not identify all of their treatments. Also, for TSP, some agencies identified the number of individual intersections with priority, whereas others only identified the specific corridors where TSP is applied, without identifying the specific number of signals in each corridor with priority.

Agencies were then asked to provide information about each transit preferential treatment within their jurisdiction. Information requested included the location and type of treatment, ridership and transit vehicle headway, and traffic information such as the average daily traffic and level of service. Details of these individual treatment responses are provided in Appendix B. A total of 197 individual treatments were recorded.

Transit agencies were asked to provide information on any "warrants" applied when considering transit preferential treatments. Most agencies that responded provided general criteria or measures applied, but mainly did not identify

FIGURE 27 Map of transit agencies responding to the survey.

TABLE 2
TRANSIT AGENCY RESPONDENTS OPERATING BUS AND LRT/STREETCAR SERVICE

Agency	Urban Area	Vehicles Operated in Maximum Service[1]
Los Angeles County Metropolitan Transportation Authority	Los Angeles	2,747
King County Metro Transit	Seattle	2,266
Southeastern Pennsylvania Transportation Authority (SEPTA)	Philadelphia	2,227
Regional Transportation District	Denver	1,486
Maryland Transit Administration	Baltimore	1,219
Utah Transit Authority	Salt Lake City	1,034
TriMet	Portland (Oregon)	881
Port Authority of Allegheny County	Pittsburgh	874
San Francisco Municipal Transportation Agency (MUNI)	San Francisco	770
Metro Transit	Minneapolis/St. Paul	767
Greater Cleveland Regional Transit Authority	Cleveland	657
Valley Metro Rail, Inc.	Phoenix	545
Sacramento Regional Transit District	Sacramento	360
Hillsborough Area Regional Transit	Tampa	235
Sound Transit	Seattle	222
Memphis Area Transit Authority	Memphis	194
New Orleans Regional Transit Authority	New Orleans	98
Central Arkansas Transit Authority	Little Rock	65
Calgary Transit	Calgary	N/A
Toronto Transit Commission	Toronto	N/A
OC Transpo	Ottawa	N/A

[1]Vehicles operated during peak period service. N/A = not available.

TABLE 3
TRANSIT AGENCY RESPONDENTS OPERATING BUS SERVICE

Agency	Urban Area	Vehicles Operated in Maximum Service (VOMS)
MTA New York City Transit	New York City	10,736
Chicago Transit Authority	Chicago	2,848
Pace	Northeastern Illinois	1,539
Miami–Dade Transit	Miami	1,258
Capital Metropolitan Transportation Authority	Austin	697
Alameda Contra Costa (AC) Transit	Oakland	651
Community Transit	Snohomish County, WA	582
Pierce Transit	Tacoma	549
Central Florida Regional Transportation Authority (LYNX)	Orlando	462
Montgomery County (MD) Transit (Ride On)	Montgomery County, MD	389
Pinellas Suncoast Transit Authority	Pinellas County, FL	340
Spokane Transit	Spokane	285
Transit Authority of River City	Louisville	279
Capital District Transportation Authority	Albany	259
Greater Richmond Transit Company	Richmond	250
Central Ohio Transit Authority (COTA)	Columbus	241
Rochester–Genesee Regional Transit Authority	Rochester	229
Fort Worth Transportation Authority	Fort Worth	214
Golden Gate Transit	San Francisco	210
Indianapolis Public Transportation Corporation (IndyGo)	Indianapolis	204
Des Moines Area Regional Transit Authority	Des Moines	193
Valley Metro Regional Public Transportation Authority	Phoenix	175
Nashville Metropolitan Transit Authority	Nashville	170
Fresno Area Express	Fresno	127
Lane Transit District	Eugene	124
Regional Transportation Commission of Washoe County	Reno	112
Central Oklahoma Transportation and Parking Authority (COTPA)—Metro Transit	Oklahoma City	74
Chattanooga Area Regional Transportation Authority	Chattanooga	70
Connecticut Department of Transportation	Connecticut	45
Halifax Regional Municipality—Metro Transit	Halifax	N/A
York Region Transit	York Region, Canada	N/A

N/A = not available.

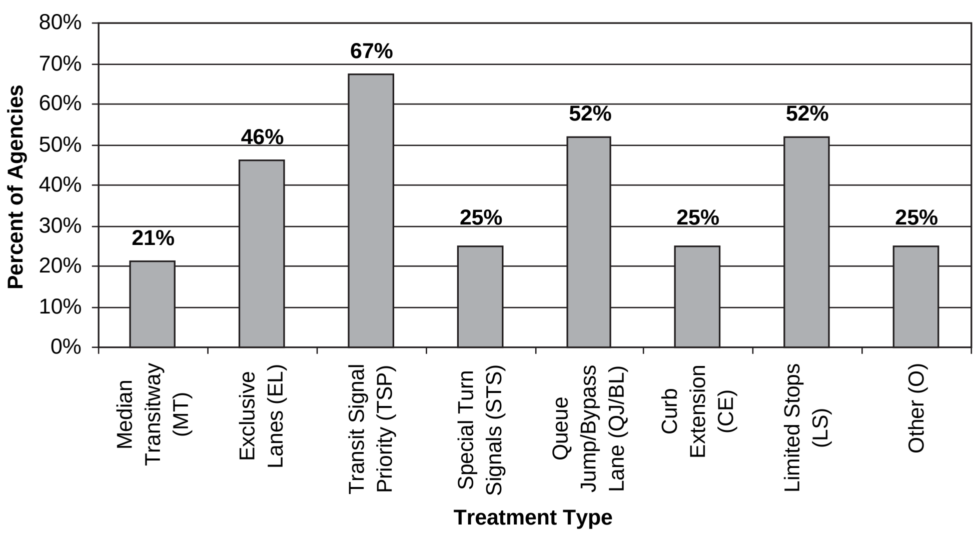

FIGURE 28 Agencies implementing transit preferential treatments.

TABLE 4
DISTRIBUTION OF TRANSIT PREFERENTIAL TREATMENTS BY TRANSIT AGENCY FROM SURVEY

Transit Agency	Bus							
	MT	EL	TSP	STS	QJ/BL	CE	LS	O
Capital Metro Transp. Auth. (Austin)			1[5]		1			
CDTA (Albany)					1			
Central Florida RTA (Orlando)						2		2[1]
Central Ohio Transit Authority		1					1	
Chattanooga Area RTA			1[6]					
Chicago Transit Authority			1[5]					
Community Transit (Everett, WA)			1[5]					
Connecticut DOT								
Denver RTD		2			2			
Ft. Worth Transportation Authority			1[5]					
Greater Richmond Transit Company		1						
Halifax Reg. Mun.—Metro Transit			13		8			
King County Metro (Seattle)		14	7[5]	4	6			3[2,3]
Lane Transit District (Eugene)	2	1	3[5]	1				
Los Angeles County MTA			3[5]					
Metro Transit (Twin Cities)		5		1	1			
Maryland Transit Administration								
Memphis Area Transit Authority								
Miami–Dade Transit		1						
Montgomery County, MD Ride On					1			1[4]
MTA New York City Transit							33	
New Orleans RTA		1						
OC Transpo (Ottawa)		2	11	1	8			
Pierce Transit			7[5]		1			
RTC of Washoe County (Reno)			1[5]		1			
Sound Transit (Seattle)								
San Francisco MTA								
SEPTA (Philadelphia)			2[5]					
Spokane Transit		1					1	
Utah Transit Authority								
Valley Metro RPTA (Phoenix)			2[5]				2	
York Region Transit			2[5]		2	2	2	
Transit Agency	Rail							
	MT	EL	TSP	STS	QJ/BL	CE	LS	O
Denver RTD			2					
Los Angeles County MTA								1[1]
Maryland Transit Administration			1					
Memphis Area Transit Authority			3					
Metro Transit (Twin Cities)	1	1	1					
New Orleans RTA	2	1						1
SEPTA (Philadelphia)			6					
Sound Transit (Seattle)		1						
Utah Transit Authority			1					

MT = median transitway, EL = exclusive lane, TSP = transit signal priority, STS = special transit signal, QJ/BL = queue jump/bypass lane, CE = curb extension, LS = limited stops, O = other.
[1]Signal preemption, [2]through traffic restrictions, [3]parking restrictions, [4]semi-exclusive lane, [5]street or corridor, [6]specific intersections.

specific numerical warrants. Tables 5 and 6 relate to the warrants for transit preferential treatments provided by survey respondents for bus and LRT/streetcar service, respectively. The criteria/warrants are grouped by treatment, using the same abbreviations as those used in Figure 28. Common themes throughout the responses included ridership, safety, and delay considerations, as well as reliability and level of service.

The popularity of TSP reflects its flexibility owing to the many different types of priority that may be employed. Priority types are typically classified as either active, where the transit vehicle initiates a request for priority, or passive, where the system is optimized for transit but individual vehicles do not make any requests. Figure 29 identifies the extent of use of different active priority types: unconditional, conditional if vehicle is behind schedule, conditional based on number of on-board passengers, and other conditional strategies. Percentages are based on the number of agencies implementing TSP; for example, more than half of all agencies that have implemented TSP apply unconditional priority at some location in their networks. No agency reported using the number of on-board riders as a metric for granting priority, even though ridership was commonly cited as a warrant for implementing TSP. This is perhaps not surprising, as automated person counters are not yet broadly used on transit vehicles.

TABLE 5
IDENTIFIED CRITERIA/WARRANTS FOR TRANSIT PREFERENTIAL TREATMENTS—BUS

Agency	Treatment	Criteria/Warrant
Golden Gate Transit	MT	Congested mixed-flow operations with undesirable delay that effects on-time performance
Regional Transportation District	MT	Reliability, ridership, time savings
San Francisco Municipal Transportation Agency	MT	Transit ridership, street width, traffic volume
Toronto Transit Commission	MT	Pro-transit policy, assisted by the fact that transit lanes carry as many people as a full auto lane
Calgary Transit	EL	Some short bus lanes have been constructed on a case-by-case basis.
Capital Metropolitan Transportation Authority	EL	City of Austin (future study)—Downtown (Lavaca and Guadalupe corridors); Texas DOT (future study)—Exclusive Bus Travel on Shoulder Program
Central Florida Regional Transportation Authority (LYNX)	EL	Traffic LOS, individual passenger trips
Chicago Transit Authority	EL	LOS, delay, CBD priority
COTA	EL	High Street downtown
Golden Gate Transit	EL	Congested mixed-flow operations with undesirable delay that effects on-time performance
Greater Richmond Transit Company	EL	Traffic volumes, safety
King County Metro Transit	EL	Benefit/cost analysis, LOS study, transit headways 10 buses/h or greater
Miami–Dade Transit	EL	Travel delay caused by heavy traffic conditions on roadway
MTA New York City Transit	EL	Ridership, reliability, traffic volumes
New Orleans Regional Transit Authority	EL	Delay, LOS, need to maintain on-time performance
OC Transpo	EL	Ridership, delay, reliability, traffic volumes
Port Authority of Allegheny County	EL	Reliability and traffic volumes
Regional Transportation District	EL	Reliability, ridership, time savings
Rochester–Genesee Regional Transit Authority	EL	Headways, LOS
San Francisco Municipal Transportation Agency	EL	Transit ridership, street width, traffic volume
Toronto Transit Commission	EL	Pro-transit policy, assisted by the fact that transit lanes carry as many people as a full auto lane
TriMet	EL	Bus volumes, loads, location of supporting bus stops
Utah Transit Authority	EL	Currently under construction...Warranted by faster trip times and higher ridership through congested corridor
AC Transit	TSP	Significantly improved bus speed
Calgary Transit	TSP	No warrants required—TSP is implemented on longer high-volume bus routes
Capital District Transportation Authority	TSP	Ridership, reliability, headway
Capital Metropolitan Transportation Authority	TSP	City of Austin (future project—2011)—Rapid Bus Program (Lamar and South Congress)
Chattanooga Area Regional Transportation Authority	TSP	Traffic volumes and route ridership
Chicago Transit Authority	TSP	Only test project planned
Community Transit	TSP	Transit delay and reliability
Des Moines Area Regional Transit Authority	TSP	Ridership
Fort Worth Transportation Authority	TSP	No specific warrants, first project applied to busiest corridor
Golden Gate Transit	TSP	Congested mixed-flow operations with undesirable delay that effects on-time performance
King County Metro Transit	TSP	Benefit/cost analysis, delay study, LOS analysis (LOS B-E)

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TABLE 5
(*continued*)

Agency	Treatment	Criteria/Warrant
MTA New York City Transit	TSP	Delay, traffic volumes
New Orleans Regional Transit Authority	TSP	Delay, LOS, need to maintain on-time performance
OC Transpo	TSP	Ridership, delay, reliability, traffic volumes
Pace	TSP	Delay due to red signal, number of times bus stops due to red light. Travel time saving potential, including frequency of bus as major factor, schedule adherence, and bus occupancy
Pierce Transit	TSP	Transit signal delay greater than 10 s
Regional Transportation District	TSP	Reliability, ridership, time savings
Sacramento Regional Transit District	TSP	One intersection
San Francisco Municipal Transportation Agency	TSP	Signal delay, ridership
SEPTA	TSP	Reduced headway times
Toronto Transit Commission	TSP	Benefit to transit on busy routes was sufficient to remove a vehicle and still provide same number of vehicle passes per hour, justifying the cost was the initial justification—later it was simply seen as a proper pro-transit tool
TriMet	TSP	Bus volumes, delay factors
Utah Transit Authority	TSP	Safer operation and faster trip times
Valley Metro RPTA	TSP	Delay
York Region Transit	TSP	All traffic signals in York Region on BRT routes
Calgary Transit	STS	No warrants required—case-by-case application
Capital Metropolitan Transportation Authority	STS	City of Austin (regular requests)—Left-turn protection signalizations
Golden Gate Transit	STS	Need for bus-only left turn signal to allow buses to turn where traffic is prohibited
King County Metro Transit	STS	Delay study, city's left-t urn signalization warrant, LOS analysis
OC Transpo	STS	Ridership, delay, reliability, traffic volume
Port Authority of Allegheny County	STS	Need to move buses through heavily congested areas
Sacramento Regional Transit District	STS	One intersection
San Francisco Municipal Transportation Agency	STS	Accommodate special transit movement
Toronto Transit Commission	STS	A good pro-transit tool
AC Transit	QJ/BL	Bypass congestion delay
Calgary Transit	QJ/BL	No warrants required—case-by-case application
Capital District Transportation Authority	QJ/BL	Bus volume
Capital Metropolitan Transportation Authority	QJ/BL	City of Austin (1st case)—North Lamar/Airport Blvd (Crestview Station)
Golden Gate Transit	QJ/BL	Congested mixed-flow operations with undesirable delay that effects on-time performance
King County Metro Transit	QJ/BL	Delay study, benefit/cost analysis, LOS analysis
MTA New York City Transit	QJ/BL	Delays, reliability
OC Transpo	QJ/BL	Ridership, delay, reliability, traffic volume
Pace	QJ/BL	Queue length, cycle failures to buses, delay due to red signal, number of times bus stops due to red light. Travel time saving potential including frequency of bus as major factor, schedule adherence and bus occupancy
Regional Transportation District	QJ/BL	Reliability, ridership, time savings
Sacramento Regional Transit District	QJ/BL	One intersection
San Francisco Municipal Transportation Agency	QJ/BL	Change from exclusive to mix flow, accommodate special transit movement
Toronto Transit Commission	QJ/BL	Justified on case-by-case basis
TriMet	QJ/BL	Bus volumes, loads, location of supporting bus stops

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TABLE 5
(*continued*)

Agency	Treatment	Criteria/Warrant
Utah Transit Authority	QJ/BL	Safety and efficiency for bus operations
York Region Transit	QJ/BL	Key locations on the BRT, which experienced major vehicle queuing and where there was sufficient road allowance to accommodate a queue jump lane
Capital Metropolitan Transportation Authority	CE	City of Austin (specific cases) at key stops—typically curb insets
Golden Gate Transit	CE	Needed for establishing accessible ADA bus stops
King County Metro Transit	CE	Delay study, pilot project with before/after study
OC Transpo	CE	Convenience for transit customers, delays, reliability, traffic volumes
San Francisco Municipal Transportation Agency	CE	Before-and-after loading delay, access to bus stop
TriMet	CE	Bus volumes; stop activity—ons/offs
York Region Transit	CE	Locations on the BRT route where provision of the curb extension would improve service reliability and minimize delays
AC Transit	LS	Significantly improve bus speed
Calgary Transit	LS	Limited stop routes are provided on an as-required basis in response to demand
Capital District Transportation Authority	LS	Ridership, reliability
Capital Metropolitan Transportation Authority	LS	City of Austin (working on Rapid Bus Program) and coordination of bus stops
Central Arkansas Transit Authority	LS	Travel time
Central Okla. Transportation and Parking Authority (COTPA)—Metro Transit	LS	Metro Transit has some routes on which we operate heritage trolleybuses and these are “limited stop”: we have no quantitative warrant associated with these.
Chicago Transit Authority	LS	Ridership, length of route, average bus speed, arterial street type
Golden Gate Transit	LS	Low ridership density corridors
MTA New York City Transit	LS	Headways, ridership
OC Transpo	LS	Ridership, delay, reliability
Pace	LS	Ons and offs, dwell time, bus travel time, density and walk time
Pinellas Suncoast Transit Authority	LS	Express bus services
Port Authority of Allegheny County	LS	A handful of routes offer limited stop service
Rochester–Genesee Regional Transit Authority	LS	Ridership
San Francisco Municipal Transportation Agency	LS	Closely located stops
Spokane Transit	LS	Potential for competitive travel time and increased ridership
Toronto Transit Commission	LS	Just a transit agency decision given that a parallel local service also provided
TriMet	LS	Type of service
Valley Metro RPTA	LS	Delay
York Region Transit	LS	Development of a service design standard that includes minimum 750-m spacing and minimum of 300 boardings per weekday
Calgary Transit	O	Bus only crossings—physical barriers or gates that allow bus passage between communities is established at the community road network planning stage
King County Metro Transit	O	Delay study, parking utilization study
Miami–Dade Transit	O	Travel delay caused by heavy traffic conditions on roadway

QJ/BL = queue jump/bypass lane, CE = curb extension, MT = median transitway, EL = exclusive lane, LOS = level of service, CBD = central business district, TSP = transit signal priority, STS = special transit signal, CE = curb extension, LS = limited stops, O = other, ADA = Americans with Disabilities Act.

TABLE 6
IDENTIFIED CRITERIA/WARRANTS FOR TRANSIT PREFERENTIAL TREATMENTS—LRT/STREETCAR

Agency	Treatment	Criteria/Warrant
Calgary Transit	MT	LRT operates within a protected, exclusive right-of-way, except in the downtown (see exclusive lanes below)
New Orleans Regional Transit Authority	MT	Delay, LOS, need to maintain on-time performance
San Francisco Municipal Transportation Agency	MT	Transit ridership, street width, traffic volume
Toronto Transit Commission	MT	Justification primarily the need to separate transit operations from effects of traffic delays; assisted by the fact that transit lanes carry as many people as a full auto lane
Calgary Transit	EL	7th Ave. S is a transit mall with access restricted to LRT, buses, and emergency vehicles
Central Arkansas Transit Authority	EL	To line up track with bridge ramp
New Orleans Regional Transit Authority	EL	Delay, LOS, need to maintain on-time performance
San Francisco Municipal Transportation Agency	EL	Transit ridership, street width, traffic volume
Utah Transit Authority	EL	Project justification through ridership. Most of street running portion of system is EL—Safety and efficiency
Calgary Transit	TSP	LRT has preemption over traffic signals outside of the downtown core
Central Arkansas Transit Authority	TSP	Safety
Los Angeles County Metropolitan Transportation Authority	TSP	Passenger volumes, distance of street run section, speed, traffic interface
Memphis Area Transit Authority	TSP	Improved transit vehicle headway and safety
New Orleans Regional Transit Authority	TSP	Delay, LOS, need to maintain on-time performance
Regional Transportation District	TSP	Reliability, ridership, time savings
Sacramento Regional Transit District	TSP	In downtown there is TSP
San Francisco Municipal Transportation Agency	TSP	Signal delay, ridership
SEPTA	TSP	Reduced headway times
Toronto Transit Commission	TSP	Benefit to transit on busy routes was sufficient to remove a vehicle and still provide same number of vehicle passes per hour; justifying the cost was the initial justification—later it was simply seen as a proper pro-transit tool
Utah Transit Authority	TSP	Safer operation, faster trip times, consistent trip times
Central Arkansas Transit Authority	STS	Safety
Sacramento Regional Transit District	STS	STS at some downtown intersections
San Francisco Municipal Transportation Agency	STS	Accommodate special transit movement
Toronto Transit Commission	STS	A good pro-transit tool
San Francisco Municipal Transportation Agency	QJ/BL	Change from exclusive to mix flow, accommodate special transit movement
Utah Transit Authority	QJ/BL	Safety
Central Arkansas Transit Authority	CE	Boarding locations
San Francisco Municipal Transportation Agency	CE	Before and after loading delay, access to bus stop
San Francisco Municipal Transportation Agency	LS	Closely located stops
Los Angeles County Metropolitan Transportation Authority	O	Safe operation of LRT

MT = median transitway, EL = exclusive lane, TSP = transit signal priority, STS = special transit signal, LOS = level of service, QJ/BL = queue jump/bypass lane, CE = curb extension, LS = limited stops, O = other.

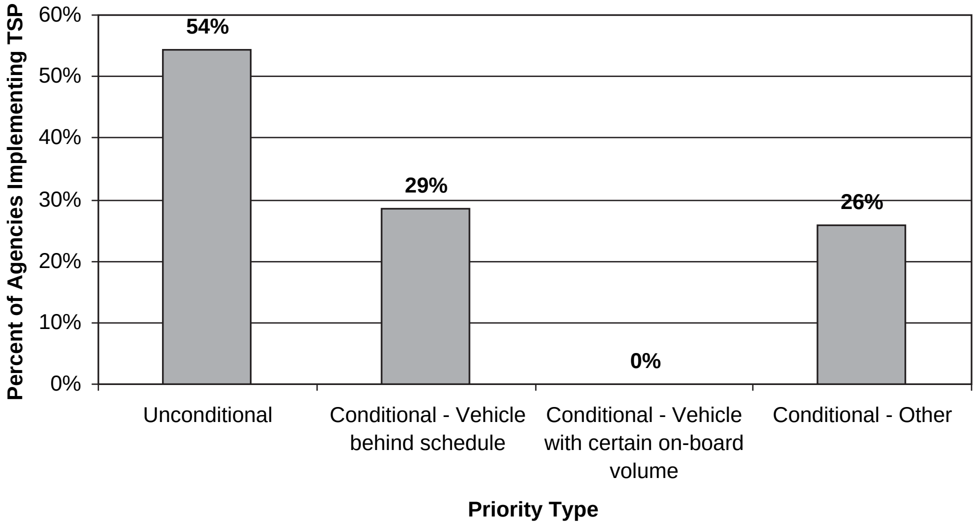

FIGURE 29 Active TSP types (bus and LRT/streetcar).

Figure 30 provides similar data for passive TSP treatments. Nearly half of all respondents implementing TSP indicated that they employ signal coordination to provide priority to transit vehicles. Some of the “other” passive treatments appear to be related to signal timing as well.

Traffic agencies were also asked about control of priority for both bus and LRT/streetcar implementations, which is illustrated in Figure 31. For the purposes of this survey, *centralized* control was considered to mean that priority decisions are made at some centralized system control center, whereas *distributed* was considered to imply that decisions are made locally at the cabinet controller where the request was received. Of those agencies responding to the survey, responses were split almost equally between centralized and distributed methods of control for bus transit, with one agency reporting that they do not implement TSP. For LRT/streetcar systems, although four responding agencies appear to implement some sort of TSP for their systems, only one agency noted that it uses a distributed approach to grant priority requests.

Transit agencies were asked to indicate what roles they played in the process of developing transit preferential treatments. This information is presented in Figure 32. From the figure, one notices that transit agencies tend to be more involved in the early phases of implementation in identifying and locating treatments and become less involved in the later stages, with the exception of monitoring performance. This is expected because local traffic engineering jurisdictions have control over the signal and roadway system and thus are typically more involved in construction and operations and maintenance of treatments. The increase in transit agency involvement in monitoring performance is not surprising because transit agencies tend to have the most to gain from this activity and there are now tools such as AVL and APC to collect data on transit operations.

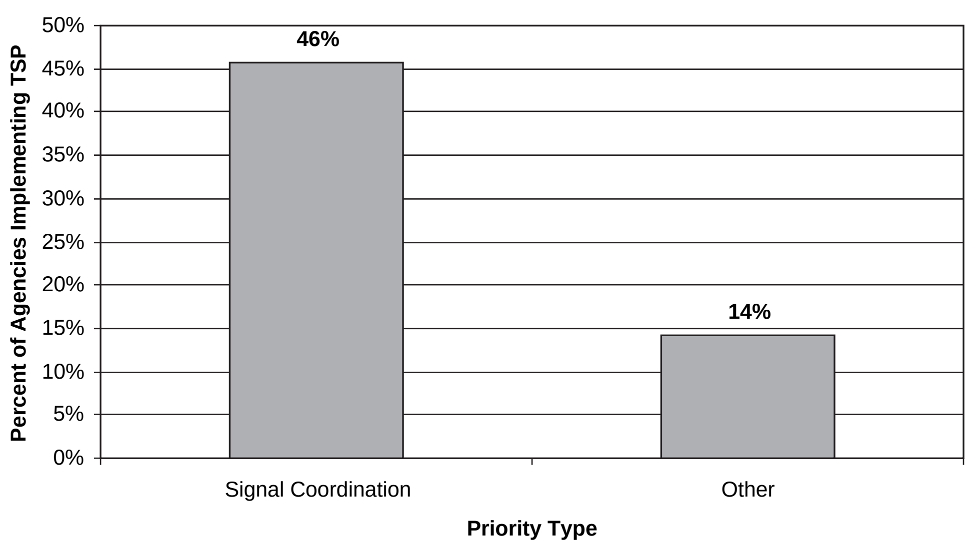

FIGURE 30 Passive TSP types (bus and LRT/streetcar).

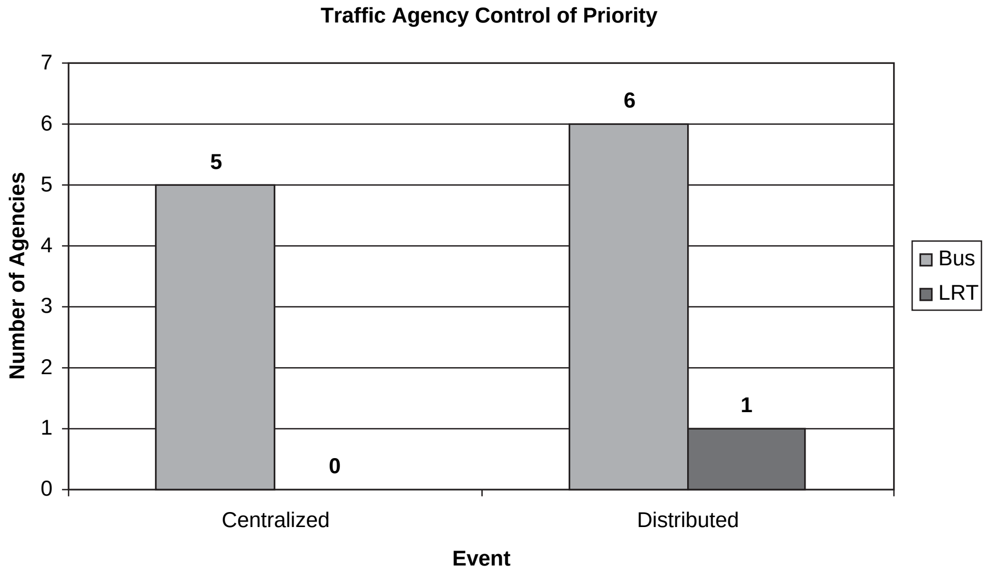

FIGURE 31 Traffic agency control of priority.

The survey asked a question on whether or not transit agencies have a comprehensive transit preferential treatment program in place to guide the development and implementation of transit preferential treatments. The vast majority (almost 80%) indicated that they do not have such a program, and that transit preferential treatments when developed occur on a case-by-case basis. Those that do have a program in place tend to be larger agencies such as the Metropolitan Transportation Authority in New York City, King County Metro in Seattle, and the Municipal Transportation Agency (MUNI) in San Francisco.

Transit agencies were also asked if they have any agreements with a traffic agency. A majority of agencies (56%) have such an agreement, although several agencies indicated that the agreements are somewhat informal in nature. This result is encouraging because it demonstrates a high-level of cooperation between transit and traffic agencies for mutual benefit. Again, larger agencies are more likely to have a comprehensive program, although some smaller agencies did as well.

Sample construction and operations and maintenance agreements related to TSP implementation were received from King County Metro in Seattle; Community Transit in Snohomish County, Washington; and TriMet in Portland, Oregon. These agreements are included in Appendix C.

Similar to the previous question, more than half of all agencies (56%) reported undertaking some sort of public input process before or during the implementation of a treatment. This result also is encouraging, because although transit preferential treatments may not be as visible to the public as new routes or transit vehicles, they do nevertheless improve

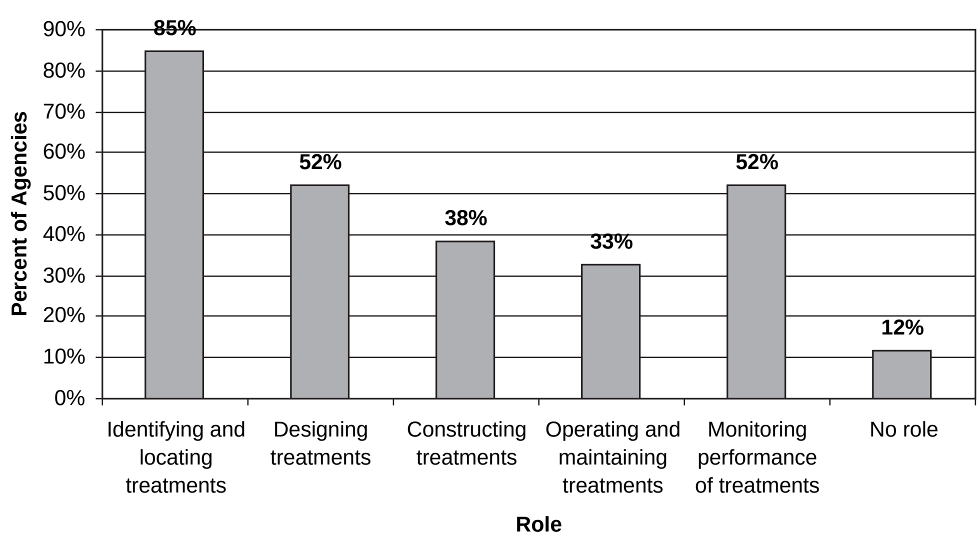

FIGURE 32 Transit agency roles.

TABLE 7
METHODS OF PUBLIC INPUT

Agency	Public Input Method
Capital District Transportation Authority	Open houses, meetings, mail outs, e-blast newsletters
Capital Metropolitan Transportation Authority	They will be part of the upcoming process (Rapid Bus—2011)
Central Florida Regional Transportation Authority (LYNX)	Public meetings
Connecticut Department of Transportation	Meetings, mailings
Fresno Area Express	Meeting, mail out
Greater Cleveland Regional Transit Authority	Numerous public meetings and outreach
Hillsborough Area Regional Transit	Meeting
King County Metro Transit	Community meetings, direct contacts to affected individuals/businesses
Lane Transit District	Workshops, charrettes, and meetings
Maryland Transit Administration	Meetings
Metro Transit	Public meetings
Miami–Dade Transit	Meetings, public announcements
Montgomery County (MD) Transit—Ride On	Generally meetings, mail outs, newsletters are proposed
MTA New York City Transit	Hearings, meetings
Nashville MTA	N/A—We don't currently have any transit preferential treatments
OC Transpo	In some cases we obtain public input/approval through public meetings; however, in many cases we do not obtain public approval before transit preferential treatments are implemented.
PACE	Meetings and handouts
Regional Transportation Commission of Washoe County	Public meeting for the BRT study on Virginia Street
Regional Transportation District	Meeting
Sacramento Regional Transit District	Mail outs and meetings
San Francisco Municipal Transportation Agency	Depending on treatment we may have community meeting and public hearing
SEPTA	City and/or township approval
Sound Transit	Meeting and mail out as well as website information
Toronto Transit Commission	Depends on the treatment—in some cases such as signal priority, no public input obtained; with any construction-related improvements such as median transit ways, extensive public process
Transit Authority of River City	Not applicable
Utah Transit Authority	Public input is considered during the public meeting process for any project. There is also consideration given to ongoing public comments provided to UTA and the various transportation departments.
Valley Metro RPTA	Meetings
York Region Transit	Public meetings, mail out

the experience of transit riders. A list of the methods employed by agencies to garner public input is provided in Table 7. The most common forms of public input are meetings/open houses and mailings.

TRAFFIC AGENCY SURVEY

Transit agencies were asked to provide contact information for traffic agencies with which they work, so that the agencies could verify information for the individual transit preferential treatments, as well as respond to a separate traffic agency survey. The following sections summarize the results of the traffic agency survey. The traffic agency survey questionnaire is in Appendix B, with detailed responses for each agency also provided in Appendix B.

A total of 12 agencies responded to the traffic agency survey:

- Washington Department of Transportation (WSDOT)
- City of Tacoma Public Works, Washington
- City of Eugene, Oregon
- City of Bellevue, Washington
- Los Angeles DOT, California
- Utah DOT
- City of Everett, Washington

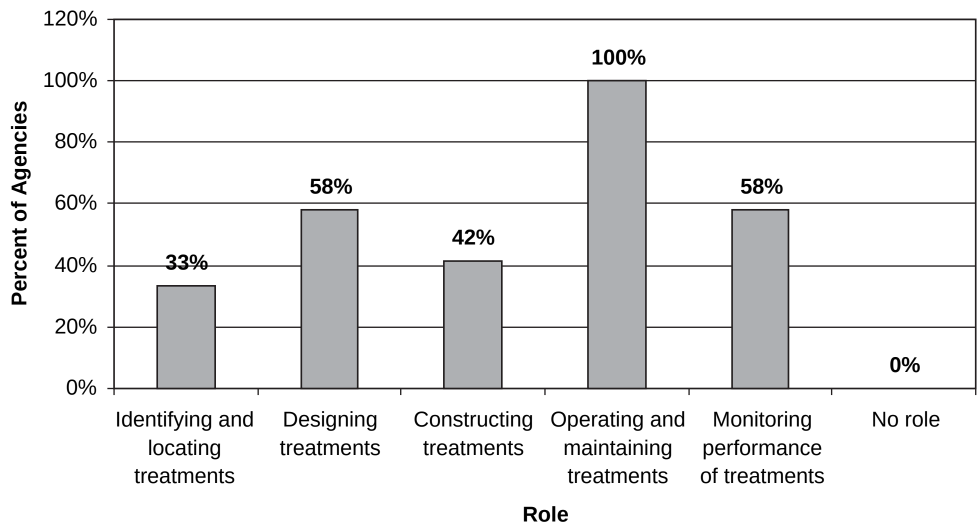

FIGURE 33 Traffic agency roles.

- Minnesota DOT (Mn/DOT)
- Sacramento County DOT, California
- City of Lynnwood, Washington
- Philadelphia Streets Department, Pennsylvania
- City of Ottawa, Ontario, Canada

Similar to the transit agencies, traffic agencies were asked to indicate what roles they played in the process of developing the transit preferential treatments identified in Figure 33. Generally, the traffic agencies verified the transit agency responses in indicating they have been more involved in the latter phases of implementation, in particular operations and maintenance. Again, the traffic agencies rely on the transit agencies primarily for identifying and locating preferential treatments. In their responses to monitoring the performance of treatments, the traffic agencies indicated a higher response owing to their focus on monitoring impacts on general traffic conditions of preferential treatments. Design and construction again appear to be shared functions. None of the responding agencies indicated they have no role whatsoever in transit preferential treatment development and monitoring.

Traffic agencies were asked about their perceptions of the impacts of various transit preferential treatments on general traffic operations. These perceptions were qualified as major, mild, or negligible, as identified in Figure 34. Not surprisingly, the two treatments considered by many to have a major impact were median transitways and exclusive lanes. These two treatments take the most ROWs and have the greatest impact on available general traffic capacity. Most remaining treatments were considered to have minor impacts. This is consistent with the relatively slight timing modifications associated with TSP (and its typical application at intersections operating under capacity), and the limited impact on through traffic with queue jump/bypass lanes. Limited stops had a nearly equal perception of minor and negligible impacts,

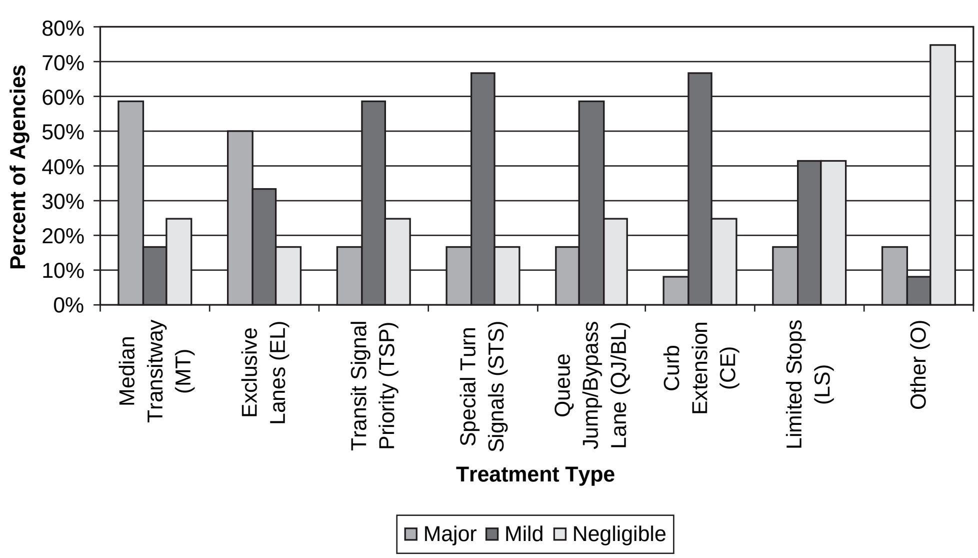

FIGURE 34 Traffic agency perception of transit preferential treatments.

TABLE 8
LANE WIDTH AND LENGTH TREATMENT

Agency	Minimum Median Transitway Width (ft) One-Way	Minimum Median Transitway Width (ft) Two-Way	Minimum Queue Jump/Bypass Lane Length (ft)
City of Eugene, OR			120
City of Everett, WA	11	22	100
City of Lynnwood, WA	9	20	80
City of Ottawa, ON	14	32	70
Los Angeles DOT	10	14	
Mn/DOT	10		300
Philadelphia Streets Department	12	24	
Utah DOT		30	

which is not surprising given that this treatment has the least impact on general traffic operations.

Traffic agencies were asked to provide geometric information concerning the minimum width of median transitway lanes and the minimum length of queue jump/bypass lane lengths. These data are presented in Table 8. One-way median transitway minimum widths are for the most part between 10 and 12 ft, whereas for two-way transitways the range is generally greater by a factor of 2 or more. Minimum queue jump/bypass lane lengths varied greatly, but centered mostly around 100 ft.

Traffic agencies were asked to provide details concerning their TSP operations. Tables 9 and 10 present the controller hardware and TSP software used, if identified, for bus and LRT/streetcar applications, respectively. Generally, cities that have both bus and LRT/streetcars employ the same controllers for both. It is clear that there are a variety of hardware and software providers to choose from.

Tables 11 and 12 indicate the types of TSP applied for both bus and LRT/streetcar, respectively. All responding agencies with TSP use early green and green extension to provide priority. Few agencies implement the other approaches, which may tend to be more disruptive, especially when considering coordinated signal systems. It is also interesting to note that the Utah DOT applies activated transit phases and phase rotation and insertion for LRT/streetcars, but not for buses.

Tables 13 and 14 identify the detection methods used for TSP calls for buses and LRT/streetcars, respectively. The most common method is optical/infrared, followed by inductive loop sensors. No agency reported using GPS despite its increasing affordability; however, there are GPS applications in certain cities that did not respond to the survey.

Continuing with TSP data collection, traffic agencies were asked whether they monitor and record TSP events or not. Only one-third of the agencies collect such information. When asked further about which events are monitored, all agencies that monitor events collect data concerning proper vehicle detection and equipment function, as displayed in Figure 35. Only one of the four agencies monitoring data indicated that they monitor use of queue jump/bypass lanes. However, this could in part be the result of other agencies not having any queue jump/bypass lanes to monitor. Furthermore, of the agencies that record data, all record the number of possible and actual TSP events, as well as their duration. This is promising as it demonstrates a continued desire to maintain and improve TSP by these agencies.

Traffic agency respondents were also asked about special actions taken for any of the transit preferential treatments, such

TABLE 9
TRANSIT SIGNAL PRIORITY EQUIPMENT—BUS

Agency	Controller	Software
WSDOT	Traconex TMP 390	J8
City of Tacoma Public Works	LMD9200	
City of Eugene, OR	170	McCain
City of Bellevue, WA	Econolite ASC/2	35906v1.04
Los Angeles DOT	2070	Los Angeles TPS Module software
Utah DOT	Econolite ASC/3	ASC/3
City of Everett, WA	Currently Multisonic; will be upgraded this year to a new controller and central system	Opticom ID tag will be used for bus priority
Sacramento County DOT		3M pre-emption with ACTRA signal system
City of Lynnwood, WA	Naztec 2070	Apogee
Philadelphia Streets Dept.	170	Bitrans
City of Ottawa, ON	Multilek	DirX

TABLE 10
TRANSIT SIGNAL PRIORITY EQUIPMENT—LRT/STREETCAR

Agency	Controller	Software
City of Ottawa, ON	Multilek	
City of Philadelphia Streets Department	170	Bitrans
Los Angeles DOT	2070	
Minnesota DOT	Don't know	Don't know
Utah DOT	Eagle M50 family	Siemens NextPhase

TABLE 11
TYPE OF TRANSIT SIGNAL PRIORITY TIMING MODIFICATIONS—BUS

Agency	Early Green	Green Extension	Activated Transit Phases	Phase Insertion	Phase Rotation
City of Bellevue, WA	x	x			
City of Eugene, OR		x	x		
City of Everett, WA	x	x			
City of Lynnwood, WA	x	x			
City of Ottawa, ON	x	x	x	x	x
City of Philadelphia Streets Department	x	x			
City of Tacoma, WA Public Works	x	x			
Los Angeles DOT	x	x	x		
Sacramento County DOT	x	x			
Utah DOT	x	x			

TABLE 12
TYPE OF TRANSIT SIGNAL PRIORITY TIMING MODIFICATIONS—LRT/STREETCAR

Agency	Early Green	Green Extension	Activated Transit Phases	Phase Insertion	Phase Rotation
City of Philadelphia Streets Department	x	x			
Utah DOT	x	x	x	x	x

TABLE 13
TYPE OF TRANSIT SIGNAL PRIORITY DETECTION—BUS

Agency	Optical/ Infrared	GPS	Inductive Loop	Wi-Fi	Wayside Reader	Other
City of Bellevue, WA			x			
City of Eugene, OR			x			
City of Everett, WA	x					
City of Lynnwood, OR					x	
City of Ottawa, ON			x		x	
City of Philadelphia Streets Department	x					
City of Tacoma, WA Public Works	x					
Los Angeles DOT			x	x		
Sacramento County DOT	x					
Utah DOT	x					
WSDOT	x					

TABLE 14
TRANSIT SIGNAL PRIORITY DETECTION TYPE—LRT/STREETCAR

Agency	Optical/ Infrared	GPS	Inductive Loop	Wi-Fi	Wayside Reader	Other
City of Philadelphia Streets Department	x					
Utah DOT			x			x

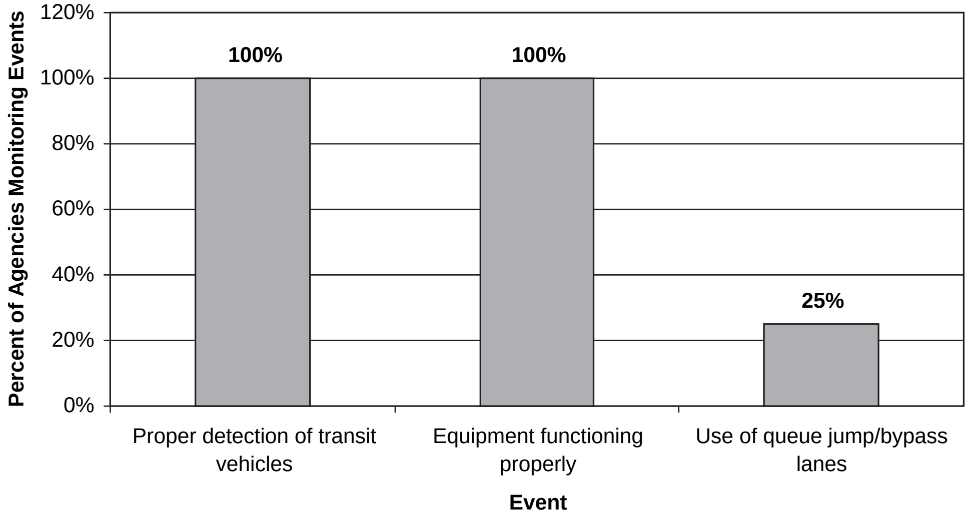

FIGURE 35 Traffic agencies monitoring events.

as special signing, striping, or design. Table 15 provides a list of these special treatments by agency.

Interesting treatments include rail-type signals being used in a block operation for the Eugene BRT and painting of exclusive bus lanes in Ottawa.

Traffic agencies were asked whether there is an intergovernmental agreement with the transit agency concerning transit preferential treatments and, if so, whether there are any enhancements that would be desirable. Four agencies indicated there was no agreement:

- WSDOT
- Los Angeles DOT
- City of Everett, Washington
- Sacramento County DOT, California

Clarification of, or the desired enhancements to, existing transit preferential treatment intergovernmental agreements for the remaining eight agencies are provided in Table 16.

Finally, traffic agencies were asked to indicate their level of support for each of the transit preferential treatment types. The results are provided in Figure 36. In general, most types enjoy major support. Similar to the level of impact, median transitways and exclusive lanes have lower levels of major support than the other types. It is interesting to note that both curb extensions and special turn signals have higher levels of "no support" than exclusive lanes, even though exclusive lanes generally have greater impacts and cost more. Both TSP and limited stops did not receive a single vote of "no support" from the respondents, indicating a high level of acceptance of these approaches.

TABLE 15
SPECIAL SIGNING/STRIPING/DESIGN TREATMENTS

Agency	Treatment
City of Bellevue	A signal priority loop is marked as "Bus Detector" with a blue light to let operator know the bus has been detected.
City of Eugene	Queue jumps have separate signal heads and lanes. Exclusive bus lanes are signed appropriately. Rail type signals are used in block protected bi-directional exclusive lanes.
City of Lynnwood	Signs indicate: Right Lane Must Turn Right Except for Bus
City of Ottawa	Bus signal signing, experiment with painting lanes red
Los Angeles DOT	Signing and striping modifications to accommodate for far-side bus stops
Minnesota DOT	Signs for the bus shoulders and for HOV bypasses. Special diamond striping and overhead changeable message signs for the HOT (high-occupancy toll) lanes
Philadelphia Streets Department	Only where there is a separate marked area in the center of Girard Avenue for the Route 15.
Utah DOT	At all sites where left turns are allowed from a parallel movement across LRT tracks there are blank-out warning signs that are lit with an image of a train when a train is approaching the intersection. Additionally, at sites where one of two dual left-turn lanes is shared with the LRT trackway, there are blank-out signs warning motorists to stay off the track when a train is approaching from the rear. The signs are not lit if vehicles are already in the lane.

TABLE 16
TRANSIT AGENCY AGREEMENT ENHANCEMENTS

Agency	Intergovernmental Agreement Enhancements
City of Bellevue	Each agreement is more project-specific, and longer ranging and lacking consistency. They appear to be highly variable depending on capital funding available and project manager.
City of Eugene	The agreement is informal and based on mutual benefit.
City of Lynnwood	The only comment is that the city has not had any discussions to determine agency-wide desires. There is some desire to add training for central software operation to include analysis and reporting.
City of Ottawa	Define the number of buses required for treatment levels.
City of Tacoma Public Works	Not sure
Minnesota DOT (Mn/DOT)	The real answer is "no," not a written agreement. However, there is an interagency working group called Team Transit that develops ideas and is chaired by Mn/DOT. The working group has developed nearly 300 miles of bus shoulders and many other transit advantages and appears to work well. There is a written policy to provide transit advantages applied to freeways and expressways as appropriate (also in statute).
Philadelphia Streets Department	For each project there is an agreement. These three were pilots.
Utah DOT	The agreement at present is informal but is undergoing review with the transit agency and other traffic agencies. It will then be formalized. One enhancement desired by all the participating agencies (traffic and transit) is that no more sites will be constructed with shared trackway/left-turn lanes, because they have been problematic.

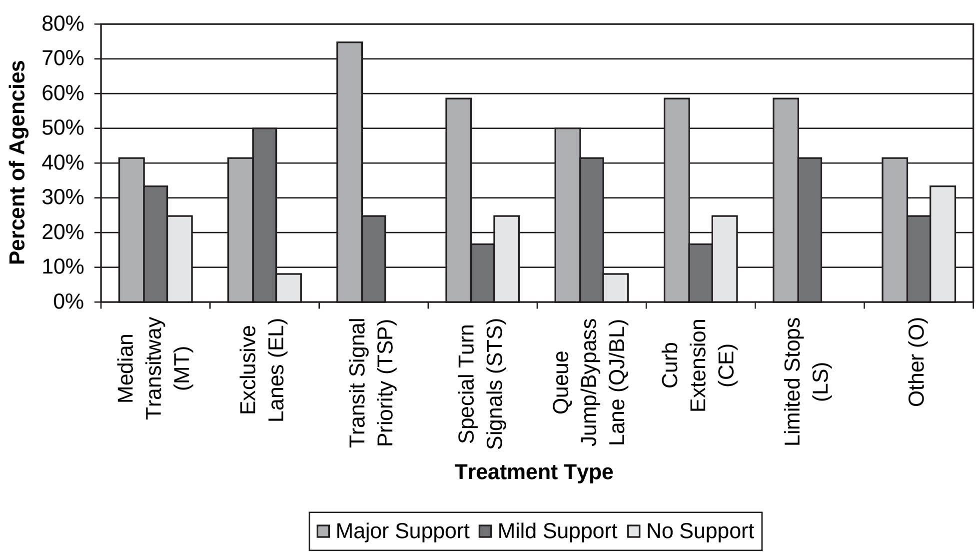

FIGURE 36 Traffic agency support for transit preferential treatments.

CHAPTER FIVE

CASE STUDIES

INTRODUCTION

This chapter presents the results of a more detailed review of certain urban areas that have implemented transit preferential treatment programs on urban streets. These areas have used a variety of different treatments and they have established partnerships between the transit agencies and traffic engineering jurisdictions to implement the treatments.

The urban areas reviewed are San Francisco, Seattle, Portland (Oregon), and Denver. Information and data on the transit preferential treatment programs in these cities were obtained by a review of documentation developed for these programs, as well as phone interviews.

SAN FRANCISCO, CALIFORNIA

The city/county of San Francisco has perhaps the most extensive transit priority system in the United States related to its surface light rail, streetcar, cable car, and bus operations. The development and operation of transit service in San Francisco are the responsibility of the Municipal Transportation Agency (SFMTA).

History

The MUNI Transit Preferential Streets Program was established in 1973. The purpose of the program is to expedite transit services, expressed in a Board of Supervisors resolution as "increased speed and regular frequency of transit service serves to encourage greater use of public transit, which in turn reduces traffic congestion and air pollution and may well increase farebox revenues." The initial program through the 1980s focused on improvements in ten corridors—Sutter and Post Streets, Geary and O'Farrell Streets, Mission Street, Stockton Street, Polk Street, 3rd and 4th Streets, and Fillmore Street. Priority treatments included exclusive transit lanes and bus bulbs, and numerous administrative and enforcement actions such as traffic signal timing improvements, tow-away lane extensions, relocation of mailbox and newspaper rack obstructions and discouragement of auto-oriented land uses on transit streets. These improvements were subsequently expanded to other corridors in the city. In the late 1990s, TSP was initiated in two major bus corridors—Mission Street and Potrero Street.

Transit Preferential Streets Committee

Because transit preferential projects often cut across the jurisdiction of several city departments in San Francisco, a Transit Preferential Streets Committee was formed in 1973 to coordinate efforts between the staffs of different city departments. Initially, the TPS committee included representatives of MUNI (then responsible only for transit operations), the Department of Public Works (then responsible for traffic engineering operations), the Police Department (responsible for traffic and parking enforcement), and the Department of City Planning, which was responsible for the city's Master Plan and Preferential Streets Program. In recent years, a new SFMTA was created that merged MUNI and a revised Department of Parking and Traffic into a single agency. With this merger a multi-faceted committee review structure has been put in place related to transit preferential treatments.

Current Treatments

Today, MUNI has more than 460 different transit priority treatments on its street system. This includes 246 intersections with signal priority, 132 boarding islands along its light rail lines (53% with low-level platforms and shelters), 52 bus bulbs, and 32 sections of exclusive transit lanes totaling 17.1 miles. Figures 37 and 38 show the locations of these various treatments.

MUNI's TSP system includes use of the V-tag detection system for light rail and streetcar priority through certain signalized intersections, and optical infrared detection for bus signal priority where applied. MUNI has plans to upgrade the signal controllers in the city to 2070 models, and install the D4 software that has the capability of instituting enhanced TSP for both rail and bus operations.

Most of MUNI's light rail system operates at-grade, on median-running transit lanes, with most median mileage shared with bus and general traffic. Dedicated median transitways for LRT are in place for the T line in the 3rd Street corridor, along the south end of the M line in the 19th Avenue corridor, and on a short section of the N line in the Judah Street corridor.

The T line was completed in 2003 as a completely dedicated median transit facility, with new 2070 signal controllers and priority through every signalized intersection

FIGURE 37 TSP treatments on San Francisco street system (*Source:* SFMTA).

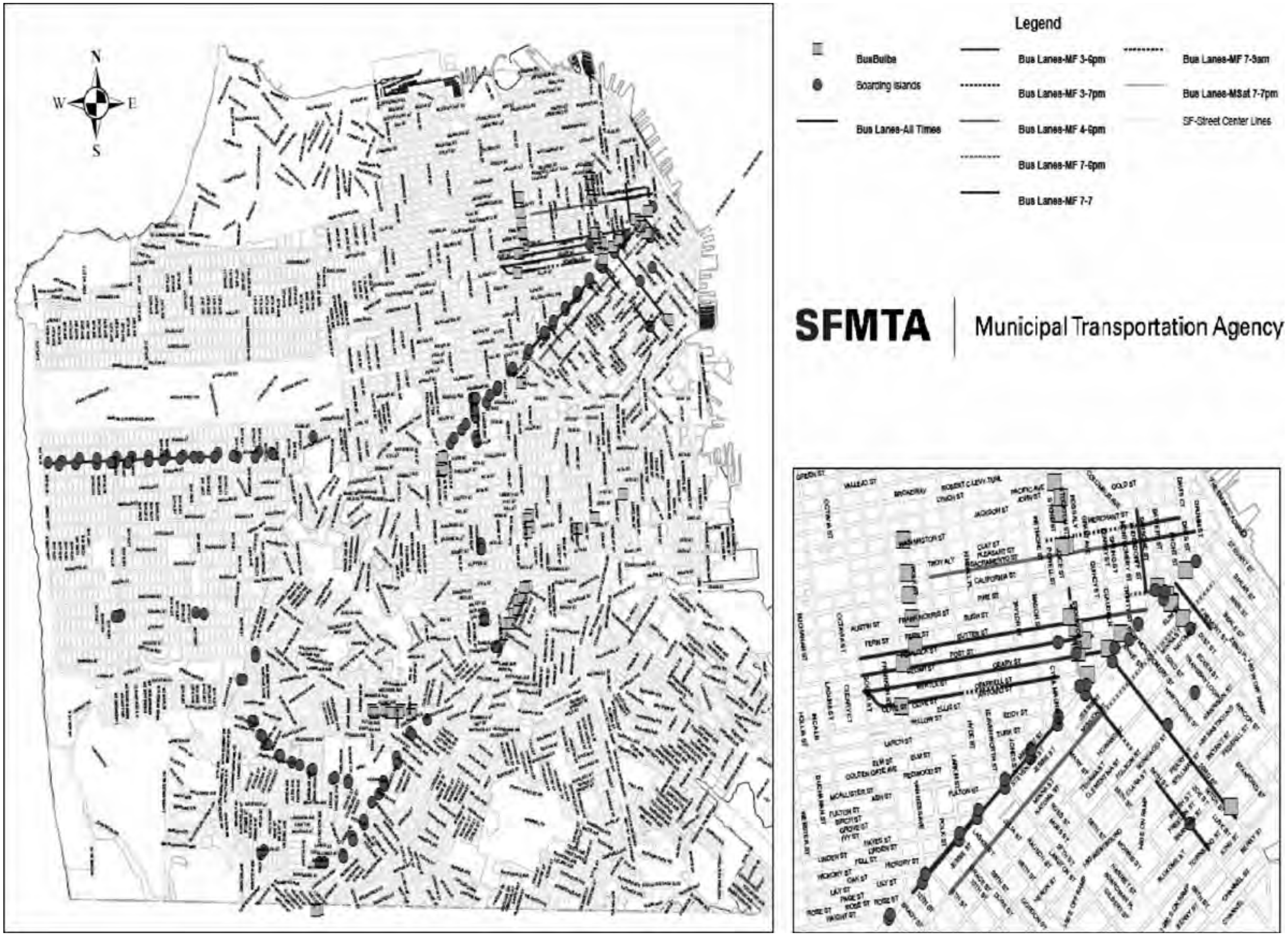

FIGURE 38 Exclusive lanes/boarding islands/bus bulb treatments on San Francisco street system (*Source:* SFMATA).

along the route. Along the other light rail and streetcar lines, only the E streetcar line has any continuous signal priority; other lines have just a few intersections with signal priority.

For the sections of the light rail and streetcar system operating in shared lanes there are several locations where boarding islands have been developed in the street to board and deboard passengers. Most of these islands are located near side, ranging in length from 40 to 140 ft. Many of the islands are not long enough to allow one or more doors of a second car on a train to align with the island, thus requiring passengers to board and alight from the street. Several islands also have a restricted width (4 to 6 ft) owing to the restricted street cross sections.

Bus bulbs are provided at scattered locations throughout the city. Most bulbs have been developed at near-side stops, and some have enhanced passenger amenities included.

Seventeen of the 32 sections of exclusive lanes are designated for all day use by buses, another four for use between 7 a.m. and 6 or 7 p.m., and the rest only during peak periods (typically 7 to 9 a.m. in the morning and 3 or 4 p.m. to 6 or 7 p.m. in the afternoon). All of these lanes are marked by side of street and overhead signage, with no use of overhead lane use control signals.

Transit Priority Organization

The current Transit Preferential Streets Program at SFMTA is housed under the Street Management Section within the MTA Planning Division. This program is responsible for identifying new and improved preferential treatments on the city street system, through field review and added studies, and developing an updated capital improvement program to advance TPS application. Within the Department of Parking and Traffic there is a separate "SFgo" section that provides assistance with scoping and implementing TSP treatments, whereas the Special Projects/Street Use section is involved in special events and associated special priority treatments.

Three committees provide input on the planning, design, and implementation of transit preferential treatments within SFMTA. First, there are bi-weekly staff meetings between the Traffic Engineering and MTA Operations groups to review short-term issues and needs with respect to improving rail and bus operations on the city street system. Every month, there is a broader MTA Street Management Committee meeting that includes the Traffic Engineering, Transit Operations, Service Planning, Transportation Planning, Police, and Parking Enforcement Groups to review street operations, transit preferential treatment needs, and implementation issues. Every two weeks there is also a meeting between MTA Planning and Traffic Engineering and the City Planning, Public Works, Police, and Fire Departments. These groups, in addition to the San Francisco County Transportation Agency, also meet on an annual basis to develop updated 5-Year Capital Improvement Plans, including transit preferential treatment improvements.

In 2007, SFMTA initiated a Transit Effectiveness Program (TEP) to identify improvements in the management and operation of MUNI services and facilities to improve travel time, reliability, and overall service accessibility. The program includes the designation of a rapid route system that includes all rail lines plus the development of new limited stop and BRT service in certain bus corridors (see Figure 39). A cornerstone of the program is the development of further transit priority improvements on the surface rail and bus system. A part of this program will include a major expansion of TSP, including the replacement of the current optical infrared bus detection system with a GPS or another more advanced system. The program also includes the development of added boarding islands on the surface rail system and bus bulbs, and potentially relocating certain existing boarding islands to be more compatible with added signal priority for surface rail operations.

The TEP is incorporating a thorough review and modification of bus and rail stop locations to facilitate transit operations in the city. This includes stop consolidation on new limited stop routes, and moving certain stops to provide better overall stop spacing and to provide added opportunities to apply TSP. The TEP has its own division within the Department of Parking and Traffic at SFMTA. Staff interacts with the other divisions in scoping transit priority treatments associated with its program.

SEATTLE, WASHINGTON

History

In 1993, King County Metro established its Transit Speed and Reliability Program. Now in its 16th year, it has been responsible for scoping and coordinating the development of more than 200 transit priority treatments on the street system within King County, including TSP (using radio frequency tag/wayside reader technology), special signal phasing, queue jump/bus bypass lanes, curb extensions, and stop consolidation and relocation. The program's most recent budget for FY 2009 was $25.5 million.

There have been several studies over the past ten years conducted by or for Metro to identify the effectiveness of TSP implementation in the Rainier Avenue South, Aurora Avenue North, and First Avenue South corridors, and to identify potential bus priority strategies in other corridors.

Current Focus

Today the Speed and Reliability Program is comprised of ten staff in its technical work group: four Traffic Engineers, two Senior Project Managers, two Information System

FIGURE 39 SFMTA TEP recommended network (*Source:* SFMTA).

professionals, one Project Assistant, and one Supervisor. There are five areas where this staff provides services:

1. Partnerships on corridor-level improvement projects led by others, where county participation is identified through interagency agreements.
2. Traffic operations analysis/technical support to King County Metro's Transit (Operating) Division.
3. Speed and reliability project initiatives, including scoping both spot improvements and corridor-level solutions. Spot improvements that are completed in the previous six months are highlighted in a bi-annual report.
4. Regional TSP development, testing, and acceptance of new signal priority installations, operations and maintenance agreements with local jurisdictions, and re-engineering of the transit priority request technology.
5. Special ITS assignments, which have included managing a real-time bus information demonstration and the design of a real-time bus monitoring system for the Seattle CBD, providing technical support for a new on-bus ITS system, providing support to King County Roads for the selection and installation of their central traffic control system, and participation in national Transit Communication Informational Protocol and National Transportation Information Communication Information Protocol Standards committees for TSP.

King County Metro has entered into several intergovernmental agreements in recent years related to transit preferential treatment implementation on the roadway system in the county. Appendix C includes the blanket agreement covering overall King County and city of Seattle participation in this program. Also included in Appendix C is a sample agreement between King County and a smaller city, the city of Shoreline, related to the design, construction, operations, and maintenance of transit preferential treatments in the Aurora Avenue Corridor. The Shoreline agreement includes an interesting payback provision that requires the city to reimburse a prorated portion of the initial $1 million contribution by Metro to the project if the city were at any time over the next 15 years to cease the restricted use of the bus lanes planned for the project.

Speed and Reliability Service Partnerships

King County Metro has adopted a 10-year transit service improvement plan, called *Transit Now* that has as its cornerstone the development of new BRT service in five corridors, as well as extensive service improvements on its local and express bus system. A key strategy in this implementation effort is entitled *Speed and Reliability Partnerships.* These arrangements between King County and any of the 20 cities within the county contain eligible core service connections in Metro's system, including Rapid Ride corridors. The cities agree to complete changes to traffic operations and facilities within five years that will improve bus travel time by at least 10% on these routes. In exchange, Metro commits to adding 5,000 transit service hours per year for each core route along the improved corridor(s) that achieves the travel time savings. Metro reserves the added service hours at the time of the agreement, and the service is added after the traffic improvements are complete. Metro also will help cities identify the types of improvements that are likely to achieve sufficient travel time savings and the traffic field data collection or operations models that will be used to measure the savings.

Most of the 20 cities within King County share core service connections with one or more jurisdictions, and the 10% transit speed improvement must be measured along the entire corridor. Thus, cities considering speed and reliability partnerships have been encouraged to include other cities in their agreement with Metro. The speed improvement must be in both directions along a route, for 12 core hours of weekday operation: three hours in both the a.m. and p.m. peak, and six hours between these peaks.

Metro's primary evaluation tool to assess transit speed improvements is the traffic operations software known as Synchro. When cities submit their proposals for evaluation, they must supply models for the applicable weekday a.m. and p.m. peak and off-peak conditions for the applicable street segments. These models must be based on traffic counts obtained within the past three years and signal timing plans that have been optimized within the past three years. Using current data, Metro staff then supplies transit travel times and transit travel time variability along the length of each route being evaluated by time of day and direction of travel, which will serve as the baseline for computing the 10% travel time savings. Metro will proceed and run the Synchro model, without and with the identified travel time improvements, and evaluate the results.

A checklist has been developed by Metro for use by cities in reviewing the applicability of their proposal(s) (see Figure 40). A sample Speed and Reliability Partnership Agreement is found in Appendix C.

Effectiveness of Transit Signal Priority System and Planned Enhancements

The evaluation studies conducted for the Rainier Avenue South, Aurora Avenue North, and First Avenue South corridors revealed a peak-hour bus travel time savings ranging from 5.5% to 8%, with bus delay decreases ranging from 23% to 34%. Average person delay during peak hours decreased from 2% to 13%. In the Aurora Avenue North corridor, bus travel time variability was reduced by 39% to 50%. Based on field observations and simulation modeling, TSP as implemented had minimal impacts on queue lengths on side streets and left-turn lanes on the major street.

Checklist for Transit Now speed and reliability partnership
Requirements and priority criteria

Partner(s): ____________________

Proposal location: ____________________

Proposed implementation date: ____________________

Applicant: Please complete both pages of this checklist and include with your proposal.

Requirements

Yes/No	Speed and reliability partnership requirements
	Capital improvements or traffic operations changes will be made along a RapidRide or core service connection corridor. Which one(s)? ____________
	The traffic operations changes are projected by Metro to result in transit speed improvements of 10 percent or more on each affected core route for 12 core hours of weekday operation. The speed improvements are projected to be met in both directions and during six-hour weekday am and pm peak as well as six-hour midday.
	Proposed service will be managed by Metro and available to the general public.
	Proposed service will operate primarily on local streets and arterials, not primarily on state or interstate highways.
	Proposed new partnership hours fit within the calendar year limit of half of total new service hours funded by Transit Now.
If the answer to all applicable requirements above is "yes," your proposal is eligible and will be reviewed against the priority criteria on the next page.	

Priority criteria for eligible speed and reliability partnership

Yes/No	**Speed and reliability partnership priorities—in priority order** Note: Direct financial partnerships have priority over speed and reliability partnerships
	The capital investment or traffic operations change by the partner or partners will create a transit speed and reliability benefit along a continuous RapidRide corridor.
	The partner(s) will commit to additional traffic operations management actions that achieve transit priority in excess of the required projected 10% travel-time savings.
	The improvements can be completed within five years.
	The partner(s) will commit to provision of complementary actions that improve operations or ridership, such as: ___ Implementing innovative transit signal phases and timing; ___ Providing the infrastructure, preferably fiber, required to support communication between transit signal priority equipment in the field and from the field back to the applicable agency and to Metro; ___ Adding curb space for transit terminal or layover; ___ Establishing parking management to increase the attractiveness of ridesharing; ___ Implementing pass subsidy and promotional programs that achieve higher ridership; ___ Taking other actions that improve the pedestrian environment.

checklist_speed_reliability.doc

FIGURE 40 King County Metro Speed and Reliability Partnership Criteria (*Source:* King County Metro).

The King County Metro Transit Speed and Reliability Program has developed a Transit Signal Priority Interactive Model to be used in estimating the impact on transit operations of implementation of TSP at an intersection. The model can identify the vehicle and passenger travel time savings per trip and for the entire analysis period for particular signal controller settings to institute transit priority. Figure 41 presents an example worksheet developed for the Fremont Avenue/39th Street intersection associated with an evaluation of bus priority treatments along Route 5 in north Seattle.

With the implementation of the Rapid Ride program, Metro is reassessing its TSP strategy and looking at new technology and operating options that would give buses a greater degree of priority at signalized intersections. This includes assessment of both a "conservative" and an "advanced" approach.

Intersection #:	30	(FREMONT AVE N & N 39th ST)
Progression Effectievness	Cycle Defined	
Number of TSP Readers	2	

Reader Information	Distance (feet)	Travel Speed
Reader 1	500	25
Reader 2	500	25

SUMMARY OF RESULTS	
Daily Transit Vehicle Trips:	91
Daily Transit Vehicle Time Savings:	0:19:56
Daily Passenger Trips:	1,787
Daily Passenger Time Savings:	6:24:10
Intersection Capital Costs:	$36,500
Annual Operational Costs:	$1,000
Total Present Value Costs (10 years):	**$45,030**
Annual Transit Benefits:	$5,813
Annual Passenger Benefits:	$17,608
Annual Benefits	$23,421
Total Present Value Benefits (10 years):	**$199,783**
Benefit to Cost Ratio (B/C):	**4.4**

Time Period:	AM	Load Timings from Synchro Report	Cycle Lengths:	144
Begin AM:	6:30 AM		Total Transit Trips:	20
End AM:	9:00 AM		Transit Trip Check:	Okay
TSP Frequency:	3X Cycle		Ring 1 Check:	Okay
User Defined TSP Frequency:	360		Ring 2 Check:	Okay

Ring 1				
Signal Progression Phase	1	2	3	4
TSP Phase	1	No	2	No
Average Phase Split	32	31	48	33
TSP Split	29	20	43	28
Green Extension	10		10	
Progression Effectiveness				
Number of Transit Trips	10		10	
Average Passengers Per Trip	32.3		11.6	
Benefits Per Trip	14.4	0.0	14.3	0.0
Transit Travel Time Savings	144	0	143	0
Passenger Time Savings	4,644	0	1,658	0

Ring 2				
Signal Progression Phase	1	2	3	4
TSP Phase	No	No	No	No
Average Phase Split	32	31	48	33
TSP Split	29	20	43	28
Green Extension				
Progression Effectiveness				
Number of Transit Trips				
Average Passengers Per Trip				
Benefits Per Trip	0.0	0.0	0.0	0.0
Transit Travel Time Savings	0	0	0	0
Passenger Time Savings	0	0	0	0

AM Summary	
Benefits Per Trip	28.7
Transit Travel Time Savings	287
Passenger Time Savings	6,302

FIGURE 41 King County Metro TSP Interactive Model—Example spreadsheet [*Source:* Route 5 Evaluation Final Report, DKS Associates (*30*)].

The conservative approach involves modifications to the existing priority system such as increasing the frequency of priority calls, allowing any bus to obtain priority regardless of the number of passengers on board or its on-time performance, and longer green extension/red truncation green phase allocations to bus operations. The advanced approach would take the necessary steps to ensure that a bus clears an intersection without stopping, similar to the full priority operation used for light rail.

From a technology perspective, Metro is proceeding with an on-board systems integration project that will include wireless communications to the TSP equipment in the signal equipment, as opposed to the original radio frequency tag/wayside reader technology. This system has been estimated to save 70% of the cost of installing TSP per intersection. Using this new system, TSP is scheduled to be installed at 120 intersections in the five Rapid Ride corridors.

PORTLAND, OREGON

TriMet, the public transit agency in the Portland, Oregon, area, includes bus, light rail, and streetcar operations. It has been implementing transit priority treatments on the street system in its region since the late 1970s, primarily in the city of Portland.

History

Transit priority treatments in Portland started with the 5th and 6th Avenue bus malls in 1976. These streets were primarily used by local and express buses, with general traffic sharing the street, in certain blocks in their own lanes (primarily for hotel and parking garage access). This was followed by the implementation of median bus lanes on Barbur Boulevard south of downtown Portland in 1978 (these lanes were discontinued in 1984 owing to some intersection crash experience). In 1985, Portland's first light rail line opened between downtown and Gresham, with the line downtown operating in on-street dedicated lanes next to general traffic (on Morrison and Yamhill Streets), and a median transitway configuration along East Burnside Street east of I-205.

In 1992, TriMet received a grant from the FTA to develop on-street priority and stop improvements and initiated a Transit Streets Program in the city of Portland. This program was oriented to bus stop improvements (new or improved passenger waiting areas, curb ramps, shelter pads), but did include some intersection priority treatments such as bus bypass lanes, stop relocation, and special signal phasing.

In 1994, TriMet ventured into bus signal priority development. It started with a test of two alternate bus detection technologies on Powell Boulevard (LoopComm—an inductive loop/transponder system and TOTE—a radio frequency tag/wayside reader system). This was followed by a test of the Optical Infrared bus detection technology on Multnomah Boulevard in 1995. After further testing of the Optical Infrared technology in a suburban area west of Portland—on Tualatin Valley Highway, TriMet was ready to proceed with a wider scale application of this technology.

At the same time, the city of Portland was interested in applying the Optical Infrared technology for emergency vehicle preemption on a portion of its signal system, and hence TriMet and the city cooperated on submitting a grant application for $4.5 million to obtain Congestion Mitigation and Air Quality (CMAQ) funding to develop a combined transit priority/emergency vehicle preemption system in the city. This was known as the "Streamline" program. The intended goal of the program for TriMet was to recoup its investment through running time saved by "streamlining"—in other words, if four or five buses could be saved during peak period operation, the bus operating cost savings would offset the investment in transit preferential treatments paid for through TriMet's contributions to the program. To date, signal priority has been installed at 275 intersections using the Opticom Infrared technology.

Since the opening of the first LRT line in 1986, two additional lines have been developed with extensive street-running operation: (1) the Westside line (opened in 1998), which operates on-street using Morrison/Yamhill Streets, 18th Avenue, and SW Jefferson Street on the west side of downtown, and along Washington Street through central Hillsboro (now connected with the Eastside line to form the Blue Line), and (2) the Yellow Line (opened in 2004), which operates much of its route along North Interstate Avenue in a median transitway through north Portland.

In 2001, the Portland Streetcar line opened, operating along 10th and 11th Avenues though downtown Portland and along Lovejoy and Northrup Streets in northwest Portland—sharing the right through lane on these streets with general traffic. In September 2009, the original bus malls along 5th and 6th Avenues were reopened to include LRT vehicles and general traffic along their entire length, along with bus traffic.

Impacts of the Streamline Program

The Streamline program was applied to 12 of the more heavily used routes in TriMet's bus system. In an evaluation of the effectiveness of the program, four specific measures were identified through "before" and "after" assessments of each route: ridership changes, additional fare revenue, on-time performance, and roundtrip time savings. The following is a summary of streamlining impacts that have been identified to date, from a 2007 report:

1. The time savings resulting from streamlining has not allowed any permanent reduction in the number of peak buses on a route—therefore, no short-term operations savings.
2. The 12 streamlined routes, on average, operate a round trip 0.8 s faster than during the weekday a.m. peak period in 2000. In comparison, seven non-streamlined routes in

the city of Portland were identified as having a round-trip travel time 1.3 s slower than in 2000, and four suburban routes were shown to operate 2.3 s slower than in 2000.

3. The running time savings that have been achieved through streamlining have delayed adding buses to streamlined routes by an estimated eight years. An annual $140,000 operating cost per saved bus, multiplied by 12 routes over eight years, results in $13.4 million in long-term savings. The value of delaying the purchase of 12 additional buses for eight years is an added capital cost savings.
4. The combination of focusing service increases on frequent service routes, accompanied by streamlining and marketing efforts, has resulted in 12,000 more weekday bus boardings than would have occurred if service change resources were spread systemwide. These added passengers result in added fare box revenue of approximately $1.7 million annually.

Figure 42 shows TriMet's current bus signal priority system as it is relates to its four proposed BRT routes and the rest of the transit system.

DENVER, COLORADO

The Regional Transportation District (RTD) in Denver has been involved in transit priority development on its urban streets since the early 1980s. Four substantial transit service and facility improvements were implemented in the 1981–1984 time frame:

- 16th Street Transit Mall
- Skip-stop operation on 15th and 17th Streets
- Broadway/Lincoln bus lanes
- Limited Stop Service on East Colfax Avenue.

Each of these projects has had a significant impact on providing travel time improvements to and through the downtown Denver area. A further description of each project, how it developed, and its current impact are described here.

16th Street Mall

The 16th Street mall was a project completed in 1982 that provided new low-floor, electric bus service connecting two new transit centers at the east and west ends of downtown; at Blake Street and the Civic Center. The transit mall was developed as a complete rebuild of 16th Street, with granite pavers and expanded sidewalks. The mall was developed with no lanes for general traffic, with emergency vehicles allowed to use the transit lanes when needed.

A key element of the 16th Street shuttle operation is a TSP system that enables shuttle buses to navigate the length of the mall with a highly reliable signal progression system. The city/county of Denver traffic engineering staff, in conjunction with RTD staff, developed a "single alternate progression" system based on a 75-s downtown traffic signal cycle length. It provides a green signal at each intersection along the mall after a shuttle bus has traversed a block, made a near-side stop to board and deboard passengers, and is ready

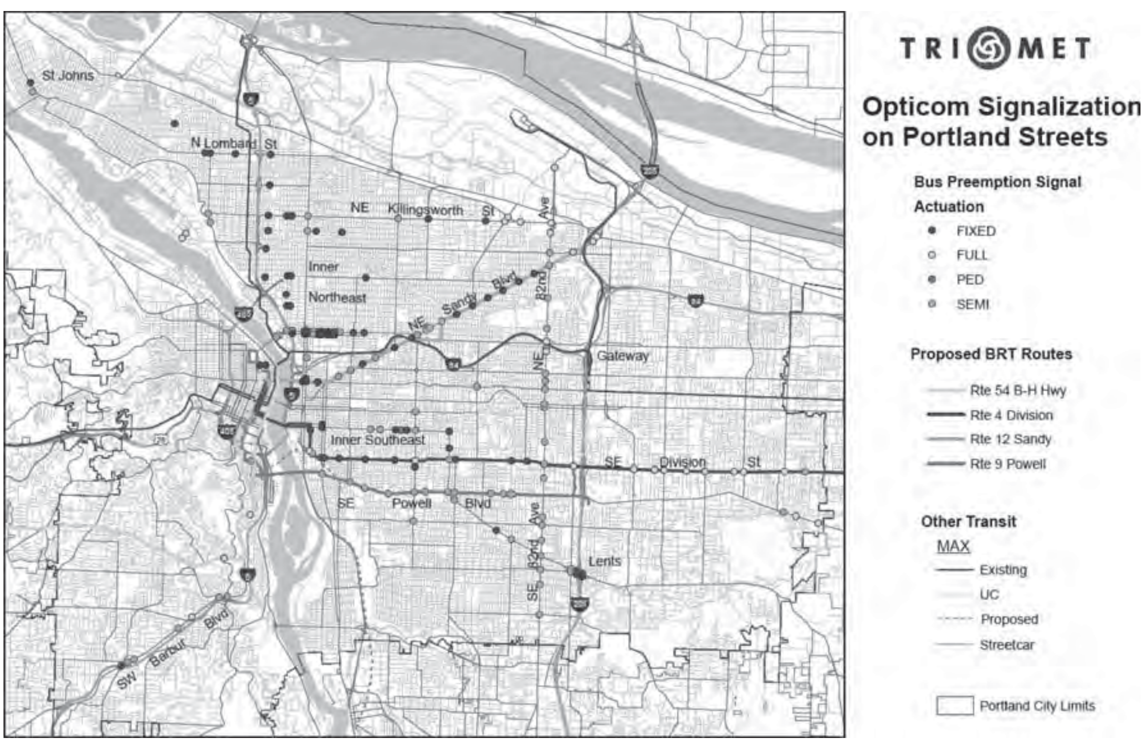

FIGURE 42 TriMet TSP locations (*Source:* TriMet).

to proceed to the next bus stop. Vehicle bus dwell times are highly consistent, between 12 and 15 s for normal boarding conditions. Any bus bunching resulting from wheelchair boardings or other anomalies is handled by variation in recovery time at one of the transit centers at the end of the mall.

Another priority measure is the starting signal used at each transit center. The signal aspects display both the number of traffic signal cycles since the last shuttle departure (multiples of 75 s) and a diagonal bar "proceed with caution" aspect that assures the bus operator they will have a green signal indication at the next intersection.

15th/17th Street Skip-Stop Operation

Associated with the development of the 16th Street Mall, the bus lanes on these two one-way streets were replaced with an "XYZ skip-stop pattern" in 1981. The stop pattern involves three groups of buses stopping every third block, with three buses per stop. There is one stop common to all buses. The specific stop pattern for 17th Street was previously shown in chapter two. A total of 15 bus routes use this stop pattern on both 15th and 17th Streets. The basic bus operation is as follows:

1. Buses leaving stop pick up the green traffic signal progression band.
2. Next passenger stop is made during the red signal phase. Buses load and unload passengers, then proceed on next green wave.

The three-block travel, and the increase in general traffic speed (by an average of 12.5 mph), are major factors in improved travel times. Also, with the spreading of stops, sidewalk crowding at bus stops decreased 40% to 50%. The more organized bus operation also resulted in a 25% to 40% increase in the speed of general traffic on 15th and 17th Streets.

Broadway/Lincoln Bus Lanes

Bus lanes on Broadway and Lincoln Streets, a major north–south one-way pair between I-25 and downtown Denver, were initiated in 1976. The bus lanes, each 4 miles in length, were found to provide an average travel time savings of 5 min per bus during the peak period (0.8 min per mile). The bus lanes operate as exclusive transit lanes from 6 to 10 a.m. in the morning and from 3 to 7 p.m. in the afternoon on weekdays.

The initial passive bus lane signs were replaced by current bus lane signs with flashing yellow lights marking the times when the bus lanes are in operation, thus better alerting adjacent general motorists (see Figure 43). There is a single bus queue jump traffic signal on northbound Lincoln at 13th Avenue to facilitate left turns by all buses at Colfax Avenue into the Civic Center station.

FIGURE 43 Overhead signal and signage—Broadway Bus Lane—Denver (*Source:* Denver Regional Transportation District).

East Colfax Avenue Limited Stop Service

In 1985, the RTD implemented one of the first BRT-type services in the United States, along East Colfax Avenue between Fitzsimmons Medical Center and downtown Denver. This service focused on the introduction of limited-stop bus service in the corridor, with enhanced bus stops at certain locations including greater shelter and other passenger amenities. At the time of this service implementation, TSP strategies were still not fully developed, and hence the RTD undertook extensive bus travel time and delay studies to determine where stops might be consolidated and moved to reduce bus travel time in the corridor.

Existing Light Rail Lines

The Denver RTD to date has implemented three light rail lines: (1) the Southwest Line from downtown to Mineral Avenue, (2) the Southeast Line from downtown to the Denver Tech Center, and (3) the Central Line to Union Station. The Southwest and Southeast lines operate at-grade on Stout and California Avenues in downtown in contraflow operation on the right side of each street either next to the curb or parking lane (see Figure 6).

Current FasTracks and FastConnects Programs

Since 2000, the RTD has embarked on a program, called FasTracks, to develop more than 150 miles of new rapid transit corridors in the Denver region, including BRT operating on-street in certain corridors. Associated with FasTracks is a program called FastConnects, which addresses strategies to facilitate passenger transfers between major routes (see Figure 44). These programs have as their core a program of transit priority treatments. Transit priority strategy investments are being identified based on cost-effectiveness—specifically relating ridership to capital and operating costs. The investment

FIGURE 44 Denver RTD FastConnects system (*Source:* Denver Regional Transportation District).

strategy that has been developed focuses on the following activities:

1. Measuring and comparing average bus versus general traffic performance for selected links in different corridors.
2. Identifying potential locations to implement travel time improvement measures.
3. Identifying facilities, priorities, or other measures that may improve bus travel time, by how much and the extent of riders affected.
4. Developing specifications for the identified improvements to estimate annualized capital and operating costs and savings.
5. Selecting projects for implementation based on funding and other relevant system-wide considerations.

Measures of effectiveness that are being used in different corridor evaluations include:

- Effects on Transit: vehicle travel time, vehicle on-time performance; and
- Effects on Traffic: vehicle-hours of delay, person-hours of delay, vehicle travel time, vehicle travel speed, travel time variability, and level of service.

Coordination among different affected organizations in implementing transit priority treatments is being addressed through a work group of the regional Metropolitan Planning Organization, the Denver Regional Council of Governments (DRCOG). In addition, ad hoc work groups have been established specific to certain projects.

Denver Regional Transit Signal Priority Project

Since 1989, the DRCOG has been working with the Colorado DOT and local governments to coordinate and improve timing of the traffic signals on major streets in the region. In 2005, DRCOG and RTD entered into an agreement to conduct a Transit Signal Priority Study Project. The scope of the project included goals and objectives setting, system inventory and evaluation, technology review, technology strategy selection, and implementation sites selection and functional design.

As part of the study, five corridors were chosen as test bed TSP corridors and simulated and analyzed under both existing traffic conditions and a "with TSP" scenario to determine the effect that the addition of TSP would have on both buses and general traffic. Findings were summarized in four categories: (1) TSP Corridor Findings, (2) TSP Intersection Findings, (3) TSP Transit Route Findings, and (4) Corridor-Specific Findings. Key general findings were as follows:

- Larger TSP benefits to transit vehicles can be achieved on corridors with regularly spaced signalized intersections that have good progression or the potential for good progression.
- TSP is best applied to a long series of signalized intersections along a single travel corridor.
- TSP study intersections with major street crossings and heavy side-street vehicle demand are more negatively affected with TSP calls.
- Intersections near or at capacity are more negatively affected by TSP than other intersections.
- Transit routes with less frequent stops and travel along one street corridor realize more travel time benefits with TSP.
- Near-side bus stops limit the distance between the TSP check-in detector and the intersection from the recommended 500 ft, reducing the effectiveness of TSP.

Based on the results of the simulation results and discussions of the findings with DRCOG, RTD, the city/county of Denver, and the city of Boulder, specific recommendations to institute TSP were made for the South Broadway, Colfax Avenue, Colorado Boulevard, and Lincoln Street corridors in Denver, and the HOP corridor in Boulder.

CHAPTER SIX

WARRANTS, COSTS, AND IMPACTS OF TRANSIT PREFERENTIAL TREATMENTS

This chapter presents information on the warrants, costs, and impacts of different transit preferential treatments, where information is available on these subjects. The information is derived from a review of information in the documents evaluated in the literature review for this report, and insights from the transit and traffic agency web surveys and case studies conducted. Primary documents with useful information include *TCRP Report 100: Transit Capacity and Quality of Service Manual*, 2nd Edition (*3*), *Highway Capacity Manual 2000* (*19*), *TCRP Report 118: Bus Rapid Transit Practitioner's Guide* (*5*), *TCRP Report 90: Bus Rapid Transit, Volume 2: Implementation Guidelines* (*4*), and *NCHRP Report 155—Bus Use of Highways: Planning and Design Guidelines* (*2*).

This chapter also reviews the applicability of different analytical tools to assess the impacts of different transit preferential treatments on transit and traffic operations.

WARRANTS AND CONDITIONS FOR APPLICATION

Median Transitways

Exclusive median facilities or transit malls are typically applied for LRT operations on urban streets owing to the length of the trains (and hence potential substantial impact to local access if operated curbside) and the need to preserve some operating speed advantages for such a mode. For streetcars and buses, impetus for operation in a median transitway is a greater number of vehicles (thus to reduce conflicts with general traffic) and again a desire for higher operating speeds.

Wider arterial streets are needed to implement median transitways. Sufficient ROWs must exist to provide for adequate transit station platforms (whether near side or far side) and the provision for near-side left-turn lanes at signalized intersections. If a median busway is used by more than one route, then building in passing lanes may be desirable in station areas.

In *NCHRP Report 155* (*2*), warrants for "median bus lanes" were defined as ranging from 60 to 90 one-way buses per peak hour, with a minimum daily bus volume of 600. The bus volumes were correlated to a one-way bus passenger volume of 2,400 to 3,600 per peak hour.

Exclusive Transit Lanes

Exclusive transit lanes outside of median facilities within the street ROW require (1) a sufficient frequency of transit service, (2) traffic congestion along the roadway, (3) suitable street geometry, and (4) community willingness to enforce the regulations. From a premium transit perspective, transit lanes are useful in establishing a clear identity for such service within the street ROW. Guidelines for the operation of exclusive transit lanes on urban streets include the following, separated by bus versus LRT/streetcar operations (*5*).

Bus

1. Concurrent-flow lanes may operate along the outside curb, in the lane adjacent to a parking lane (interior lane) or in a paved median area (without a dedicated median transitway).
2. Concurrent-flow lanes can operate at all times, for extended hours (e.g., from 7 a.m. to 7 p.m.), or just during peak hours.
3. Contraflow lanes should operate at all times.
4. Under conditions of heavy bus volumes, dual concurrent-flow or contraflow lanes may be desirable.
5. Where the bus lanes operate at all times, special colored pavement may be desirable to improve the identity of the BRT operations.
6. Bus lanes should be at least 11 ft wide to accommodate an 8.5-ft bus width.
7. The bus lanes should carry as many people as in the adjacent general traffic lane. Generally, at least 25 buses should use the lanes during the peak hour. (Ideally, there should be at least one bus per signal cycle to give buses a steady presence in the bus lane.) There should be at least two lanes available for general traffic in the same direction, wherever possible.
8. Parking should be prohibited where bus lanes are along the curb, but it may remain where interior bus lanes are provided. (Interior bus lanes are located in the lanes adjacent to the curb lanes.)
9. There should be suitable provisions for goods delivery and service vehicle access, either during off-hours or off-street.

In *NCHRP Report 155* (*2*), volume warrants for both concurrent-flow and contraflow curb bus lanes were identified. Table 17 identifies the peak hour and daily bus volumes and

TABLE 17
VOLUME WARRANTS FOR CURB BUS LANES

Curb Bus Lane	Minimum Daily Bus Volume	Range in One-Way Peak-Hour Volume	
		Bus	Passengers
Concurrent flow			
In CBD	200	20–30	800–1,200
Outside CBD	300	30–40	1,200–1,600
Contraflow			
Short segment	200	20–30	800–1,200
Extended segment	400	40–60	1,600–2,400

Source: *NCHRP Report 155*, Table 43 (*2*).
CBD = central business district.

assumed bus passengers associated with different treatments in downtown areas versus outside of downtown areas.

LRT/Streetcar

1. It is important that LRT/streetcar lanes operate in the same direction as parallel general traffic (contraflow lanes are discouraged);
2. That any dedicated LRT/streetcar lanes operate at all times;
3. That LRT/streetcar lanes have a more substantial element to separate operations from general traffic, such as low-profile pavement bars, rumble strips, contrasting pavement texture, or mountable curbs, than just paint or striping; and
4. Separate LRT signals clearly distinguishable from traffic signals in design and placement be provided.

The primary basis for determining whether lane dedication is applicable typically involves a comparison of costs and benefits. In this case, the mixed-traffic operating scenario would be compared with a dedicated running way scenario. Effectiveness can then be analyzed in terms of changes in total person travel time for all travelers in the given corridor irrespective of mode. The analysis can take into account potential shifts by motorists to parallel arterials if capacity is taken away from general traffic on the arterial in question.

The most critical parameters affecting the results of any evaluation of dedicated bus lanes are the number of buses in the peak hour and peak direction and the number of people on the buses. Travel time savings for current transit users and the potential attraction of new riders, along with potential operating and maintenance cost savings, is traded off against changes in travel times for current general traffic, access, and parking impacts at adjacent land uses.

Transit Signal Priority

TSP is typically applied when there is significant traffic congestion and, hence, transit delays along a roadway. Estimated bus travel time and delay can be identified through field surveys of existing conditions or through simulation modeling of future conditions. Studies have found that TSP is most effective at signalized intersections operating within LOS “D” and “E” conditions with a volume-to-capacity ratio (*v/c*) between 0.80 and 1.00. There is limited benefit in implementing priority under LOS “A” through “C” conditions as the roadway is relatively uncongested and neither major bus travel time or reliability improvements can be achieved. Under oversaturated traffic conditions (*v/c* greater than 1.00), long vehicle queues prevent transit vehicles from getting to the intersection soon enough to take advantage of TSP without disrupting general traffic operations.

A basic guideline is to apply TSP when there is an estimated reduction in transit vehicle delay with negligible change in general traffic delay. Given this condition, the net total person delay (on both buses or trains and general traffic) should decrease with application of TSP at a particular intersection or along an extended corridor.

Given the frequency of transit service in a given corridor, TSP may only be given to certain transit vehicles such that the disruption to general traffic operations is minimized. Conditional priority is most commonly accepted as an initial TSP application for bus operations in a corridor, assuming that buses would be issued priority only if they are behind schedule or have a certain number of persons on board the bus. Los Angeles Metro Rapid, for example, limits TSP to every other signal cycle.

TSP has been found to be most effective with transit stops located on the far side of signalized intersections so that a bus, streetcar, or train activates the priority call and travels through the intersection and then makes a stop. Past studies and actual applications have shown that greater reduction in transit travel time and variability in travel times can be achieved with a far-side versus near-side stop configuration.

Curb Extensions

Curb extensions are typically warranted when there are difficulties for buses trying to reenter the traffic stream, usually because of high traffic volumes. Conditions that support the construction of curb extensions related to bus operations include:

- Street traffic speeds are relatively low.
- General traffic volumes are relatively low (fewer than 400 to 500 vehicles per hour).
- Right turns are relatively low (particularly for larger vehicles such as trucks).
- Bus stop patronage and overall pedestrian volumes are substantial.
- On-street parking is available.
- Two travel lanes are available in the particular direction (to allow passing of stopped buses).
- There is interest on the part of local business/property owners for such treatments.

Curb extensions can only be applied where it is possible to widen the sidewalk either at an intersection or mid-block. For use as bus stops, curb extensions are typically associated with near-side bus stops. If far-side stops are developed as curb extensions, blockage to general traffic caused by the bus stopping should not result in unacceptable queuing and potential traffic conflicts at the intersection. Thus, with far-side curb extensions, two travel lanes are desirable.

Other conditions that may limit the use of curb extensions include two-lane streets, complex drainage patterns, and high bicycle traffic on the street.

CAPITAL AND OPERATING COSTS

Median Transitways and Bus Lanes

The cost of implementing dedicated bus lanes depends on the existing roadway configuration and the extent of the planned changes to accommodate dedicated lanes. Unit costs for both initial construction and subsequent lane operation and maintenance can be obtained from local government and state DOTs in the respective community.

Capital costs are affected by ROW needs and costs, the design details of the existing street (e.g., Are utilities to be moved? Is a median to be cleared and paved? Will sidewalks be rebuilt?), and the design details of the new lanes themselves. If existing lanes are used with no new construction, the initial capital costs will primarily be limited to modest re-striping and signage costs.

According to *TCRP Report 90,* published in 2007, the range of costs for adding new bus lanes is as identified in Table 18 (*4*).

TABLE 18
RANGE OF CAPITAL COSTS FOR ADDING NEW TRANSIT LANES ON URBAN STREETS

Type of New Arterial Transit Lanes	Cost Range (exclusive of right-of-way and with uncolored pavement)
Curb or off-set lanes (bus)	$2 to $3 million per lane-mile
Median transitway (bus)	$5 to $10 million per lane-mile
Median transitway (LRT)	$20 to $30 million per track-mile

Source: *TCRP Report 90* (*4*).

Where existing lanes are converted to bus lanes, capital costs may range from $50,000 to $100,000 per mile for re-striping and signing. Where street reconstruction is required to provide new bus lanes, as noted in Table 15, the costs are substantially higher. In Boston, the reconstruction of 2.2 miles of Washington Street for the Silver Line Phase 1 cost $10.5 million per mile, of which about 20% was for brick-paved sidewalks and crosswalks, architectural street lighting, and landscaping.

The O&M cost for dedicated bus lanes includes the costs for street lighting and routine maintenance (e.g., pothole filling and resurfacing, cleaning, and snow plowing). The incremental O&M costs for a dedicated bus lane depend on the nature of the situation before and after the dedication. If the dedicated bus lanes were formerly devoted to either parking or general traffic, there would be no incremental operating and maintenance costs other than those associated with more frequent maintenance given the greater wear and tear associated with bus operation.

The O&M costs of the new dedicated bus lanes themselves are not the only O&M cost impact. If a bus lane saves enough time such that a decrease in the number of buses necessary to provide a given level of service is possible, there will be a decrease in transit operating and maintenance costs as well.

If the proposed dedicated lanes result from a widening, the incremental O&M costs would be modest; certainly under $10,000 per lane-mile per year (based on national average O&M costs for arterial streets).

Most transit agencies have fully allocated or marginal O&M cost models that have vehicle hours and peak vehicle requirements as primary input. Analysis of revenue service travel speeds and times is necessary to determine the degree to which both of these would be decreased as the result of the dedicated bus lanes.

Transit Signal Priority

Costs for implementing TSP along a transit corridor will depend on the configuration of the existing signal control system, with higher costs associated with signal upgrades, equipment/software for the intersection, vehicles, or the central traffic control and transit management systems.

Costs specifically associated with TSP are highly dependent on whether the TSP system will be localized to a corridor or centralized and integrated into a transit or regional traffic management center. To implement a conditional priority system, the central signal system may be integrated into the transit management center. A key assessment in determining cost is whether or not existing traffic control software and controllers are compatible with TSP. Estimates for traffic signal controller replacement range between $3,500 and $5,000, depending on the vendor and the functionality prescribed for TSP. Costs for communication links needed to integrate these traffic signals into the existing signal system and costs for future signal system upgrades would be extra and would vary depending on the specific signal system configuration and extent of TSP application. In general, if existing software and controller equipment can be used, costs can be under $5,000 per intersection; however, costs can increase to $20,000 to $30,000 per intersection if equipment needs to be replaced.

Costs for transit detection vary significantly based on the ultimate technology chosen. Table 19 provides ranges and typical capital and operating costs for different TSP detection systems.

Queue Jumps and Bypass Lanes

The cost of a queue jump or bypass lane will vary widely based on whether or not there is an existing right-turn lane or shoulder present to develop a transit queue bypass. If existing roadway lanes or shoulders are available to develop an adequate queue jump or bypass lane treatment, then the costs of the installation will focus on roadway signing and striping modifications and the provision of a separate signal for the queue jump treatment. For applications in the United States, the signing and striping costs have ranged from $500 to $2,000. The cost of a bus queue jump signal is estimated to range from $5,000 to $15,000, based on the type of detection deployed. A queue jump signal with loop detection typically has a lower cost than with video detection.

The development of a new separate lane for buses for a bypass or the development of a new or lengthened right- or left-turn lane will be dependent on the availability of ROW, existing utilities present, and other roadside features. Costs for new lane construction will vary widely based on the extent of roadway reconstruction, utility modification, and ROW

TABLE 19
COSTS OF DIFFERENT TSP DETECTION SYSTEMS

System	Technology	Equipment Cost/ Intersection	Equipment Cost/Bus	Operating and Maintenance Costs	Jurisdictions Using This Detection
Optical	Optical emitters	Moderate ($8,000–$10,000)	Moderate ($1,000)	Emitter replacement ($1,000)	Portland; San Francisco; Tacoma; Kennewick, WA; Houston; Sacramento; ,and others
Wayside Reader	Radio frequency technology. Uses vehicle-mounted tags and wayside antenna, which must be located within 35 ft of transit vehicle. Radio transmits and decoder reads rebound message.	High ($20,000–$40,000)	Low ($50)	Tag replacement ($50)	King County, WA
"Smart" Loops	Loop amplifier detects transmitter powered by vehicle's electrical system.	Low ($2,500 per amplifier; use existing loop detector)	Low ($200)	Same as loop detector	Los Angeles; Chicago; Pittsburgh; San Mateo County, CA
GPS	GPS receivers mounted on transit vehicle. Line of sight not required for detection.	Moderate ($6,000–$10,000)	High ($2,500)	N/A	Broward County, FL; San Jose
Wireless	Applies unused bandwidth. Use of mesh networking.	Moderate (Under $10,000)—Dependent on number of access points	Moderate (under $1,000)	High if Cellular Digital Packet Data system, low if LAN	Los Angeles County

N/A = not available; LAN = local area network.
Source: TCRP Report 118 (2007) (*5*) and *JTA ITS Signal Priority Program Study Final Report* (2008) (*31*).

acquisition required. If a far-side bus pullout is provided, added costs would be incurred.

Curb Extensions

The cost of a curb extension varies based on the length and width of the treatment, site constraints, and the specific design of the curb extension. In San Francisco, costs of existing curb extensions have ranged from $40,000 to $80,000 each. Much of the cost is derived from the need to provide adequate drainage, which often requires re-grading the street and sidewalk and moving drains, manholes, street lights, signal poles, street furniture, fire hydrants, and other features.

IMPACTS ON TRANSIT OPERATIONS

Transit preferential treatments will have an impact on three major components of transit operations: (1) travel time, and (2) reliability, which will then have an impact on (3) capital and operating cost savings. The impact on transit operations of the different types of transit preferential treatments are described as follows.

Median Transitways and Exclusive Lanes

The primary reason to add dedicated transit lanes to an at-grade premium transit service is to improve travel times and reliability over mixed-traffic operations. The benefits of reduced travel times for transit users and improvements in reliability are traded off against increased travel times for other roadway system users and the potential diversion to other roadway corridors (with associated impacts) if the new dedicated arterial transit lanes are developed by removing general traffic lanes.

Reliability is as important to transit users and service providers as travel time savings. Improved travel time consistency means that regular transit users enjoy the ability to begin their trips at the same time every day, and transit operators can reduce the amount of recovery time built into their schedules, which can save O&M costs.

The likely benefits of median transitway and exclusive transit lane operation depend on the length of the lane and the amount of time saved. Observations included the following:

- A small amount of time savings primarily results in passenger benefits.
- As the travel time savings increases, it may reduce fleet requirements and operating costs.
- A time savings of more than 5 min (on a typical trip) can affect mode choice, further increase ridership, and possibly encourage land development.

Figure 45 illustrates these relationships for exclusive bus lanes.

Examples of travel time savings observed with certain arterial street bus lane treatments are shown in Table 20. Examples of improvements in bus lane reliability are shown in Table 21. The improved reliability is measured by the percent change in the coefficient of variation (standard deviation divided by the mean).

Transit Signal Priority

Tables 22 and 23 present the measured/estimated impacts of bus TSP in selected cities in North America on travel time, reliability (schedule adherence), and operating costs, as well

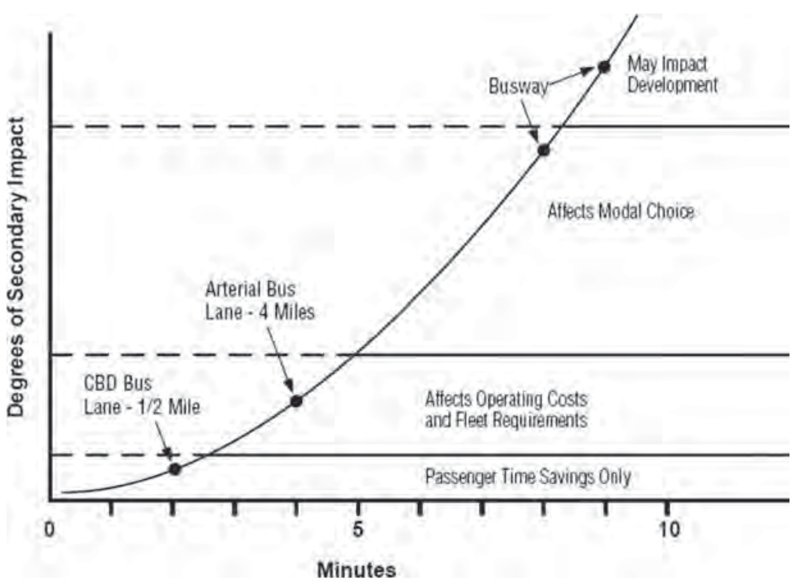

FIGURE 45 Degree of bus lane impacts [*Source: TCRP Report 26* (*16*)].

TABLE 20
OBSERVED TRAVEL TIME SAVINGS WITH ARTERIAL BUS LANES

City	Street	Savings (minutes per mile)
Los Angeles	Wilshire Blvd.	0.1 to 0.2 (a.m.) 0.5 to 0.8 (p.m.)
Dallas	Harry Hines Blvd.	1
Dallas	Ft. Worth Blvd.	1.5
New York City	Madison Ave. (dual bus lanes)	43%* express bus 34%* local bus
San Francisco	1st Street	39%* local bus

*Percent reduction in travel time.
Source: TCRP Reports 26, 90, and 118 (*16,4,5*).

TABLE 21
OBSERVED RELIABILITY IMPROVEMENTS WITH ARTERIAL BUS LANES

City	Street	Percent Improvement*
Los Angeles	Wilshire Blvd.	12 to 27
New York City	Madison Ave.	57

*Coefficient of variation multiplied by 100.
Source: *TCRP Reports 26 and 90* (*16,4*).

as the impacts of TSP on general traffic. Expected benefits of TSP vary depending on the application and the extent to which the signal system in a particular area already has optimized progression before TSP application. A summary of these impacts follows.

Travel time savings associated with TSP in North America and Europe have ranged from 2% to 18%, depending on the length of corridor, particular traffic conditions, bus operations, and the TSP strategy deployed. A reduction of 8% to 12% has been typical. The reduction in bus delay at signals has ranged from 15% to 80%.

In Los Angeles, in the initial Wilshire–Whittier and Ventura BRT corridors, average running time along both corridors associated with TSP decreased by 7.5%. This corresponds to an average decrease of 0.5 min per mile on Wilshire–Whittier Boulevard and a decrease of 0.3 min per mile on Ventura Boulevard. The reduction in bus signal delay at intersections with TSP was 33% to 36%. In Chicago, buses have achieved an average 15% reduction in running time along Cermak Road, with the reductions varying from 7% to 20% depending on the time of day. Along San Pablo Avenue in Oakland, each bus has saved an average of 5 s per intersection with TSP. BRT vehicles along Vancouver's 98-B line have saved up to 1.5 min per trip (*5*).

Schedule adherence as measured by variability in bus travel times and arrival times at stops improves significantly with TSP application. In Seattle, along the Rainier Avenue corridor, bus travel time variability has been reduced by 35%. In Portland, TriMet was able to eliminate one bus assignment to one of its corridors by using TSP and has experienced up to a 19% reduction in travel time variability in certain corridors. In Vancouver, the travel time variability along its BRT routes has decreased approximately 40%.

By reducing bus travel time and delay and the variability in travel time and delay, transit agencies have realized both capital cost savings (by saving one or more buses during the length of the day to provide service on a route) and operating cost savings (owing to more efficient bus operation). In Los Angeles, the MTA indicated that before the Wilshire–Whittier and Ventura BRT implementation, the average cost of operating a bus was $98 per hour. A traffic signal delay reduction of 4.5 min per hour translates into a cost savings of approximately $7.35 per hour per bus for the initial two BRT corridors. For a bus operating along these corridors for 15 hours a day, the cost savings would be approximately $110.25 per day. Assuming 100 buses per day for an average of 300 days per calendar year in the two corridors, this translates into an approximately $3.3 million annual operating cost savings for the MTA. This savings does not include the added benefit

TABLE 22
REPORTED INITIAL ESTIMATES OF BENEFITS TO BUSES FROM TRAFFIC SIGNAL PRIORITY

Location	% Running Time Saved	% Increase in Speeds	% Reduced Intersection Delay
Anne Arundel County, MD	13–18	—	—
Bremerton, WA	10	—	—
Chicago, IL—Cermak Road	15–18	—	—
Hamburg, Germany	—	25–40	—
Los Angeles—Wilshire/Whittier Metro Rapid	8–10	—	—
Pierce County, WA	6	—	—
Portland, OR	5–12	—	—
Seattle, WA—Rainier Avenue	8	—	13
Toronto, ON	2–4	—	—

Source: *TCRP Reports 90* and *100* (*4,3*), FTA CBRT Document (*32*).

TABLE 23
ITS AMERICA'S SUMMARY OF TSP BENEFITS AND IMPACTS—BUS AND RAIL

Location	Transit Type	No. of Inter-sections	TSP Strategy	Benefit/Impact
Portland, OR—Tualatin Valley Hwy.	Bus	10	Early green, green extension	Bus travel time savings = 1.4%–6.4%. Average bus signal delay reduction = 20%.
Portland, OR—Powell Blvd.	Bus	4	Early green, green extension, queue jump	5%–8% bus travel time reduction. Bus person delay generally decreased. Inconclusive impacts of TSP on traffic.
Seattle, WA—Rainier Ave. at Genesee	Bus	1	Early green, green extension	For prioritized buses: • 50% reduction of signal-related stops • 57% reduction in average signal delay 13.5% decrease in intersection average person delay. Average intersection delay did not change for traffic. 35% reduction in bus travel time variability. Side-street effects insignificant.
Seattle, WA—Rainier Ave. (mid-day)	Bus	3	Early green, green extension	For TSP-eligible buses: • 24% average reduction in stops for eligible buses • 34% reduction in average intersection delay 8% reduction in travel times. Side-street drivers do not miss green signal when TSP is granted to bus.
Toronto, ON	Street-car	36	Early green, green extension	15%–49% reduction in transit signal delay. One streetcar removed from service.
Chicago, IL—Cermak Rd.	Bus	15	Early green, green extension	7%–20% reduction in transit travel time. Transit schedule reliability improved. Reduced number of buses needed to operate the service. Passenger satisfaction level increased. 1.5 s/vehicle average decrease in vehicle delay. 8.2 s/vehicle average increase in cross-street delay.
San Francisco, CA	LRT and Trolley	16	Early green, green extension	6%–25% reduction in transit signal delay.
Minneapolis, MN—Louisiana Ave.	Bus	3	Early green, green extension, actuated transit phase	0%–38% reduction in bus travel times depending on TSP strategy. 23% (4.4 s/vehicle) increase in traffic delay. Skipping signal phases caused some driver frustration.
Los Angeles, CA—Wilshire and Ventura Blvds.	Bus	211	Early green, green extension, actuated transit phase	8% reduction in average running time. 35% decrease in bus delay at signalized intersections.

Source: *An Overview of Transit Signal Priority*, ITS America (*21*).

of travel time savings for the Rapid Bus passengers. With an anticipated project life cycle of 10 years, the relative benefit–cost ratio for TSP associated with the Wilshire–Whittier and Ventura BRT corridors was estimated to be greater than 11:1 (*5*)

Several studies of the streetcar system in Toronto (*24*) found TSP to be beneficial, with reductions identified in streetcar travel times and improvements in on-time performance. The streetcar as a whole has experienced reductions in travel times of between 6% and 10%. This is based on a system with only 77% of signals operating TSP. The Dundas streetcar line, which travels through 31 signalized intersections, including 27 with TSP operation, has seen a significant reduction of almost 50% in signal delays during the weekday a.m. and p.m. peak periods, and a slightly lower delay reduction during the off-peak period. Similarly, the Carlton streetcar has experienced a major reduction in intersection delay with TSP ranging from 21% to 28%. The variability in TSP travel time savings across routes results from the variation on the percent of intersections with near-side stops, service frequency, degree of separation from traffic, length of route, and ridership increase following TSP implementation. The service reliability improvements associated with TSP on the streetcar system have included a reduction in vehicle bunching and headway variability.

Queue Jumps and Bypass Lanes

By allowing a transit vehicle to bypass general traffic queuing at a signalized intersection, transit travel time is reduced with improved service reliability. The extent of transit travel time savings will depend on the extent of general traffic queuing at a signalized intersection, the extent to which a bypass treatment can be developed to bypass the general traffic queue, and the magnitude of right-turn traffic if the queue bypass uses such a lane (and also whether or not free right turns are allowed from the right-turn lane). With either a queue jump or bypass lane some increase in delay to right-turn traffic could occur if a separate lane for buses is not provided. Transit travel time savings are reduced if the right-turn lane traffic volume is heavy and there is limited opportunity for free right turns or right turns on red.

Application of bus queue jumps has been shown to produce 5% to 15% reductions in travel time for buses through intersections. Service reliability is improved because of reduced bus delay at signals. Reported travel time savings associated with queue jumps and/or bypass lanes are as follows (*5*):

- 7- to 10-s bus intersection delay savings on Lincoln Street at 13th Avenue in Denver.
- 27 s reduction in bus travel time along the NE 45th Street route in Seattle during the weekday a.m. peak period.
- 12 s reduction in bus travel time along the NE 45th Street route in Seattle during the weekday p.m. peak period in Seattle.
- 6 s reduction in bus travel time along the NE 45th Street route in Seattle across an entire day.

By reducing bus travel time, some operating cost savings can be achieved with queue jumps and/or bypass lanes if implemented in a systematic manner, particularly if the cumulative effect were the elimination of a bus to meet the service need.

Curb Extensions

By allowing a bus to stop in the general traffic lane and not have to pull over to a curb at a bus stop, travel time is reduced by eliminating "clearance time." This is the time a bus waits to find an acceptable gap in the traffic stream so that the bus can pull back into the general traffic lane. The clearance time depends on the adjacent lane traffic volume and bus operator experience, and various studies have shown that clearance times can range from 9 to 20 s.

Table 24 identifies clearance times associated with different adjacent-lane mixed-traffic volumes under particular bus operating conditions, based on research conducted in developing *TCRP Report 100* (*3*). A volume range of 0 to 1,000 vehicles per lane per hour typically results in an average bus clearance time of 0 to 15 s. By eliminating clearance time through curb extension application, the variability of dwell time at stops along an arterial corridor can be improved and, thus, bus

TABLE 24
AVERAGE BUS CLEARANCE TIME
(Random Vehicle Arrivals)

Adjacent-Lane Mixed-Traffic Volume (vehicles/hour)	Average Re-Entry Delay (seconds)
100	1
200	2
300	3
400	4
500	5
600	6
700	8
800	10
900	12
1,000	15

Source: *TCRP Report 100* (*3*). Computed using *Highway Capacity Manual 2000* (*19*) unsignalized intersection methodology (minor street right turn at a bus stop) assuming a critical gap of 7 s and random vehicle arrivals. Delay based on 12 buses stopping per hour.

service reliability also can be improved. At the same time, provision of a near-side curb extension precludes the ability to provide a dedicated right-turn lane at an intersection.

By reducing bus travel time, some operating cost savings can be achieved with curb extensions if implemented in a systematic manner.

An extensive evaluation of the impact of curb extensions on transit operations was conducted in 1999 as part of a project along Mission Street in San Francisco to convert bus bays to bus bulbs. As part of the TCRP A-10A project on Evaluation of Bus Bulbs (*8*), a before-and-after study was undertaken at the bus stop locations along Mission Street. The study revealed about a 7% increase in bus operating speeds along the corridor. The study also assessed the change in pedestrian flow rates next to one of the bus stops with the added pedestrian area associated with the provision of a bus bulb versus the original sidewalk with a bus bay. The study revealed an average 11% improvement in pedestrian flow rate (ped/min/ft) during the peak 15-min periods evaluated.

The TCRP A-10A study also conducted a simulation analysis in a corridor in San Francisco to evaluate the impact of bus bulbs on transit and general traffic operations. The simulation runs included both far-side and near-side bus stops, and bus bays and bus bulbs. For near-side stops, it was determined that the bus bulb design is beneficial over the bus bay design with respect to average traffic speeds at lower volumes (below 1,000 vehicles/h), regardless of the bus dwell time. For far-side stops, it was determined that there was no practical difference in average traffic speeds.

Stop Consolidation

Research was undertaken as part of TriMet's bus stop consolidation program to try to quantify the travel time savings associated with implementation of stop consolidation in a

TABLE 25
BEFORE AND AFTER RESULTS OF SFMTA BUS STOP REDUCTION IN SEVEN CORRIDORS

Street	Before		After		Change	
	Stops per Mile	Avg. Bus Speed	Stops per Mile	Avg. Bus Speed	Stops per Mile	Avg. Bus Speed
Haight	10.7	8.2 mph	7.1	9.4 mph	–3.6	+14.6%
Union	11.0	9.1 mph	7.1	10.0 mph	–3.9	+9.9%
Van Ness	10.6	6.2 mph	8.2	6.5 mph	–2.4	+4.8%
Polk (NB)	12.0	9.1 mph	7.8	9.5 mph	–4.2	+4.4%
Mission (NB)	10.4	6.1 mph	5.2	6.8 mph	–5.2	+11.5%
Sacramento/ Columbus (NB)	13.2	5.4 mph	7.3	5.8 mph	–5.9	+7.4%

Source: SFMTA Transit Preferential Streets Program—1985–1988 Final Report (*34*). NB = Northbound.

corridor (*33*). Route 4–Fessenden/104–Division, which provides radial service interlined through downtown Portland, was the subject of the analysis. Both control and "with treatment" segments were evaluated, each comprising a length of two miles. The "with treatment" segment had a net reduction of four inbound and six outbound stops, whereas the 104/Division route had a net reduction of five inbound and seven outbound stops. The net reduction in stops resulted in an increase in average spacing of 6% for inbound and 8% for outbound stops. A 5.7% reduction in bus running time attributable to stop consolidation was identified.

In the late 1980s, MUNI in San Francisco undertook a systematic evaluation of the impact of bus stop reduction and relocation in seven bus corridors: Haight Street, Union Street, Van Ness Avenue, Polk Street, Mission Street, Sacramento Street, and Columbus Avenue. Table 25 shows the results of this program. Bus stops were reduced from 2.5 to 5.9 stops per mile, with average bus speeds increasing from 4.4% to 14.6% (*32*).

TCRP Reports 26, 90, and *118* (*16,4,5*) all addressed the impact of stop spacing on arterial bus travel time. Table 26 relates the average arterial bus travel time rate (minutes per mile) to the number of bus stops and the average dwell per stop. Using such a table, with knowledge of how dwell time might change with a stop consolidation strategy, the travel time savings associated with stop consolidation along a bus route can be estimated.

ANALYSIS METHODS

There are various methodologies for assessing the impacts of different transit preferential treatments on both transit operations (change in delay, operating speed, on-time performance)

TABLE 26
BASE ARTERIAL BUS TRAVEL TIMES WITH DIFFERENT STOP SPACING AND DWELL TIMES

Average Dwell Time Per Stop (sec)	Stop Made Per Mile								
	2	4	5	6	7	8	9	10	12
10	2.40	3.27	3.77	4.3	4.88	5.53	6.23	7.00	8.75
20	2.73	3.93	4.60	5.3	6.04	6.87	7.73	8.67	10.75
30	3.07	4.60	5.43	6.3	7.20	6.20	9.21	10.33	12.75
40	3.40	5.27	6.26	7.3	8.35	9.53	10.71	12.00	14.75
50	3.74	5.92	7.08	8.3	9.52	10.88	12.21	13.67	16.75
60	4.07	6.58	7.90	9.3	10.67	12.21	13.70	15.33	18.75

Source: *TCRP Reports*, *26*, *90*, and *118* (*16,4,5*).

and general traffic operations. This section describes the use of field surveys, application of refined data and guidance from different documents, and micro-simulation to identify these impacts. Which analysis method to apply will usually be dictated by the desired information and complexity of the evaluation, as well as funds available. In certain cases, basic analytical models with typical values for certain cases may be adequate (particularly for earlier planning-level evaluations), where simulation modeling would be more appropriate when the effects of a system of treatments are desired to be evaluated, and where different scenarios (such as alternate signal timing settings for TSP) need to be evaluated.

Exclusive Transit Lanes

Analysis of the travel time implications of new dedicated transit lanes can address all persons traveling in the respective corridor, including auto drivers and passengers, not just existing and future transit passengers. Historic information on changes in transit travel times from implementation of bus lanes can be obtained from a variety of sources, including the FTA document *Characteristics of Bus Rapid Transit for Decision-Making* (*32*) and *TCRP Report 90* (*4*).

Highway Capacity Manual 2000 (*19*) can be used to calculate the impact of removing a general traffic lane from an arterial and dedicating it to the exclusive use of transit. When an analysis of the effect of removing a lane from general traffic use is done, any route diversion for existing highway users must be accounted for. For example, if the corridor is part of a continuous grid of major arterials, some general traffic may divert to parallel streets after a lane is removed.

The likely changes in travel times resulting from installing a bus lane can be estimated in three basic ways:

1. Analogy (an estimate based on a synthesis and analysis of actual operating experience; see subsequent discussion),
2. Application of the *Highway Capacity Manual* Signalized Intersection Delay Analysis, and
3. Computer simulation.

TABLE 27
ESTIMATED TRAVEL TIME RATE REDUCTION WITH ARTERIAL BUS LANES—ANALOGY

Location	Minutes per Mile Reduction
Highly Congested CBD	3 to 5
Typical CBD	1 to 2
Typical Arterial	0.5 to 1

Source: *TCRP Report 118* (*5*).
CBD = central business district.

Estimated travel time rate reductions based on analogy (analysis/synthesis of experience) are shown in Table 27. These values can provide an initial order of magnitude estimate of time savings. More refined estimates of travel time savings and speed increases can be obtained from the values shown in Table 28 and Figures 46 and 47, as developed through the TCRP A-23A research.

The top half of Table 28 shows the estimated speed changes resulting from installing a curb bus lane for various initial speeds. Figure 46 graphs the speed before and after bus lane installation. Given the initial bus speed, the chart may be used to estimate the benefits of a curb bus lane. The gain in speed ranges from 1.5 mph for speeds lower than 6 mph to 2 mph for greater speeds.

The bottom half of Table 28 and Figure 47 show the time savings in minutes per mile resulting from installing a bus lane. The percent of time saved declines from approximately one-third at the lowest speeds to about 20% at speeds that are typical for an arterial bus (or BRT route).

The actual time saved depends on the length of the bus lane. For example, based on Figure 47, a bus traveling at about 5 mph (12 min per mile) before bus lane installation may expect a savings of about three minutes per mile after bus lane installation. If the bus lane is 5 miles long, the total savings would be 15 s.

TABLE 28
ESTIMATED TRAVEL TIME RATE REDUCTION WITH ARTERIAL BUS LANES—FOR SPECIFIC CASES BASED ON ANALOGY

Item	Case A	Case B	Case C	Case D	Case E
Initial Speed (mph)	3.0	4.0	6.0	8.0	10.0
Speed with Curb Bus Lane (mph)	4.4	5.7	8.0	10.2	12.2
mph Gain	1.4	1.7	2.0	2.2	2.2
% Gain	47.0	42.0	33.3	27.5	22.0
Initial Minutes/Mile	20	15	10	7.5	6.0
Minutes/Mile with Bus Lane	13.5	10.5	7.5	5.9	4.0
Minutes/Mile Gain	6.5	4.5	2.5	1.6	1.1
% Gain	32.5	30.0	25.0	21.3	18.3

Source: *TCRP Report 90* (*4*).

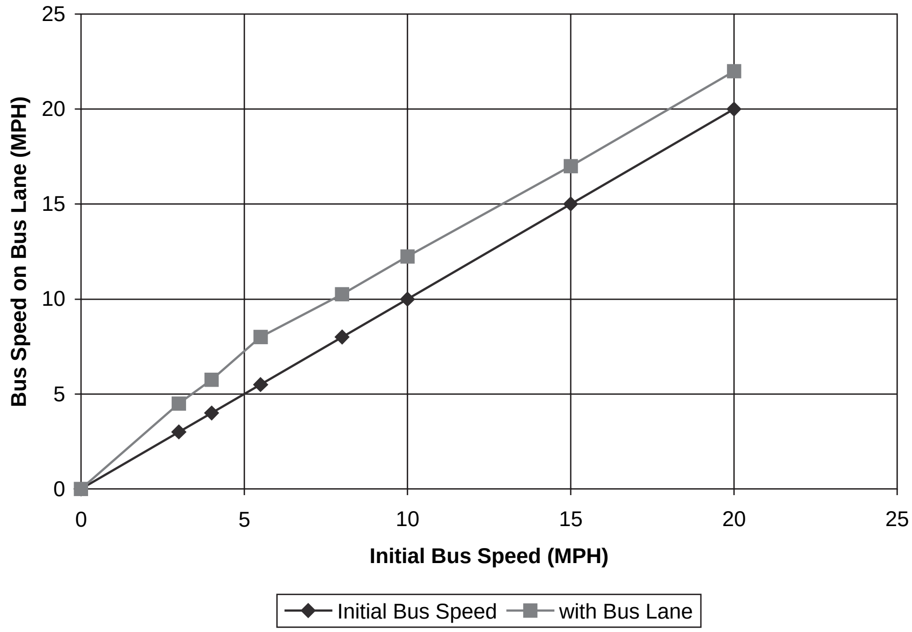

FIGURE 46 Impact of curb bus lanes on bus speed [*Source: TCRP Report 118* (*5*)].

Transit Signal Priority

Field surveys and both analytical and simulation modeling can be used to estimate the reduction in bus delay and, hence, reductions in overall travel time associated with the application of TSP. A description of the potential application of surveys and simulation follows.

Field Surveys

The most accurate yet perhaps most time-consuming and expensive means to identify the impact of TSP is to conduct a "before" and "after" evaluation of changes in transit travel time and schedule adherence through field data collection. An on-board transit travel time and delay survey is the most appropriate tool to be applied. Measuring changes in general traffic delay associated with TSP is much more cumbersome because extensive staff is required to manually record vehicle delays in the field, videotape general traffic conditions, and then decipher changes in delay through video observations.

Analytical Model

As mentioned previously, TSP advances or extends the green time whenever a transit vehicle arrives within the designated windows at the beginning or end of the cycle. This has the

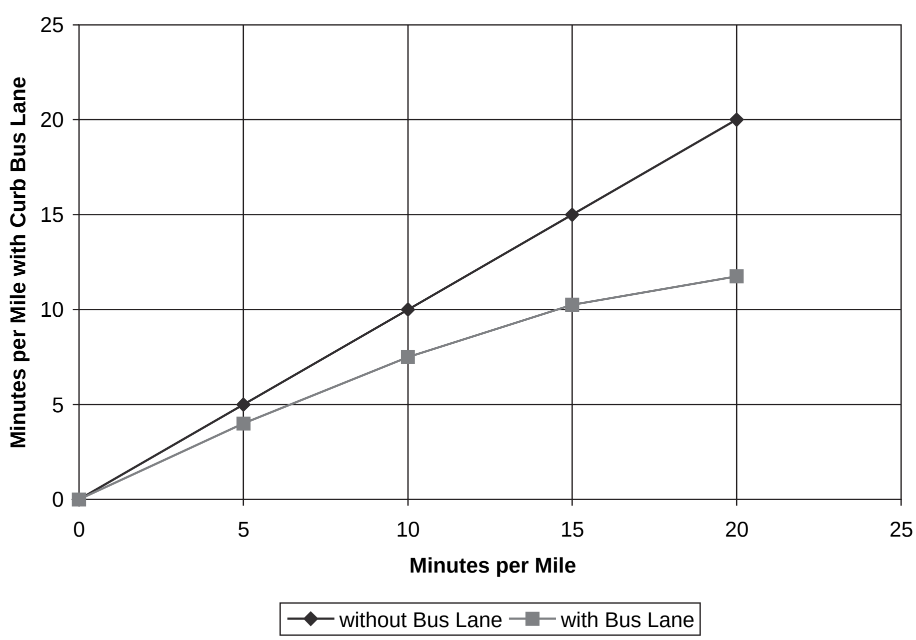

FIGURE 47 Travel time savings with curb bus lane [*Source: TCRP Report 118* (*5*)].

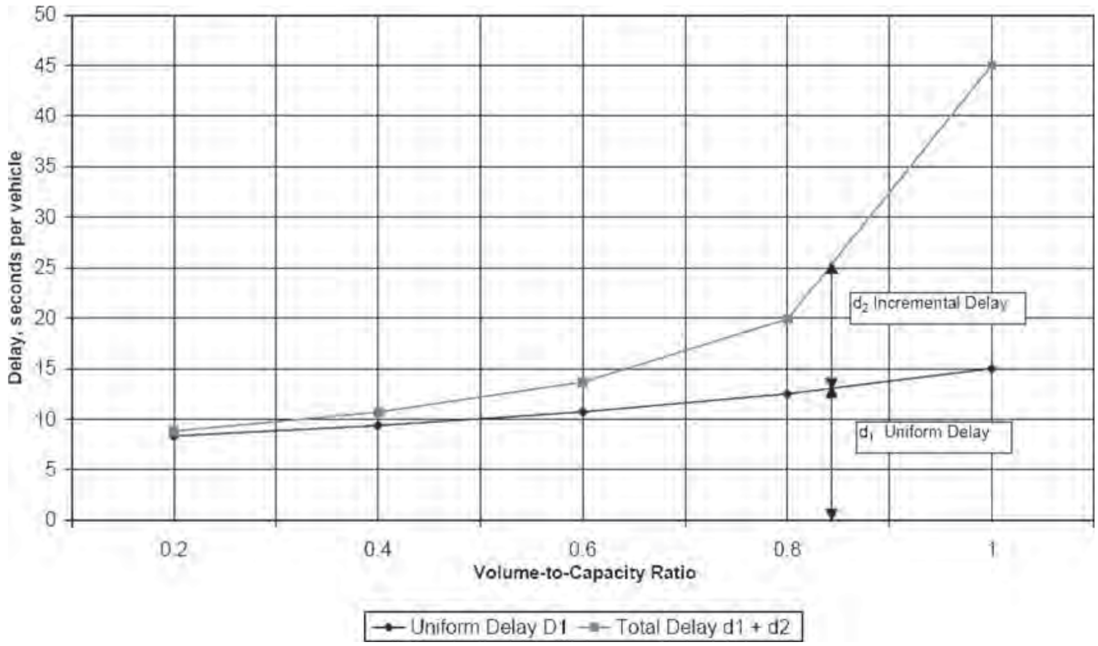

FIGURE 48 Signalized intersection delay (60-second cycle and 50% effective green) [*Source: TCRP Report 118* (*5*)].

effect of reducing the red time that transit vehicles incur. Delays to transit vehicles with and without TSP can be approximated by using delay curves for signalized intersections that relate intersection approach green time available (*g/C*) to the *v/c* ratio of the approach. Such signalized intersection delay curves are presented in Figures 48 through Figure 51 for different signal cycle lengths. Therefore, assuming 10% of the cycle time for a TSP window, the delay savings for any given *v/c* for the particular intersection approach can be estimated by comparing the delays for the initial *g/C* value with those for an appropriate curve with a higher value (e.g., comparing the curves in Figures 48 through 51).

Figure 52 gives an example of how priority for transit can reduce delay. A 90 s cycle with a *g/C* of 0.4 is assumed as a base with a *v/c* ratio of 0.8. The base delay is 33 s. An increase in *g/C* to 50% would result from TSP. The longer green period would result in a 26 s delay, which is a savings of 7 s or 21%

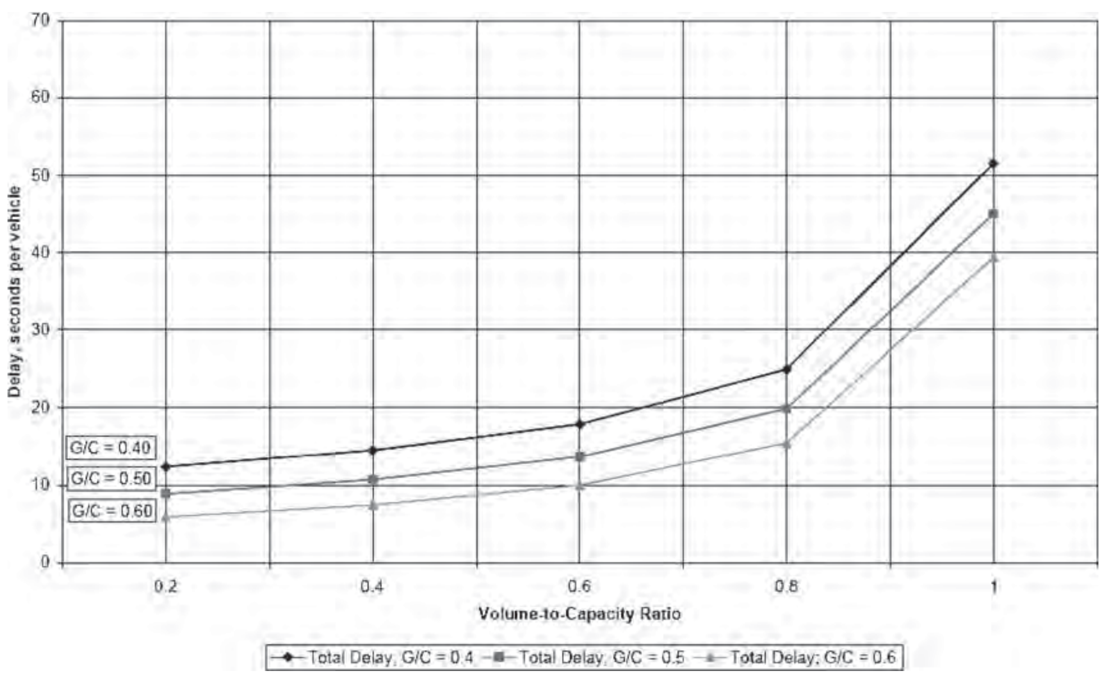

FIGURE 49 Signalized intersection delay (60-second cycle and range of effective green) [*Source: TCRP Report 118* (*5*)].

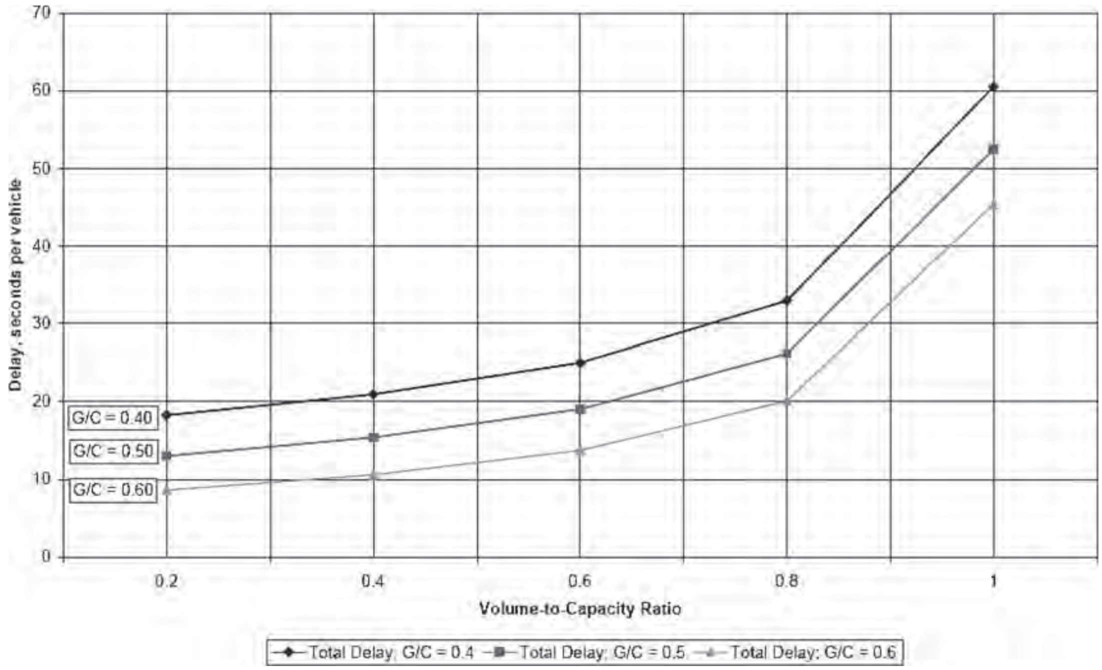

FIGURE 50 Signalized intersection delay (90-second cycle and range of effective green) [*Source: TCRP Report 118* (*5*)].

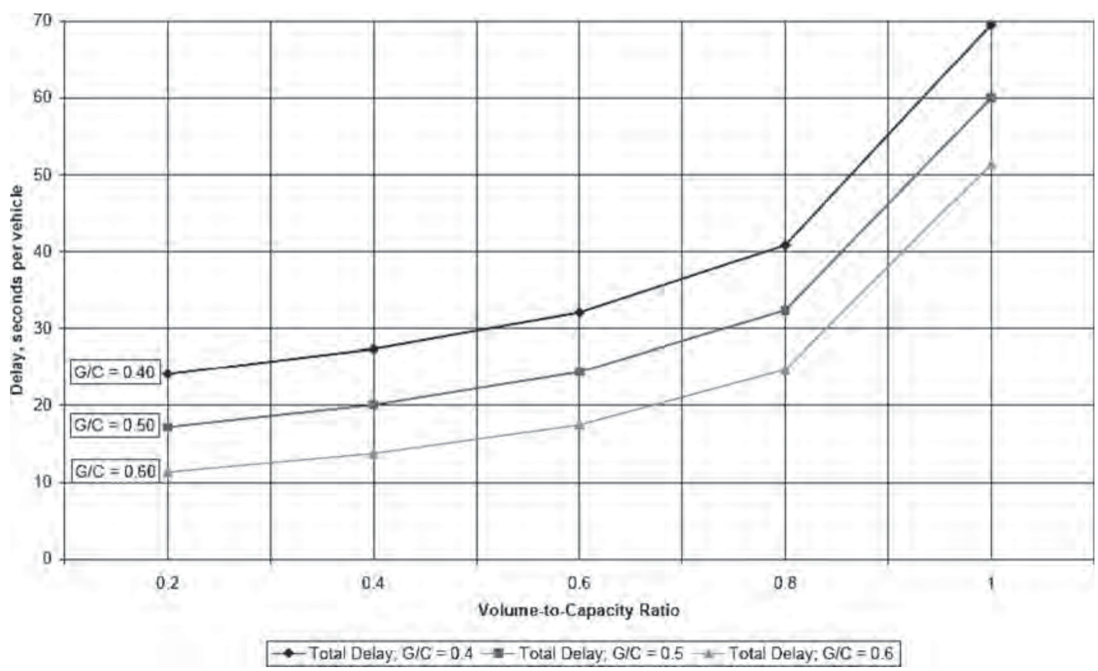

FIGURE 51 Signalized intersection delay (120-second cycle and range of effective green) [*Source: TCRP Report 118* (*5*)].

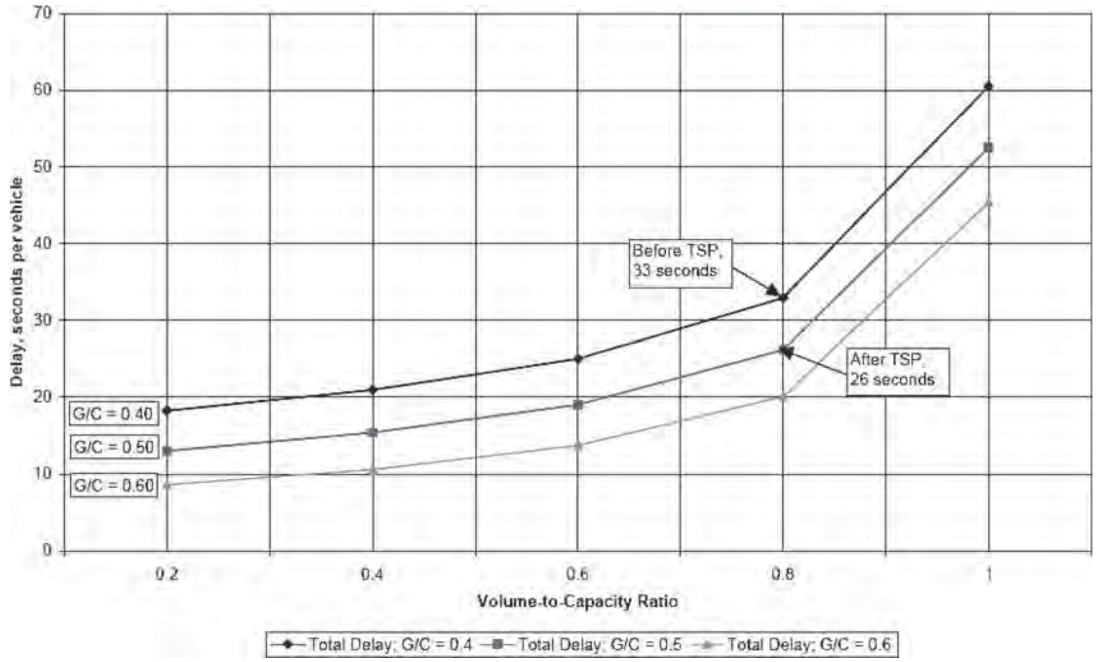

FIGURE 52 Effect of TSP on signalized intersection delay (90-second cycle) [*Source: TCRP Report 118* (*5*)].

per signalized intersection. This savings compares with an average of 5 to 6 s saved per bus found along Wilshire–Whittier and Ventura Boulevards in Los Angeles and along San Pablo Avenue in Oakland.

Simulation Modeling

Another method to identify TSP impacts is to develop a simulation model of before and after conditions at an intersection or along a corridor and measure the change in bus travel time and delay and general traffic delay. The model is normally calibrated to field conditions through some level of field data collection of bus travel times and bus and general traffic delays. Given the time to develop a simulation model plus added field data collection for calibration, this analysis approach tends to be more expensive. However, simulation modeling does allow for the testing of the impact of different traffic volume, controller setting, and degree of lateness conditions in the most economical manner in evaluating the sensitivity and overall impact of TSP on intersection and corridor operations.

Queue Jumps and Bypass Lanes

The reduction in bus delay and, hence, travel time associated with the provision of queue jumps or bypass lanes can be estimated by using procedures in the 2000 *Highway Capacity Manual* (*19*). Intersection approach delay for general traffic can be identified for a condition where buses would be in the general traffic stream with no queue bypass treatment being provided. The delay to buses with the queue bypass treatment can then be estimated in the separate lane where buses would operate, accounting for any delays associated with turning traffic. With a queue jump signal, some increased general traffic delay would occur as a result of the reduction of green time typically from the parallel through traffic phase to create a separate bus signal phase.

Figure 53 presents a graph that identifies the travel time savings associated with a queue jump treatment assuming (1) the queue bypass lane is long enough to function effectively and (2) an advance green of about 10% of the cycle length is provided. The example assumes an initial *g/C* (effective green time per cycle) of 50% and *v/c* of 0.8. After the bypass is installed, the *g/C* is assumed as 0.6 and the *v/c* at 0.2. In this example, a bus travel time savings of 17 s would result. Comparative benefits for other values of *g/C* and *v/c* can be obtained either by interpolation or by application of the delay equations.

Simulation modeling can also be applied to identify impacts to both bus travel time and general traffic delay associated with queue jump or bypass lane application. As with TSP, before and after conditions can be modeled using existing field data.

Curb Extensions

The travel time savings associated with individual curb extension treatments can be estimated through the transit vehicle clearance time savings identified from the analytical model reflective of the values in Table 24. As for other transit preferential treatments, simulation modeling can also be applied when it is desired to assess the impacts of a series of curb extensions on overall general traffic travel time in a corridor.

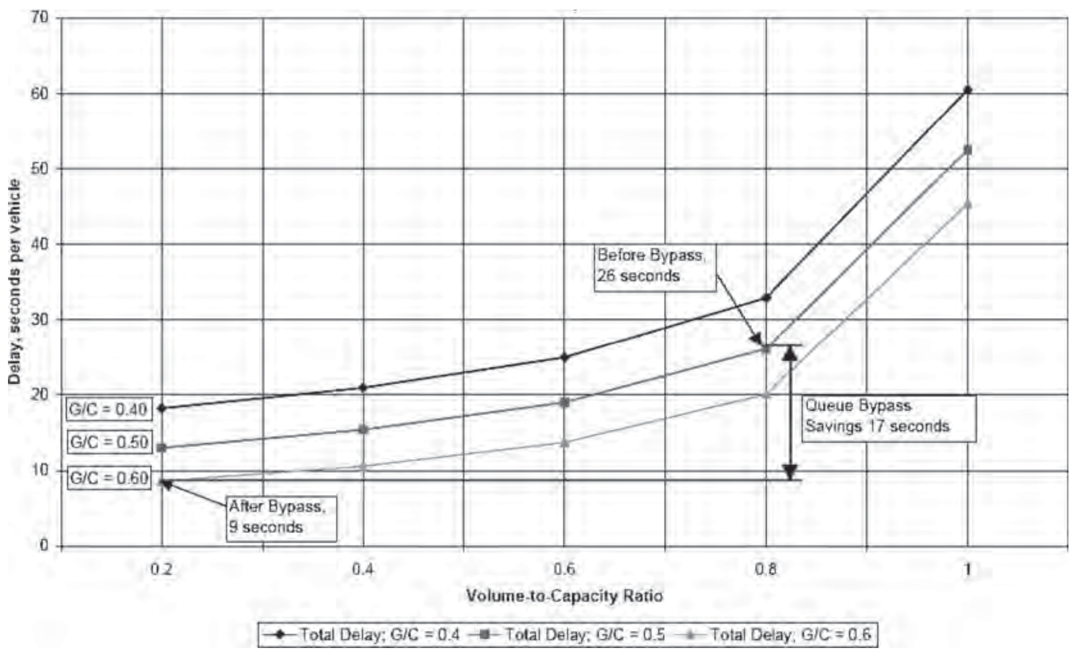

FIGURE 53 Effect of queue bypass with advanced green on signalized intersection delay (90-second cycle) [*Source: TCRP Report 118* (*5*)].

Stop Consolidation

The travel time savings associated with different bus stop spacing along an urban street can be estimated for planning applications using Table 26. Simulation modeling can also be applied if desired.

Cumulative Impact Assessment

In addition to analyzing the impact of individual transit preferential treatments, many times there is a need to compare and prioritize different preferential treatments within a corridor or at an intersection. One potential analysis methodology involves scoring and weighing different preferential treatments for potential application. Such a methodology was developed for a study for HART in Tampa to identify transit improvements in certain corridors.

The evaluation framework that was developed is a planning-level tool that is intended to both prioritize corridors and identify specific "hot spots" where there is a compelling need for a particular type of transit improvement. Three categories of improvements, service improvements, bus preferential treatments, and facility improvements, were considered. Figure 54 presents the bus preferential treatment worksheet that lists potential bus preferential improvements that can be applied to a corridor, bus stop, or intersection. This worksheet was developed to help determine if a certain location meets the identified thresholds to warrant the improvement or improvements. The framework's factors reflect existing and potential passenger demand, transit service characteristics, traffic flow characteristics, and elements of geometric feasibility (e.g., roadway cross section).

The evaluation process as defined would identify bus preferential treatments based on the following steps:

1. For each location (i.e., corridor segment, intersection, or bus stop), evaluate the factors described in Figure 54.
2. If all of the thresholds are met for a potential improvement at a given location, assign the weights for that potential improvement to the corridor for four different factors—increasing ridership, increasing travel speed (or decreasing delay), increasing passenger comfort, and increasing service reliability).
3. Sum the weights for each location in the corridor for use in corridor prioritization.

The weights identified were based on a scale of 0 to 10, where 0 means that it would have no positive impact and 10 means it would have a significant positive impact.

To properly compare corridors given that each corridor HART had evaluated has a different length, number of bus stops, and number of intersections, total scores (i.e., tallied weights) for the bus preferential treatment improvement category were normalized (divided by the number of signalized intersections in a corridor) so that a consistent unit comparison among corridors could be made. Table 29 identifies the

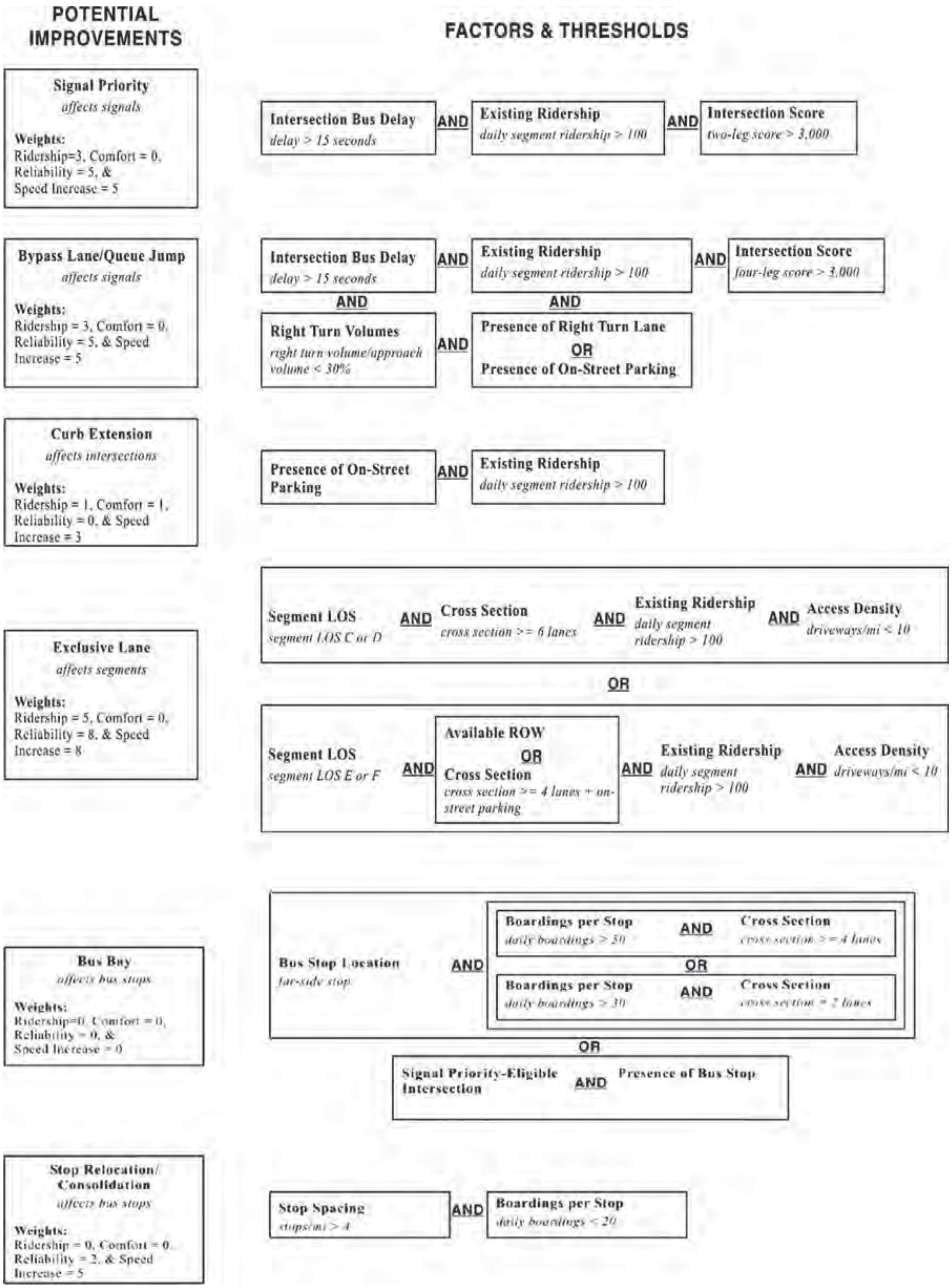

FIGURE 54 Scoring/weighing system for bus preferential treatments—HART study [*Source:* "Transit Corridor Evaluation and Prioritization Framework," 2006 TRB Annual Meeting (*14*)].

TABLE 29
SCORING OF BUS PREFERENTIAL TREATMENTS BY HART CORRIDOR AND NUMBER OF WARRANTED IMPROVEMENTS

	Raw Scores			Normalized Scores	
Corridor	Direction 1	Direction 2	Total	No. of Signals*	Score
Florida Ave.	555	547	1,102	27.5	40.1
Nebraska Ave.	760	751	1,511	39	38.7
Columbus Dr.	706	720	1,426	38.5	37.0
M.L. King, Jr. Blvd.	462	535	997	34	29.3
Hillsborough Ave.	741	775	1,516	39.5	38.4

*This is the average of both directions. Directions may not be symmetric.
Source: "Transit Corridor Evaluation and Prioritization Framework," 2005 TRB Annual Meeting (*14*).

TABLE 30
EXAMPLE OF SCORING EVALUATION OF TRANSIT PRIORITY TREATMENTS—ROUTE 5 CORRIDOR IN SEATTLE

Location	Cost	Transit Delay Savings	GP Delay Savings	Parking Impacts	Implemen-tation Times
Fremont Ave N & N 39th St TSP	**2**	**5**	**4**	**3**	**5**
Phinney Ave N & N 46th St					
Option 1 TSP	**3**	**5**	**4**	**3**	**5**
Option 2 Parking Restriction	**5**	**5**	**4**	**1**	**5**
Phinney Ave N & N 50th St TSP	**3**	**5**	**3**	**3**	**5**
Phinney Ave N & N 60th St TSP	**3**	**3**	**2**	**3**	**5**
Phinney Ave N & N 65th St					
Option 1 TSP	**3**	**4**	**2**	**3**	**5**
Option 2 Queue Jump	**4**	**5**	**2**	**2**	**4**
Greenwood Ave N & N 80th St TSP	**2**	**5**	**5**	**3**	**5**
Greenwood Ave N & N 85th St					
Option 1 TSP	**3**	**5**	**1**	**3**	**5**
Option 2 Parking Restriction	**5**	**5**	**4**		**5**
Greenwood Ave N & N 87th St TSP	**2**	**3**	**2**	**3**	**5**
Greenwood Ave N & N 105th St TSP	**3**	**5**	**1**	**3**	**5**
Westminster Way N & Dayton Ave N TSP	**3**	**4**	**4**	**3**	**5**

Evaluation Criteria Definitions

Cost
1. Over $100,000
2. $50,000-$100,000
3. $25,000-$49,999
4. $10,000-$24,999
5. Minimal Cost (Less than $10,000)

Transit Delay Savings
1. Over 10 seconds per bus trip degradation
2. 1 to 10 seconds per bus trip degradation
3. No measurable change in delay time
4. 1 to 10 seconds per bus trip improvement
5. Over 10 seconds per bus trip improvement

Worse ↔ **Better**

1	2	3	4	5

General Purpose Traffic Delay Savings
1. Over 5 seconds per vehicle degradation
2. 1 to 5 seconds per vehicle degradation
3. No measurable change in delay time
4. 1 to 5 seconds per vehicle trip improvement
5. Over 5 seconds per vehicle trip improvement

Parking Impacts
1. Greater than 50% utilization of removed parking
2. Up to 50% utilization of removed parking
3. No change
4. Up to 50% utilization of added parking
5. Greater than 50% utilization of added parking

Implementation Time
1. Greater than 24 months to implement
2. 19 to 24 months to implement
3. 13 to 18 months to implement
4. 7 to 12 months to implement
5. 0 to 6 months to implement

Source: King County Route 5 Corridor Evaluation Report, DKS Associates (*30*).

TABLE 31
APPLICABILITY OF DIFFERENT ANALYSIS METHODS FOR TRANSIT PREFERENTIAL TREATMENTS

Preferential Treatment	Field Survey	Analytical Model	Simulation[1]	Data Requirements
Median Transitway/Exclusive Lanes		X	X	Transit and general traffic volumes, transit travel speed
Transit Signal Priority	X	X	X	Transit and general traffic volumes, transit delay, signal timing
Queue Jumps/Bypass Lanes	X	X	X	Transit and general traffic volumes, transit delay, traffic queues, signal timing
Curb Extensions		X		Transit and general traffic volumes, right turn volume, clearance time estimate
Stop Consolidation		X	X	Transit travel speed

[1]Could include application of regional model to assess traffic diversion impacts to other roadways.

final corridor scores and the number of different bus preferential treatments warranted in each corridor evaluated.

Another procedure to identify the cumulative effects of corridor transit priority treatments on arterials has been applied in Seattle, involving rankings on a 1 through 5 scale based on multiple criteria, as shown in Table 30 (*30*). In this case, measures include cost, transit delay savings, general traffic impact, parking impact, and the time to implement the transit priority treatment.

SUMMARY OF TREATMENT ANALYSIS METHODS

Table 31 presents a summary of the applicability of different analysis methods and data requirements associated with different transit preferential treatments.

CHAPTER SEVEN

CONCLUSIONS

INTRODUCTION

This synthesis report offers a review of the application of a number of different transit preferential treatments in mixed traffic. It is highlighted by the presentation of the results of a survey of transit agencies and traffic agencies related to transit preferential treatments on urban streets. The survey results are supplemented by a literature review of 23 documents on the subject; a more in-depth case study evaluation of preferential treatment application in four cities—San Francisco, Seattle, Portland (Oregon), and Denver; and what are the warrants, costs, and impacts associated with different treatments, based on all of the information obtained.

This final chapter reviews the decision-making process, which can be applied in deciding which preferential treatment might be most applicable in a particular location. Also, the types of items to be addressed in intergovernmental agreements and monitoring programs to develop and evaluate such treatments are presented. Finally, areas for future research on the topic are suggested.

SURVEY RESPONSES

Eighty urban areas in the United States and Canada were contacted for the transit/traffic survey (30 with combined bus and light rail and/or street systems, and another 50 with just bus systems); with 52 transit agencies and 12 traffic engineering jurisdictions responding (80% response rate). A total of 197 individual preferential treatments were reported on the survey forms. In addition, the San Francisco Municipal Transportation Agency submitted spreadsheets that identified another 400 treatments in San Francisco alone.

The transit agency survey responses revealed the following insights on transit preferential treatment application:

- Transit signal priority (TSP) (67% of respondents), queue jump and bypass lanes and limited stops (each 52%), and exclusive transit lanes (46%) are the most popular treatments that have been applied. Other identified preferential treatments (median transitway, special signal phasing, curb extensions) each had 25% or less with respect to application.
- There are no standard warrants being applied to identify the need for particular treatments. Several different criteria have been applied, including ridership, service frequency, and transit delay and speed.
- A majority of transit agencies (54%) install TSP as an unconditional strategy, although conditional priority is increasing in application.
- Improving signal timing and coordination were identified (by almost half of the survey respondents) as the primary passive TSP applied.
- Green extension/red truncation is the most popular signal priority.
- Most transit agencies (80%) do not have formal comprehensive transit preferential treatment programs, but instead address transit preferential treatment needs and projects on a case-by-case basis.
- A slight majority of the transit agencies (52%) have intergovernmental agreements with the traffic engineering jurisdiction(s) in their service area.
- Transit agency involvement in transit preferential treatment development focuses on initially identifying and locating treatments (85% of respondents), and design of improvements monitoring their performance upon implementation (each 52%). Only slightly more than half the transit agencies design the improvements, and a lesser percent construct improvements.

Twelve traffic engineering jurisdictions responded to the traffic agency survey. Because of the low number of responses it is difficult to identify a composite trend in opinion on the part of traffic engineers on transit preferential treatments. Nonetheless, there were some notable trends in the responses:

- All traffic agency respondents indicated that they are involved with operating and maintaining transit preferential treatments, with a majority (58%) also involved in designing improvements and monitoring performance. The traffic agencies were least involved in identifying and locating treatments.
- Median transitways and exclusive lanes were perceived to have the greatest impact on general traffic operations, with limited transit stops the least impact.
- Early green/red truncation is the traffic signal timing modification strategy used most by traffic agencies.
- Most of the traffic agencies use either optical/infrared or inductive loops for transit vehicle detection.
- When monitoring TSP events, the traffic agencies indicated they identify the number of possible TSP events, the number of actual TSP events, and the duration of TSP events.

- Traffic agencies indicated they were most supportive of TSP, queue jump and bypass lanes, exclusive lanes, and limited stops, and least supportive of median transitways, special signal phasing, and curb extensions.

WARRANTS, COSTS, AND IMPACTS OF TRANSIT PREFERENTIAL TREATMENTS

This synthesis report presents documented information on the warrants, costs, and impacts of different transit preferential treatments. Most of this information comes from previous NCHRP and TCRP research efforts, in particular *NCHRP Report 155: Bus Use of Highways: Planning and Design Guidelines* (*2*), *TCRP Report 26: Operational Analysis of Bus Lanes on Arterials* (*16*), *TCRP Report 90: Bus Rapid Transit—Volume 2: Implementation Guidelines* (*4*), *TCRP Report 100: Transit Capacity and Quality of Service Manual* (*3*), and *TCRP Report 118: Bus Rapid Transit Practitioner's Guides* (*5*).

NCHRP Report 155 identified both general traffic and transit volume thresholds for exclusive lane and signal priority treatments for buses. A similar set of thresholds for light rail transit (LRT) and streetcar operations has not been identified. The transit and traffic agency survey responses from this synthesis identified a set of criteria used to establish the need for certain preferential treatments, but in general specific warrant values were not identified.

For the different transit preferential treatments, both capital and operating and maintenance costs have been identified. The synthesis revealed that there can be a significant range in costs based on the technology deployed (related to signal modifications) and the extent of physical roadway improvements (mainly in the development of exclusive transit lanes).

Documentation of impacts of different transit preferential treatments has focused on the travel time savings and improved on-time performance to transit. The extent of the benefits is associated with the degree of application and the level of congestion associated with general traffic operations on the street. There has been less documentation on the impact to general traffic operations of different treatments, although it has been identified in some studies that TSP can have a negligible impact on general traffic operations if applied where traffic operations are under capacity. Also, converting a general traffic lane to an exclusive transit lane can cause increased congestion in the remaining general traffic lanes or diversion to parallel streets if the exclusive transit lane and level of transit service cannot sufficiently attract former automobile users to take transit to lower overall traffic volumes.

DECISION-MAKING FRAMEWORK

Exclusive Lanes

The decision to develop dedicated transit lanes within a street right-of-way, whether in a separate median transitway or in a street travel lane, appears to be driven by answers to the following three questions:

1. Is the transit demand high enough to warrant service so frequent that exclusive transit lanes will be well-used and even self-enforcing?
2. Is there adequate roadway right-of-way available to develop a median transitway or added traffic lanes that could be dedicated to transit use?
3. Will the development of exclusive transit lanes still allow adequate local access in a corridor, recognizing that median transitways block mid-block and unsignalized intersection left-turn access, and curbside transit lanes have to share the lanes with local driveway movements and right turns at intersections?

Median transitways on urban streets to date have largely been applied to light rail service. This application is prevalent, as light rail over an entire corridor has a greater investment than a bus facility and that the maximum travel speed and on-time performance that can be achieved with an exclusive transitway is critical in making LRT a cost-effective investment. On one-way streets, however, LRT has operated curbside, to facilitate pedestrian access to stations.

Over the past 20 years, there have been only two applications of a median busway in North America, the original busway on Road No. 3 in Vancouver, British Columbia, and the new median busway at the west end of the Euclid Corridor in Cleveland. The decision to develop the median facility in Cleveland was driven by the need to preserve on-street parking in Cleveland close into downtown.

In evaluating the feasibility of developing dedicated transit lanes in a street right-of-way, the costs and impacts of such treatments must be evaluated. Figure 55 presents a flow chart from *TCRP Report 118* that identifies the different factors that have been considered and their relationship.

The decision where to locate a bus lane if developed outside of the median, and the hours of operation of the lane for exclusive use by buses, will be dependent on the desired length and limits of the exclusive lane, the importance of keeping on-street parking all day, and the general traffic volume pattern on the street. If on-street parking can be eliminated during peak hours, then locating a bus lane in the parking lane is doable and there are several successful applications in North America. Typically, such lanes operate as transit lanes for 2 to 4 h during the weekday a.m. and p.m. peak period. Operating a bus lane in the travel lane next to a parking lane, or "offset" lane, is desirable where on-street parking has to be maintained at all times. Contraflow lanes typically are only applied for short lengths, and in downtown areas, and operate all day as exclusive transit facilities.

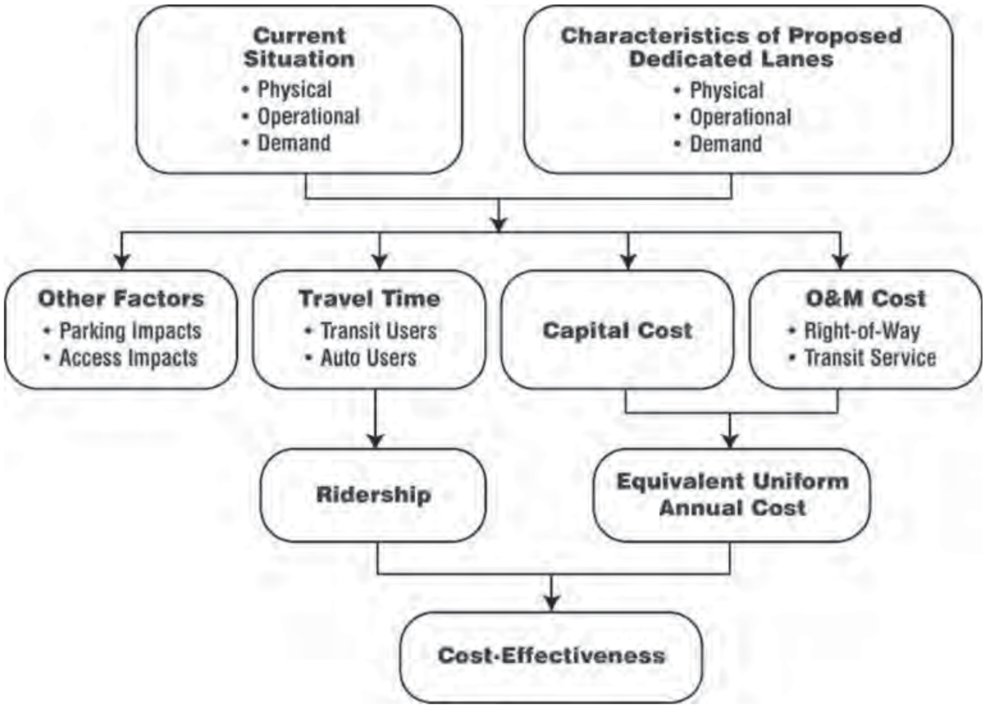

FIGURE 55 Evaluation process for dedicated transit lanes [*Source: TCRP Report 118* (*5*)].

Transit Signal Priority

TSP priority can be applied as a separate preferential treatment or in combination with other treatments, such as exclusive lanes and stop consolidation. Several questions must be addressed in deciding if and how TSP is to be implemented in a transit corridor:

- Are traffic conditions and transit volumes along a corridor currently within or projected to be within the "operationally feasible" range to successfully implement TSP?
- Can TSP be implemented without creating unacceptable congestion on cross streets?
- Is it possible to implement an extended TSP treatment along a corridor with a median tramway or exclusive transit lanes and, if so, would it provide added benefit to warrant the added cost?
- Can transit stops be located on the far side of an intersection, or mid-block, so that effective TSP can be provided?
- Is the existing traffic signal control system capable of accommodating TSP, or are signal hardware and/or software modifications needed?
- Will automatic vehicle location (AVL) or automatic passenger counter (APC) be integrated with transit vehicles, which will dictate whether conditional or unconditional TSP can be applied?

Figure 56 presents a flow chart, also presented in *TCRP Report 118*, that provides a decision framework for identifying the warrant and configuration of implementing TSP at an intersection or along a corridor.

Queue Jumps and Bypass Lanes

If TSP is not possible to apply at an intersection given (1) overall traffic conditions, (2) the absence of an AVL or APC system to allow for conditional priority if that is the only acceptable treatment, and/or (3) the need to have a near-side transit stop, then a queue jump signal or bypass lane into a far-side stop could be an option. To make this decision, the following questions can be asked:

- Is there a right-turn lane (or left-turn lane) available to serve as a transit bypass lane?
- If not, is there an ability to cost-effectively develop within the street right-of-way a separate auxiliary bypass lane for transit vehicles?
- Whether or not a turn lane exists or a new auxiliary lane could be developed, is the lane long enough to allow transit vehicles to bypass the through traffic queue on the intersection most of the time, particularly during peak periods?
- Can the bypass lane be developed so that transit vehicles would not conflict with turning traffic?
- Can the intersection signal timing be modified to take away a few seconds of green time from the main street through traffic to give to a queue jump signal?
- Is there a far-side pullout or zone available to accept transit vehicles going through the intersection using a bypass lane if a far-side stop is desired?

Given their potential costs and impacts to general traffic, queue jump signals and bypass lanes can be developed to

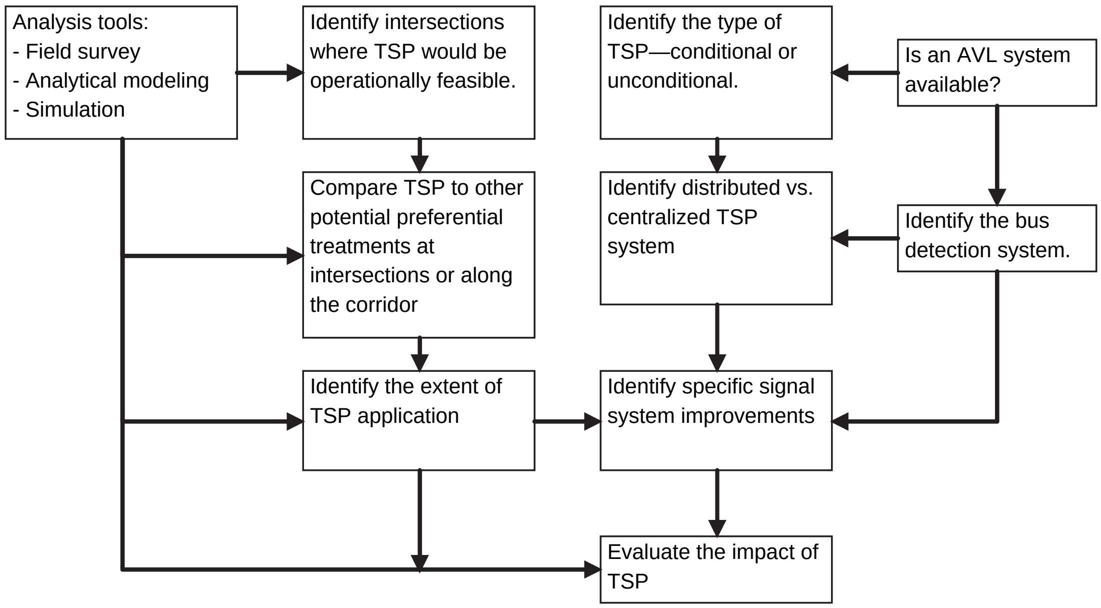

FIGURE 56 TSP decision framework [*Source: TCRP Report 118* (*5*)].

supplement and not replace TSP along a corridor, to reflect unique conditions at particular intersections.

Curb Extensions

TCRP A-10A developed a detailed set of questions that might be reviewed in making the decision to install a curb extension at an intersection or a number of these treatments on an urban street (see Table 32). The basic conditions for the application of a curb extension are: (1) a near-side transit stop is preferable, (2) at least two traffic lanes are available if the curb extension is to be far side (to allow general traffic to get around a stopped transit vehicle and not block the preceding intersection, and (3) there are very high passenger volumes at a stop where the added passenger waiting area associated with a curb extension is critical.

INTERGOVERNMENTAL AGREEMENTS

Based on the transit and traffic agency responses to the surveys conducted in this synthesis, a slight majority of those respondents indicated that they have formal intergovernmental agreements in place related to the implementation, operations and maintenance, and monitoring of performance of transit preferential treatments. Most of these agreements relate to TSP. This is an area where more emphasis might be given in the future, with intergovernmental agreement(s) integrated into formal comprehensive transit preferential treatment programs. Such agreements could clearly identify transit versus traffic agency responsibility with respect to the following:

- Design and construction/installation of facilities and equipment;
- Operations monitoring of equipment (mainly related to TSP—setting/adjustment to signal timing plans);
- Maintenance of facilities and equipment (TSP, signage, street cleaning/snow plowing, etc.);
- Replacement of equipment, including technology upgrades (TSP);
- Monitoring of impact on transit operations (use of AVL/APC equipment and/or field surveys);
- Monitoring of impact on traffic operations (system detection, field surveys); and
- Coordination meetings to review project implementation/operations/monitoring issues and strategize on future improvements

Examples of intergovernmental agreements executed between the transit and traffic agencies in King County and Snohomish County, Washington are presented in Appendix C. King County's sample Speed and Reliability Partnership agreement that relates the provision of added transit service in a corridor to local agency provision of transit preferential treatments is a novel concept that could have applicability to transit agencies across the United States.

FURTHER RESEARCH NEEDS

This synthesis includes a literature review of several past research studies related to transit preferential treatments, and incorporates the results of a comprehensive survey of transit and traffic agencies. Based on a review of this material, the following added research needs are suggested.

TABLE 32
QUESTIONS TO BE ADDRESSED IN DECIDING ON INSTALLATION OF CURB EXTENSIONS

Community / Neighborhood	• Does the area have a neighborhood feel? • How involved will the citizens be in the project? • Will the bulbs help pedestrian accessibility? • Will the presence of bulbs on one street cause cut-through traffic on a parallel street (i.e., traffic calming)? • Is transit an acceptable means of transportation within the community?
Business Owners	• Will business owners support construction in front of their stores? • Will business owners perceive that the bulbs are removing parking spaces?
Pedestrians	• Does the area have high pedestrian demand? • Is the sidewalk congested at or near the bus stops? • Is there a need to add amenities at the bus stops? • Is there a need to reduce pedestrian exposure in crosswalks and to improve pedestrian safety? Consider curb extensions on two approaches at the same corner—nearside on one corner and a farside on the other corner. • Will a midblock bulb encourage jaywalking? • Is there a need to place a greater emphasis on nonmotorized transportation in the corridor or region?
Bicyclists	• Do bicyclists currently use the parking lane as a travel lane? • How will bicyclists interact with buses that are stopped at the bus bulbs if there is no defined bicycle lane? • Are there defined bicycle facilities on parallel streets (e.g., bike lanes)?
ADA Wheelchair Lift Deployment	• Will vans serve the bus stop (e.g., it is acceptable for the van to be present for up to 10 min while the wheelchair lift deploys)? • Where will the bus shelter, benches, and signs be placed with respect to the ADA landing pad? • How will placement of vending machines be controlled to avoid machines being placed near the pad?
Transit Operations	• Are there high transit ridership numbers in the corridor? • Are there a high number of boardings and alightings at a stop? • Is the site a transfer point? • Will more than one bus be arriving at the site at the same time? Will articulated buses be stopping at the site? • What is the preferred location of bus stops—nearside, farside, or midblock? • What is the frequency of stops? • Will the presence of bulbs provide an opportunity for consolidation of stops?
Traffic	• Are there high traffic volumes on the roadway? • Are the speeds on the street too fast for bus bulbs? • Is the posted speed 45 mph or higher? • Is there a concern for the speed differentials between stopped or slower transit vehicles and faster-moving, general-purpose traffic? • Is the bus having re-entry difficulties at the bus bay stop? • Are buses currently stopping in the travel lane to avoid the re-entry problem? • Will bus bulbs be perceived as traffic-calming measures? • Are erratic maneuvers frequent in and around the bus stop to avoid the stopped bus? • Does the potential exist for conflict between right-turning vehicles and the stopped buses? • Will the all-red phase be extended to avoid having cars trapped in the intersection at farside stops? • Will the back-end of the bus extend into the intersection and block the intersection at a farside stop? • Are there signalized intersections with general-capacity concerns? • How frequently will the bus stop in the travel lane? • Will a stopped bus in the travel lane create unacceptable traffic queues behind the bus? • Are the streets too narrow to have a bus or other traffic pass a stopped bus at a bulb without encroaching on the oncoming traffic lane? • Should a no-turn-on-red restriction be implemented to reduce traffic and pedestrian conflicts, especially if the queue from the farside stop enters the intersection or if there is a history of vehicles going around the bus stopped at a nearside stop to turn right?

(*continued on next page*)

TABLE 32
(*continued*)

Parking	• Is there 24-hr curbside parking available? • Will the addition of the bulb add or remove parking? • What types of parking control markings will be installed at the site—signs, tape, or paint? • Will additional parking enforcement be provided to reduce illegal parking at the bulbs and to reduce double-parking before and after the bulbs? • How will the placement of parking signs affect the operations of the wheelchair lift extension? • Will the conversion reduce illegal parking because drivers will be more hesitant to park in a travel lane rather than in a bus bay?
Length and Width of the Bus Bulb	• Will more than one bus be arriving at the site simultaneously? • Will articulated buses be arriving at the site simultaneously? • Is the site a transfer site? • What is the policy of the transit agency regarding which doors are used for boarding and alighting (e.g., all doors or just the front door)? • What is the policy of the transit agency regarding how fares are collected? Are fares collected on both inbound and outbound routes? • Will the bulbs be used to help consolidate bus stops in the corridor? • Will the bulbs also be fitted with pedestrian curb extensions on both approaches to the intersection? • Will bus stop amenities, such as shelters, be added to the bulb?
Construction / Design	• Will utilities (e.g., fire hydrants, light poles, signs) need to be relocated if bulbs are constructed? • How will the street storm water drainage be handled? • How will the sidewalk drainage be handled with the extension of the curb? • Will the design create areas on the sidewalk for standing water, which creates the potential for ice in colder climates? • What will the return radius be on the curb—does a motorized street cleaner need to maneuver in and around the bulb? • To encourage patrons to wait a foot from the curb, consider adding a colored concrete strip, stamped concrete, or brick pavers along the curb to provide a visible line between the waiting area or sidewalk and the roadway. • Bollards have been used to prevent vehicles from encroaching on the bus stop waiting area.

Source: *TCRP Report 65: Evaluation of Bus Bulbs* (*8*).

Warrants for Transit Preferential Treatment Application

The transit agencies responding to the survey associated with this synthesis identified "warrants" for different transit preferential treatments, primarily in terms of evaluation criteria or performance measures—and not specifically numerical warrants. *NCHRP Report 155* presented some numerical warrants for different treatments; however, this report is more than 30 years old and an updated assessment of warrants would be a worthy research topic.

Benefits of Multiple Transit Preferential Treatment Applications

There appears to be little guidance on identifying the incremental benefits of packaging multiple transit preferential treatments in a corridor, such as the impact of adding TSP to the provision of exclusive bus lanes or limited stop application with TSP. Conducting some research on this topic could give agencies more information on the application of the most cost-effective strategy for transit preferential treatments along a corridor. This could include the tradeoffs of using simulation versus analytical modeling in conducting such assessments.

Limited Stop/Stop Consolidation Impacts

Little documentation was found related to guidelines for consolidating transit stops in a corridor to facilitate transit operations and identifying the specific impact on transit travel time savings and on-time performance. A further survey of transit agencies to probe their policies related to stop consolidation for different transit services would be desirable, as well as selection of a couple of corridors to conduct a "before" and "after" evaluation of stop consolidation application.

Tradeoffs on Intersection-Based Transit Preferential Treatments

There appears to be little guidance on when to apply different intersection transit preferential treatments, in particular when TSP might be provided versus a queue jump lane and signal, or curb extensions. This study might involve the use of a simulation model to estimate the impacts on bus delay and general traffic operations for these different transit preferential treatments under different traffic and transit volume conditions.

Intergovernmental Relationships in Transit Preferential Treatment Development

Survey results indicated that most transit and traffic agencies do not have formal transit preferential treatment programs, with many not having formal intergovernmental agreements with respect to planning, design, construction, operations and maintenance, and performance monitoring of treatments. Added study would be helpful to identify the process of establishing transit preferential treatment needs on a corridor and regional scale, and identifying alternate implementation strategies, including potential funding sources. This could include an assessment of the costs and impacts of alternate governmental relationships, and the development of one or more sample agreements, similar to the Speed and Reliability Partnership agreement developed by King County Metro.

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APPENDIX A

Transit Agency Survey and Responses

TRANSIT AGENCY SURVEY
TCRP J-7/SA-22 - Bus and Rail Preferential Treatments in Mixed Traffic Environments

This page shows all the questions on a single page to help your agency determine who should answer the survey. When you are ready to begin the survey, use the link here or at the bottom to go back to the start page

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1. Has your agency been involved with implementing any of the following preferential treatments for bus or LRT/streetcar operations on the street system in your urban area? (Check all that apply)

- [ ] Median Transitway (MT)
- [ ] Exclusive Lanes (EL)
- [ ] Transit Signal Priority (TSP)
- [ ] Special Turn Signals (STS)
- [ ] Queue Jump/Bypass Lane (QJ/BL)
- [ ] Curb Extension (CE)
- [ ] Limited Stops (LS)
- [ ] Other (O)

Identify:

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Transit Preferential Treatment Applications

You will be asked to complete a table of all transit preferential treatments your agency has implemented. The following questions apply to each transit preferential treatment.

Add a new treatment:

Please fill in the information below. You may only add one treatment type per entry, but please group similar treatments along a corridor if the are in proximity to one another. You are also asked to locate each treatment on a map. Use pins for point treatments (e.g. intersections) and lines for linear treatments (e.g. exclusive transit lanes). For example, if your agency employs TSP along a corridor, please draw pins at each intersection along the corridor for which TSP is applied.

To draw point treatments, click the pin icon, then click the map on the point where the treatment is located. For linear treatments, click the polyline button and draw the line on the map, clicking once for each point in the line. Double-click to stop drawing the line. It you make a mistake, click the 'Clear Map' link to clear the map. You can pan (move) the map while drawing treatments by holding the mouse button down while dragging the mouse.

Answer the questions you know - traffic/roadway agencies will be asked later to provide answers to those you do not know.

Transit Type:

Treatment Type:

If other, Identify:

Street:

Year Built:

Direction of Treatment:

Please answer the remaining questions with respect to the number of directions indicated above.

Peak Hour Transit Volume: Transit *vph*

Off-Peak Transit Volume: Transit *vph*

Daily Traffic Volume:

Peak Hour *LOS*:

Captial Cost: $

Annual *O & M* Cost: $

Travel Time Savings: %

Reduction in Travel Time Variability: %

Average Daily Ridership:

Enter the treatment location(s) on the map. Use pins for point treatments (e.g. intersections) and lines for linear treatments (e.g. exclusive transit lanes).

Clear Map

Impact on General Traffic Operations:

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2. What warrants have you applied in identifying the need for different transit preferential treatments for bus or LRT/streetcar operations on your street system? (e.g. particular transit service headway, ridership, delay, reliability, traffic volumes, level of service, other)

Bus Operations

Median Transitway (MT)

Exclusive Lanes (EL)

Transit Signal Priority (TSP)

Special Turn Signals (STS)

Queue Jump/Bypass Lane (QJ/BL)

Curb Extension (CE)

Limited Stops (LS)

Other (O)

LRT/Streetcar Operations

Median Transitway (MT)	
Exclusive Lanes (EL)	
Transit Signal Priority (TSP)	
Special Turn Signals (STS)	
Queue Jump/Bypass Lane (QJ/BL)	
Curb Extension (CE)	
Limited Stops (LS)	
Other (O)	

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3. What types of priority are applied at your transit signal priority preferential treatments? (Check all that apply)

***Active* Treatments:**

- ☐ Unconditional
- ☐ Conditional - Vehicle behind schedule
- ☐ Conditional - Vehicle with certain on-board volume
- ☐ Conditional - Other

Identify:

***Passive* Treatments:**

- ☐ Signal Coordination
- ☐ Other

Identify:

4. What is the role of your agency related to transit preferential treatment development in your service area? (Check all that apply)

- ☐ Identifying and locating treatments
- ☐ Designing treatments
- ☐ Constructing treatments
- ☐ Operating and maintaining treatments
- ☐ Monitoring performance of treatments
- ☐ No role

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5. Does your agency have a comprehensive transit preferential treatment program in place which guides the development and implementation of different treatments associated with bus and LRT/streetcar operations?

- Yes
- No

6. Is there an agreement in place with the local traffic engineering jurisdiction related to the development, operation, and/or maintenance of transit preferential treatments?

- Yes
- No

7. Do you obtain public input/approval before transit preferential treatments are implemented?

- Yes
- No

If yes, what public forum? (e.g. meeting, mailout)

8. Please provide a contact e-mail address for each traffic agency with which you cooperate on transit preferential treatments. Choose someone who is likely to be able to answer any blank sections in the table you filled out for each treatment. Please separate each address with a comma.

<< Back to the start page

Transit Agency Responses

ID	Agency	Name	Service	Q1 - Treatments	Q1 - Other	Q2 - Bus Treatment Warrants MT	EL	TSP
1	Valley Metro Rail, Inc.	James Mathien	lrt	mt, tsp,				
2	Fresno Area Express	Jeff Long	bus	o	Bus only turn lanes			
3	Capital District Transportation Authority	Kristina Younger	bus	tsp, qj, ce, ls,				Ridership, reliability, headway
4	Halifax Regional Municipality - Metro Transit	Dave Reage	bus	tsp, sts, qj, ls,				
5	Metro Transit	Charles Carlson	both	mt, el, tsp, sts, qj, ce, ls,				
6	Pace	Taqhi Mohammed	bus	tsp, qj, ls, o	Shoulder Lanes			Delay due Red Signal, Number of times Bus Stops due to redlight. Travel time saving Potential including frequency of bus as mojor factor, schedule adherence and Bus occupancy
7	Lane Transit District	Graham Carey	bus	mt, el, tsp, qj, ls,				
8	Calgary Transit	Neil McKendrick	both	el, tsp, sts, qj, ls, o	Bus Only Crossings		Some short bus lanes have been constructed on a case by case basis.	No warrants required - TSP is implemented on longer high volume bus routes
9	Valley Metro RPTA	Jim Book / Ratna Korepella	bus	tsp, qj, ls, o	Unique Station Design			Delay
10	Central Florida Regional Transportation Authority (dba LYNX)	Doug Jamison	bus	el, tsp,			traffic LOS, individual passenger trips	

Transit Agency Responses

ID	Agency	Q2 - Bus Treatment Warrants				
		STS	QJ/BL	CE	LS	OTHER
1	Valley Metro Rail, Inc.					
2	Fresno Area Express					
3	Capital District Transportation Authority		bus volume		ridership, reliability	
4	Halifax Regional Municipality - Metro Transit					
5	Metro Transit					
6	Pace		Queue Length, Cycle failures to buses,Delay due Red Signal, Number of times Bus Stops due to redlight. Travel time saving Potential including frequency of bus as major factor, schedule adherence and Bus occupancy		On & offs, dwell time, bus travel time, density and walk time.	
7	Lane Transit District					
8	Calgary Transit	No warrants required - case by case application	No warrants required - case by case application		Limited stop routes are provided on an as required basis in response to demand	Bus only crossings - physical barriers or gates that allow bus passage between communities is established at the community road network planning stage
9	Valley Metro RPTA				Delay	
10	Central Florida Regional Transportation Authority (dba LYNX)					

Transit Agency Responses

ID	Agency	Q2 - LRT/Streetcar Treatment Warrants							
		MT	EL	TSP	STS	QJ/BL	CE	LS	OTHER
1	Valley Metro Rail, Inc.								
2	Fresno Area Express								
3	Capital District Transportation Authority								
4	Halifax Regional Municipality - Metro Transit								
5	Metro Transit								
6	Pace								
7	Lane Transit District								
8	Calgary Transit	LRT operates within a protected, exclusive right of way except in the downtown (see exclusive lanes)	7th Ave S is a transit mall with access restricted to LRT, buses and emergency vehicles	LRT has preemption over traffic signals outside of the downtown core.					
9	Valley Metro RPTA								
10	Central Florida Regional Transportation Authority (dba LYNX)								

Transit Agency Responses

ID	Agency	Q3 TSP Types	Q3 Active - Other	Q3 - Passive - Other	Q4 - Agency Role	Q5	Q6	Y/N	Q7 - Public Forum? If Yes, Type
1	Valley Metro Rail, Inc.	a_cond-other,	predictive priority; early green, green extension, phase insertion		design, construct, o/m,	No	No	No	
2	Fresno Area Express	no_tsp			planning, design, o/m,	No	No	Yes	meeting, mailout
3	Capital District Transportation Authority	a_cond-behind, p_sgnl_coord,			planning, design, performance,	No	Yes	Yes	open houses, meetings, mailouts, e-blast newsletters
4	Halifax Regional Municipality - Metro Transit	a_uncond, a_cond-other,	Red truncation/green extension		planning,	No	Yes	No	
5	Metro Transit	a_uncond,			planning,	No	Yes	Yes	Public Meetings
6	Pace	a_cond-behind, p_sgnl_coord, p_other		Signal Timming Optimization	planning, design, construct, o/m, performance,	Yes	Yes	No	
7	Lane Transit District	a_uncond,			planning, design, construct,	No	Yes	Yes	workshops, charrettes and meetings
8	Calgary Transit	a_uncond, p_sgnl_coord,			planning, design, performance,	No	Yes	No	
9	Valley Metro RPTA	a_cond-behind, p_sgnl_coord,			planning, design, construct, performance,	No	Yes	Yes	meetings
10	Central Florida Regional Transportation Authority (dba LYNX)	a_uncond, a_cond-other,	addition of transit phase is vehicle present		none	No	Yes	Yes	public meetings

Transit Agency Responses

ID	Agency	Name	Service	Q1 - Treatments	Q1 - Other	Q2 - Bus Treatment Warrants MT	Q2 - Bus Treatment Warrants EL	Q2 - Bus Treatment Warrants TSP
11	Los Angeles County Metropolitan Transportation Authority	Bruce Shelburne	both	tsp, o	Traffic Signal Priority = Synchronization			
12	Pierce Transit	Tina Lee	bus	tsp, qj,				Transit Signal delay greater than 10 sec.
13	TriMet	Young Park	both	el, tsp, qj, ce, ls,			bus volumes; loads; location of supporting bus stops	bus volumes; delay factors
14	New Orleans Regional Transit Authority	Edward J. Bayer	both	mt, el, sts, ce,			Delay, level of service, need to maintain on time performance	Delay, level of service, need to maintain on time performance
15	Transit Authority of River City	Carrie Butler	bus					
16	Toronto Transit Commission	Gary Carr	both	mt, el, tsp, sts, qj, ls,		pro-transit policy, assisted by the fact that transit lanes carry as many people as a full auto lane	pro-transit policy, assisted by the fact that transit lanes carry as many people as a full auto lane	benefit to transit on busy routes was sufficient to remove a vehicle and still provide same no. of vehicle passes per hour, justifying the cost was the intial justificaiton - later it was simply seen as a proper pro-transit tool
17	Nashville MTA	Jim McAteer	bus					
18	Central Arkansas Transit Authority	Eric Meyerson	both	tsp,		none	none	none
19	San Francisco Municipal Transportation Agency	Javad Mirabdal	both	mt, el, tsp, sts, qj, ce, ls, o	Boarding Island, Turn Restriction	Transit ridership, Street width, Traffic volume	Transit ridership, Street width,Traffic volume	Signal delay, Ridership
20	King County Metro Transit	Ellen Bevington	both	el, tsp, qj, ce, ls, o	HOV lane, Parking Restrictions		Benefit/Cost Analysis, LOS Study, transit headways 10 bus/hr or greater	Benefit/Cost Analysis, Delay Study, LOS Analysis (LOS B-E)

Transit Agency Responses

ID	Agency	Q2 - Bus Treatment Warrants STS	QJ/BL	CE	LS	OTHER
11	Los Angeles County Metropolitan Transportation Authority					
12	Pierce Transit		None			
13	TriMet		bus volumes; loads; location of supporting bus stops	bus volumes; stop activity - ons/offs	type of service	
14	New Orleans Regional Transit Authority					
15	Transit Authority of River City					
16	Toronto Transit Commission	a good pro-transit tool	justified on case-by-case basis		just a transit agency decision given that a parallel local service also provided	
17	Nashville MTA					
18	Central Arkansas Transit Authority	none	none	none	travel time	
19	San Francisco Municipal Transportation Agency	Accomodate special transit movement	Change from exclusive to mix flow, Accomodate special transit movement	Before and after loading delay, Access to bus stop	Closely located stops	
20	King County Metro Transit	Delay Study, City's LT signalization warrant, LOS Analysis	Delay Study, Benefit/Cost Analysis, LOS Analysis	Delay Study, Pilot project with before/after study		Delay Study, Parking Utilization Study

Transit Agency Responses

ID	Agency	Q2 - LRT/Streetcar Treatment Warrants							
		MT	EL	TSP	STS	QJ/BL	CE	LS	OTHER
11	Los Angeles County Metropolitan Transportation Authority			Passenger volumes, distance of street run section, speed, traffic interface					Safe operation of LRT
12	Pierce Transit								
13	TriMet								
14	New Orleans Regional Transit Authority	Delay, level of service, need to maintain on time performance	Delay, level of service, need to maintain on time performance	Delay, level of service, need to maintain on time performance					
15	Transit Authority of River City								
16	Toronto Transit Commission	justification primarily the need to separate transit operations from effects of traffic delays; assisted by the fact that transit lanes carry as many people as a full auto lane	n/a	benefit to transit on busy routes was sufficient to remove a vehicle and still provide same no. of vehicle passes per hour, justifying the cost was the intial justificaiton - later it was simply seen as a proper pro-transit tool	a good pro-transit tool	n/a	n/a	n/a	
17	Nashville MTA								
18	Central Arkansas Transit Authority	none	to line up track with bridge ramp	safety	safety	none	boarding locations	none	
19	San Francisco Municipal Transportation Agency	Transit ridership, Street width, Traffic volume	Transit ridership, Street width,Traffic volume	Signal delay, Ridership	Accomodate special transit movement	Change from exclusive to mix flow, Accomodate special transit movement	Before and after loading delay, Access to bus stop	Closely located stops	
20	King County Metro Transit								

Transit Agency Responses

ID	Agency	Q3 TSP Types	Q3 Active - Other	Q3 - Passive - Other	Q4 - Agency Role	Q5	Q6	Y/N	Q7 - Public Forum? If Yes, Type
11	Los Angeles County Metropolitan Transportation Authority	a_uncond, p_sgnl_coord,			planning,	No	No	No	
12	Pierce Transit	a_uncond,			planning, design, construct, performance,	No	Yes	No	
13	TriMet	a_cond-behind,			planning, design, construct, o/m, performance,	Yes	Yes	No	
14	New Orleans Regional Transit Authority	no_tsp			planning,	No	No	Yes	Approval by City Dept. of Public Works
15	Transit Authority of River City	no_tsp			none	No	No	Yes	not applicable
16	Toronto Transit Commission	a_uncond,			planning, design, performance,	Yes	Yes	Yes	depends on the treatment - in some cases such as signal priority, no public input obtained; with any construction-related improvements such as median transit ways, extensive public process
17	Nashville MTA	no_tsp			planning, none	No	No	Yes	N/A - We don't currently have any transit preferential treatments
18	Central Arkansas Transit Authority	a_uncond,			none	No	No	No	
19	San Francisco Municipal Transportation Agency	a_uncond, p_sgnl_coord, p_other		Shortern walk to help right turn movement	planning, design, construct, o/m, performance,	Yes	Yes	Yes	Depending on treatment we may have community meeting and public hearing
20	King County Metro Transit	a_cond-other, p_sgnl_coord, p_other	Eligible routes only, generally peak direction only	Signal timing adjustments for transit movements	planning, design, performance,	Yes	Yes	Yes	Community meetings, direct contacts to affected individuals/businesses

Transit Agency Responses

ID	Agency	Name	Service	Q1 - Treatments	Q1 - Other	Q2 - Bus Treatment Warrants MT	EL	TSP
21	Indianapolis Public Transportation Corporation (IndyGo)	Trevor Ocock	bus	qj,				
22	AC Transit	Jon Twichell	bus	tsp, qj, ls,				Significantly improve bus speed
23	COTA	Doug Moore	bus	el, ls,			High Street downtown	
24	Greater Richmond Transit Company	Scott Clark	bus	el,			traffic volumes, safety	
25	OC Transpo	Jabbar Siddique	both	el, tsp, sts, qj, ce, ls,			ridership; delay; reliability; traffic volumes	ridership; delay; reliability; traffic volumes
26	Utah Transit Authority	Jeff LaMora	both	mt, el, tsp, qj, o	UTA /UDOT are in the process of building EL's for BRT		Currently under construction… Warrented by faster trip times and higher ridership through congested corridor	Safer operation and faster trip times
27	Port Authority of Allegheny County	David Wohlwill	both	el, sts,		N.A.	Reliability and Traffic Volumes	N.A.
28	Golden Gate Transit	Alan Zahradnik	bus	mt, el, tsp, sts, qj, ce, ls,		congested mixed flow operations with undesirable delay that effects on time performance	congested mixed flow operations with undesirable delay that effects on time performance	congested mixed flow operations with undesirable delay that effects on time performance
29	Sacramento Regional Transit District	Don Smith	both	tsp, sts, qj,		None	None	one intersection
30	Fort Worth Transportation Authority	Carl Weckenmann	bus	el, tsp,				No specific warrants, first project applied to busiest corridor
31	Sound Transit	Greg Walker	both	mt, el, ce,				

Transit Agency Responses

ID	Agency	Q2 - Bus Treatment Warrants				
		STS	QJ/BL	CE	LS	OTHER
21	Indianapolis Public Transportation Corporation (IndyGo)					
22	AC Transit		Bypass congestion delay		Significantly improve bus speed	
23	COTA					
24	Greater Richmond Transit Company					
25	OC Transpo	ridership; delay; reliability; traffic volume	ridership; delay; reliability; traffic volume	convinience for transit customers; delays; reliability; traffic volumes	ridership; delay; reliability;	
26	Utah Transit Authority		Safety and efficiency for bus operations.			
27	Port Authority of Allegheny County	Need to move buses through heavily congested areas	N.A.	N.A.	A handful of routed offer limited stop service	
28	Golden Gate Transit	need for bus only left turn signal to allow buses to turn where traffic is prohibited	congested mixed flow operations with undesirable delay that effects on time performance	needed for establishing accessible ADA bus stops	low ridership density corridors	
29	Sacramento Regional Transit District	one intersection	one intersection			
30	Fort Worth Transportation Authority					
31	Sound Transit					

Transit Agency Responses

ID	Agency	Q2 - LRT/Streetcar Treatment Warrants							
		MT	EL	TSP	STS	QJ/BL	CE	LS	OTHER
21	Indianapolis Public Transportation Corporation (IndyGo)								
22	AC Transit								
23	COTA								
24	Greater Richmond Transit Company								
25	OC Transpo								
26	Utah Transit Authority		Project justification through ridership. Most of street running portion of system is EL. - Safety and Efficiency	Safer operation, faster trip times, consistent trip times		Safety			
27	Port Authority of Allegheny County	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	
28	Golden Gate Transit								
29	Sacramento Regional Transit District			In downtown there is TSP	STS at some downtown intersections				
30	Fort Worth Transportation Authority								
31	Sound Transit								

Transit Agency Responses

ID	Agency	Q3 TSP Types	Q3 Active - Other	Q3 - Passive - Other	Q4 - Agency Role	Q5	Q6	Q7 - Public Forum? Y/N	Q7 - Public Forum? If Yes, Type
21	Indianapolis Public Transportation Corporation (IndyGo)	no_tsp			none	No	Yes	No	
22	AC Transit	a_uncond, p_sgnl_coord,			planning, performance,	Yes	Yes	No	
23	COTA	no_tsp			planning,	No	No	No	
24	Greater Richmond Transit Company	no_tsp			none	No	No	No	
25	OC Transpo	a_uncond, a_cond-other, p_sgnl_coord, p_other	pre-emptions are subject to fulfilling minimum requirements for intersecting streets;	1/2 cycle operation; Standby or Non coordinated operation;	planning, design, construct, o/m, performance,	Yes	Yes	Yes	in some cases we obtain public input/approval through public meetings; however, in many cases we do not obtain public approval before transit preferential treatments are implemented
26	Utah Transit Authority	a_uncond,			planning, design, construct, o/m, performance,	Yes	No	Yes	Public input is considered during the public meeting process for any project. There is also consideration given to ongoing public comments provided to UTA and the various tranpsortation departments.
27	Port Authority of Allegheny County	no_tsp			planning,	No	No	No	
28	Golden Gate Transit	a_cond-other, p_other	we have none	we have none	planning,	No	No	No	
29	Sacramento Regional Transit District	a_uncond, p_sgnl_coord,			planning,	No	Yes	Yes	mailouts and meetings
30	Fort Worth Transportation Authority	a_uncond,			planning, design, performance,	No	No	No	
31	Sound Transit	no_tsp			planning, construct,	No	No	Yes	meeting and mailout as well as website information

Transit Agency Responses

ID	Agency	Name	Service	Q1 - Treatments	Q1 - Other	Q2 - Bus Treatment Warrants MT	EL	TSP
32	Capital Metropolitan Transportation Authority	Roberto Gonzalez	bus	sts, qj, ce, ls, o	Working on TSP for future Rapid Bus Program (2011 Implementation) / Working on Shoulder use of Urban Expressways (future)		City of Austin (Future Study) - Downtown (Lavaca and Guadalupe Corridors); TxDOT (Future Study) - Exclussive Bus Travel on Shoulder Program	City of Austin (Future Project - 2011) - Rapid Bus Program (Lamar and South Congress)
33	Spokane Transit	Gordon Howell	bus	o	Limited Stop (Route 124) Single Treatment			
34	Memphis Area Transit Authority	John C. Lancaster, AICP	both	tsp,				
35	Pinellas Suncoast Transit Authority	John Villeneuve	bus	ls,				
36	MTA New York City Transit	Ted Orosz	bus	el, tsp, qj, ls,			Ridership, reliability, traffic volumes	Delay, traffic volumes
37	Rochester-Genesee Regional Transit Authority	Charles Switzer	bus	el, ls,			headways, level of service	
38	Connecticut Department of Transportation	Micheal Sanders	bus	mt,				
39	Central Okla. Transportation and Parking Authority (COTPA) dba METRO Transit	Larry Hopper	bus	ls,				

Transit Agency Responses

ID	Agency	Q2 - Bus Treatment Warrants				
		STS	QJ/BL	CE	LS	OTHER
32	Capital Metropolitan Transportation Authority	City of Austin (regular requests) - Left-turn protection signalizations	City of Austin (1st case) - North Lamar/Airport Blvd (Crestview Station)	City of Austin (specific cases) at key stops - typically curb insets	City of Austin (working on Rapid Bus Program) and coordination of bus stops	
33	Spokane Transit				Potential for competitive travel time and increased ridership	
34	Memphis Area Transit Authority					
35	Pinellas Suncoast Transit Authority				Express Bus Services	
36	MTA New York City Transit		Delays, reliability		Headways, ridership	
37	Rochester-Genesee Regional Transit Authority				ridership	
38	Connecticut Department of Transportation					
39	Central Okla. Transportation and Parking Authority (COTPA) dba METRO Transit				METRO Transit has some routes on which we operate heritage trolleybuses and these are "limited stop": we have no quantitative warrant associated with these.	

Transit Agency Responses

ID	Agency	Q2 - LRT/Streetcar Treatment Warrants							
		MT	EL	TSP	STS	QJ/BL	CE	LS	OTHER
32	Capital Metropolitan Transportation Authority								
33	Spokane Transit								
34	Memphis Area Transit Authority			Improved transit vehicle headway and safety.					
35	Pinellas Suncoast Transit Authority								
36	MTA New York City Transit								
37	Rochester-Genesee Regional Transit Authority								
38	Connecticut Department of Transportation								
39	Central Okla. Transportation and Parking Authority (COTPA) dba METRO Transit								

Transit Agency Responses

ID	Agency	Q3 TSP Types	Q3 Active - Other	Q3 - Passive - Other	Q4 - Agency Role	Q5	Q6	Q7 - Public Forum? Y/N	If Yes, Type
32	Capital Metropolitan Transportation Authority	no_tsp			planning,	No	No	Yes	They will be part of the upcoming process (Rapid Bus - 2011)
33	Spokane Transit	no_tsp			planning, design, construct, o/m, performance,	No	No	No	
34	Memphis Area Transit Authority	a_uncond,			planning, design, construct,	No	Yes	No	
35	Pinellas Suncoast Transit Authority	no_tsp			planning,	No	No	No	
36	MTA New York City Transit	a_cond-other,	Pedestrian safety based on cycle times. Will turn or hold green light if near the beginning or end of cycle time respectively.		planning, performance,	Yes	Yes	Yes	Hearings, meetings
37	Rochester-Genesee Regional Transit Authority	no_tsp			design,	No	Yes	No	
38	Connecticut Department of Transportation	no_tsp			planning, design, construct, o/m, performance,	No	Yes	Yes	meetings, mailings
39	Central Okla. Transportation and Parking Authority (COTPA) dba METRO Transit	no_tsp			planning, design, construct, o/m,	No	Yes	No	

Transit Agency Responses

ID	Agency	Name	Service	Q1 - Treatments	Q1 - Other	Q2 - Bus Treatment Warrants MT	EL	TSP
40	Community Transit	June DeVoll	bus	tsp,				Transit Delay and reliability
41	Chicago Transit Authority	Peter Fahrenwald	bus	el, tsp, ls,			level of service, delay, CBD priority	only test project planned
42	York Region Transit	Rick Takagi	bus	tsp, qj, ce, ls,				All traffic signal in York Region on BRT routes
43	Chattanooga Area Regional Transportation Authority	Annie Powell	bus	tsp,				traffic volumes and route ridership
44	Maryland Transit Administration	Vern G. Hartsock	both	tsp, ls,				
45	Mountgomery County [MD] Transit aka Ride On	Howard Benn	bus	qj, o	semi-exclusive lanes			
46	Regional Transportation Commission of Washoe County	Tom Greco	bus	tsp, qj, o	note, both items above are in the planning stage, not yet implemented.			
47	SEPTA	Josh Gottlieb	both	tsp, o	far side stops			reduced headway times
48	Miami-Dade Transit	Steven Alperstein	bus	el, qj, ls,			Travel delay caused by heavy traffic conditions on roadway	
49	Hillsborough Area Regional Transit	Eric Sitiko	both	el, tsp, sts, qj, ce, ls,				
50	Greater Cleveland Regional Transit Authority	Michael Schipper	both	mt, el, tsp, sts, qj, ce, ls,				

Transit Agency Responses

ID	Agency	Q2 - Bus Treatment Warrants STS	QJ/BL	CE	LS	OTHER
40	Community Transit					
41	Chicago Transit Authority				ridership, length of route, average bus speed, arterial street type	
42	York Region Transit		Key locations on the BRT which experienced major vehicle queing and where there was sufficient road allowance to accommodate a queue jump lane	Locations on the BRT route where provision of the curb extension would improve service reliability and minimize delays	Development of a service design standard which includes minimum 750 metre spacing and minimyum of 300 boardings per weekday	
43	Chattanooga Area Regional Transportation Authority					
44	Maryland Transit Administration					
45	Mountgomery County [MD] Transit aka Ride On					
46	Regional Transportation Commission of Washoe County					we have no warrent standards for any of the above
47	SEPTA					
48	Miami-Dade Transit					Travel delay caused by heavy traffic conditons on roadway
49	Hillsborough Area Regional Transit					
50	Greater Cleveland Regional Transit Authority					

Transit Agency Responses

ID	Agency	Q2 - LRT/Streetcar Treatment Warrants							
		MT	EL	TSP	STS	QJ/BL	CE	LS	OTHER
40	Community Transit								
41	Chicago Transit Authority								
42	York Region Transit								
43	Chattanooga Area Regional Transportation Authority								
44	Maryland Transit Administration								
45	Mountgomery County [MD] Transit aka Ride On								
46	Regional Transportation Commission of Washoe County								
47	SEPTA			reduced headway times					
48	Miami-Dade Transit								
49	Hillsborough Area Regional Transit								
50	Greater Cleveland Regional Transit Authority								

Transit Agency Responses

ID	Agency	Q3 TSP Types	Q3 Active - Other	Q3 - Passive - Other	Q4 - Agency Role	Q5	Q6	Q7 - Public Forum? Y/N	If Yes, Type
40	Community Transit	a_cond-behind,			planning, performance,	No	Yes	No	
41	Chicago Transit Authority	a_cond-behind, a_cond-other, p_sgnl_coord,	TSP grants/hour		planning, design, performance,	No	Yes	No	
42	York Region Transit	a_cond-behind,			planning, o/m, performance,	Yes	Yes	Yes	public meetings, mailout
43	Chattanooga Area Regional Transportation Authority	a_cond-behind,			planning,	No	Yes	No	
44	Maryland Transit Administration	a_cond-other,	intersection grants priority		planning, design, construct, o/m, performance,	No	Yes	Yes	meetings
45	Mountgomery County [MD] Transit aka Ride On	no_tsp			planning, performance,	No	Yes	Yes	generally meetings, mailouts, newsletters are proposed
46	Regional Transportation Commission of Washoe County	a_uncond, p_sgnl_coord,			planning, design, construct, o/m, performance,	No	Yes	Yes	public meeting for the BRT study on Virginia st.
47	SEPTA	a_cond-other, p_sgnl_coord, p_other	2nd priority mass transit vehicle	microprocessor programs to cycle priority	planning, design, construct, o/m, performance,	No	Yes	Yes	city and/or township approval
48	Miami-Dade Transit	no_tsp			planning, design, construct, o/m, performance,	No	Yes	Yes	meeting, public announcements
49	Hillsborough Area Regional Transit	a_uncond, p_sgnl_coord,			planning, o/m,	No	Yes	Yes	meeting
50	Greater Cleveland Regional Transit Authority	a_cond-behind, p_sgnl_coord,			planning, design, construct, performance,	No	Yes	Yes	Numerous public meetings and outreach

Transit Agency Responses

ID	Agency	Name	Service	Q1 - Treatments	Q1 - Other	Q2 - Bus Treatment Warrants MT	EL	TSP
51	Des Moines Area Regional Transit Authority	Elizabeth Presutti	bus	tsp,				ridership
52	Regional Transportation District	Jeff Becker	both	el, tsp, qj, ls,		reliability, ridership, time savings	reliability, ridership, time savings	reliability, ridership, time savings

Transit Agency Responses

ID	Agency	Q2 - Bus Treatment Warrants				
		STS	QJ/BL	CE	LS	OTHER
51	Des Moines Area Regional Transit Authority					
52	Regional Transportation District		reliability, ridership, time savings			

Transit Agency Responses

ID	Agency	Q2 - LRT/Streetcar Treatment Warrants							
		MT	EL	TSP	STS	QJ/BL	CE	LS	OTHER
51	Des Moines Area Regional Transit Authority								
52	Regional Transportation District			reliability, ridership, time savings					

Transit Agency Responses

ID	Agency	Q3 TSP Types	Q3 Active - Other	Q3 - Passive - Other	Q4 - Agency Role	Q5	Q6	Q7 - Public Forum? Y/N	If Yes, Type
51	Des Moines Area Regional Transit Authority	a_cond-behind,			performance,	No	Yes	No	
52	Regional Transportation District	a_uncond, p_sgnl_coord,			planning, design, construct, o/m, performance,	Yes	Yes	Yes	meeting

Individual Transit Preferential Treatment Applications

ID	Agency	Service	Treat-ment Type	Description (if Other)	Street	Year Built	Direction	Peak Hour Transit Volume	Offpeak Hourly Volume	Average Daily Traffic	Peak Hour LOS	Capital Cost
1	King County Metro Transit	bus	ce		NE 45th St	2007	two-way	14	10			$33,000
2	King County Metro Transit	bus	ce		University Way NE	2002	two-way	28	20			
3	York Region Transit	bus	ce		Yonge Street	2005	two-way	24	10	50,000	E	
4	York Region Transit	bus	ce		Highway 7	2005	two-way	12	8	65,000	E	
5	Metro Transit	bus	el		Marquette Ave/2nd Ave		one-way	70	10	10,000		
6	Metro Transit	bus	el		4th St (Contraflow)		one-way	25	10	8,300		
7	Metro Transit	bus	el		Nicollet Mall		two-way	40	20	0		
8	Metro Transit	bus	el		Hennepin Ave (Contraflow)		one-way	30	15	17,000		
9	Metro Transit	lrt	el		5th St	2003	two-way	8	6	2,300		
10	Metro Transit	bus	el		5th St/6th St		one-way	50	25			
11	Lane Transit District	bus	el		South A Street	2005	one-way	12	12			
12	Central Florida Regional Transportation Authority (d/b/a LYNX)	bus	el		Downtown Orlando (Loop)	1997	two-way	15	6			$21,000,000
13	New Orleans Regional Transit Authority	bus	el		Crescent City Connection	1988	one-way	12	7			
14	New Orleans Regional Transit Authority	lrt	el		Mississippi Riverfront	1988	two-way	1	1			$14,000,000
15	King County Metro Transit	bus	el		Elliott Ave W / 15th Ave W	2008	two-way	19	9	48,900		
16	King County Metro Transit	bus	el		2nd Ave		one-way	111	13	15,800		
17	King County Metro Transit	bus	el		4th Ave		one-way	120	14	19,700		
18	King County Metro Transit	bus	el		Bus Tunnel	1989	two-way	60	32	0	N	$444,000,000
19	King County Metro Transit	bus	el		SODO Busway (5th Ave S)		two-way	63	42	0		
20	King County Metro Transit	bus	el		1st Ave	2006	one-way	15	10	16,400		
21	King County Metro Transit	bus	el		Aurora Ave N	2004	one-way	27	11	40,000		
22	King County Metro Transit	bus	el		West Seattle Bridge	1999	one-way	32	18			
23	King County Metro Transit	bus	el		Seneca St	2007	one-way	22	8			
24	King County Metro Transit	bus	el		4th Ave	2005	one-way	30	8	19,700		
25	King County Metro Transit	bus	el		Lake City Way	2007	two-way	20	4	37,000		
26	King County Metro Transit	bus	el		Aurora Ave N		one-way	6	4			
27	King County Metro Transit	bus	el		Aurora Ave	2007	two-way	8	4	40,000		

Individual Transit Preferential Treatment Applications

ID	Agency	Annual O/M Cost	Ridership	% Travel Time Savings	% Decrease in Travel Time Variability	Impact on General Traffic Operations
1	King County Metro Transit		4,510			Queues form behind buses at bus stops, but queue disperses quickly after bus leaves.
2	King County Metro Transit		11,500			Queues form behind buses stopped at bus stops, but queue disperses quickly.
3	York Region Transit		15,500			No impact
4	York Region Transit		10,000			No impact
5	Metro Transit					
6	Metro Transit					
7	Metro Transit					
8	Metro Transit					Hennepin Ave to be re-striped to 2-way general traffic in 2010.
9	Metro Transit					
10	Metro Transit					With-flow exclusive bus/right turn lane
11	Lane Transit District					
12	Central Florida Regional Transportation Authority (d/b/a LYNX)	$1,200,000	4,037			Operating buses in exclusive transit lanes eliminates the frequent stopping in general traffic lanes. This would have caused a removal of the vehicular capcity of the lane for the duration the bus was stopped.
13	New Orleans Regional Transit Authority		4,912			The HOV lanes operate one-way in the peak direction (toward the New Orleans CBD in the AM and from the New Orleans CBD in the PM). The lanes improve the on-time performamce of transit vehicles. Note that transit vehicles per hour and ridership reflect the lower population of New Orleans after Hurricane Katrina.
14	New Orleans Regional Transit Authority	$1,200,000	543			Operation on an exclusive transitway allows the Riverfront Line to avoid the congestion on adjoining Decatur Street in the French Quarter. Transit vehicles per hour and ridership reflect lower population post Hurricane Katrina.
15	King County Metro Transit		13,220			
16	King County Metro Transit		8,150			
17	King County Metro Transit		7,770			
18	King County Metro Transit		31,010			No impact to traffic on surface.
19	King County Metro Transit		22,030			
20	King County Metro Transit		7,540			Loss of on-street parking during PM peak.
21	King County Metro Transit		2,920			Loss of on-street parking during AM peak.
22	King County Metro Transit		8,060			
23	King County Metro Transit		4,980			
24	King County Metro Transit		7,770			Installation of Island Bus Stop removed one General traffic lane.
25	King County Metro Transit		8,280			Loss of on-street parking during peak hours.
26	King County Metro Transit		1,870			
27	King County Metro Transit		3,990			

Individual Transit Preferential Treatment Applications

ID	Agency	Service	Treat-ment Type	Description (if Other)	Street	Year Built	Direction	Peak Hour Transit Volume	Offpeak Hourly Volume	Average Daily Traffic	Peak Hour LOS	Capital Cost
28	Greater Richmond Transit Company	bus	el		Broad St	2007	two-way	104	61	15,000		
29	OC Transpo	bus	el	Bus only street designaltion	Chapel	1993	two-way	3	2			
30	OC Transpo	bus	el		Albert Street	1970	one-way					
31	Sound Transit	lrt	el		Pacific Ave.	2001	two-way	12	6			$78,200,000
32	Chicago Transit Authority	bus	el		Randolph-Washington, Adams-Jackson	1980	one-way	65	20	20,000	C	$25,000
33	Miami-Dade Transit	bus	el		South Dade Busway	1997	two-way	50	18	0		$148,000,000
34	Regional Transportation District	bus	el		Broadway/Lincoln	1980	two-way	50	20			
35	Regional Transportation District	bus	el		US36 HOT Lanes	1994	two-way	32	12			
36	Valley Metro RPTA	bus	ls		Main Street, Arizona Ave		two-way	4	2	35,000	D	$37,000,000
37	COTA	bus	ls		High		two-way	8	0	20,000	C	$0
38	Spokane Transit	bus	ls		Monroe/Wall/Hastings	2008	two-way	5	0			$1,000
39	MTA New York City Transit	bus	ls		Grand Concourse	1993	two-way	16	13			$0
40	MTA New York City Transit	bus	ls		Fordham Rd/Pelham Pkwy	1990	two-way	24	12			$0
41	MTA New York City Transit	bus	ls		Webster Av/White Plains Rd	1995	two-way	12	0			$0
42	MTA New York City Transit	bus	ls		3rd Av	1955	two-way	24	10			$0
43	MTA New York City Transit	bus	ls		5th Av/Madison Av	1991	two-way	15	10			$0
44	MTA New York City Transit	bus	ls		Riverside/5th and 6th Aves	1976	two-way	20	12			$0
45	MTA New York City Transit	bus	ls		1st Av/2nd Av	1978	two-way	30	12			$0
46	MTA New York City Transit	bus	ls		Amsterdam Av/Lexington Av/3rd Av	1991	two-way	16	12			$0
47	MTA New York City Transit	bus	ls		Church Av/39th St	2005	two-way	16	12			$0
48	MTA New York City Transit	bus	ls		Flatbush Av	1992	two-way	27	12			$0
49	MTA New York City Transit	bus	ls		Nostrand Av/New York Av	1995	two-way	20	12			$0
50	MTA New York City Transit	bus	ls		Utica Av/Malcolm X	1994	two-way	30	15			$0

Individual Transit Preferential Treatment Applications

ID	Agency	Annual O/M Cost	Ridership	% Travel Time Savings	% Decrease in Travel Time Variability	Impact on General Traffic Operations
28	Greater Richmond Transit Company					unknown - exclusive lane is often blocked by illegally parked vehicles with little enforcement. Lane is exclusive at peak times only.
29	OC Transpo		890			Short bus-only street providing bus access where general traffic is not permitted
30	OC Transpo		30,967			Minimal impact on general traffic
31	Sound Transit	$3,800,000				No significant impact. System was designed to maintain automobile capacity.
32	Chicago Transit Authority	$0				Minimal -- right turns are allowed from bus lane.
33	Miami-Dade Transit		23,355	10		This is an exclusive busway running parallel to a major traffic corridor. Impacts occur when auto traffic crosses Busway at signalized intersections. Traffic signal coordination is an import component of the exclusive lanes to minimize travel time.
34	Regional Transportation District		5,000	25	50	
35	Regional Transportation District		5,000	25	50	
36	Valley Metro RPTA		2,000	33	23	
37	COTA		320	40		
38	Spokane Transit	$496,000	420	10		
39	MTA New York City Transit	$0	42,294	15		
40	MTA New York City Transit	$0	42,633	17		
41	MTA New York City Transit	$0	28,020	12		
42	MTA New York City Transit	$0	16,706			
43	MTA New York City Transit	$0	14,886	8		
44	MTA New York City Transit	$0	11,898			
45	MTA New York City Transit	$0	57,793	14		
46	MTA New York City Transit	$0	36,423	20		
47	MTA New York City Transit	$0	38,330	12		
48	MTA New York City Transit	$0	39,457	18		
49	MTA New York City Transit	$0	41,446	10		
50	MTA New York City Transit	$0	52,681	8		

Individual Transit Preferential Treatment Applications

ID	Agency	Service	Treat-ment Type	Description (if Other)	Street	Year Built	Direction	Peak Hour Transit Volume	Offpeak Hourly Volume	Average Daily Traffic	Peak Hour LOS	Capital Cost
51	MTA New York City Transit	bus	ls		Bay Pkwy/Ave J/Flatlands Av	2000	two-way	15	12			$0
52	MTA New York City Transit	bus	ls		Richmond/Arthur Kill Rd	2002	one-way	3	0			$0
53	MTA New York City Transit	bus	ls		Richmond Av/Bayonne Bridge	2007	two-way	8	0			
54	MTA New York City Transit	bus	ls		Victory Bl/Bradley Av	1989	one-way	7	0			$0
55	MTA New York City Transit	bus	ls		Harlem River Dr/3rd Av/Lexington Av	1987	two-way	16	0			
56	MTA New York City Transit	bus	ls		Victory Bl	1988	one-way	4	0			$0
57	MTA New York City Transit	bus	ls		Richmond Rd/New Dorp La	2003	one-way	4	0			$0
58	MTA New York City Transit	bus	ls		Clove Rd/Verrazano Bridge	2001	two-way	8	0			$0
59	MTA New York City Transit	bus	ls		Richmond Av	1994	one-way	4	0			$0
60	MTA New York City Transit	bus	ls		Castleton Av	1996	one-way	4	0			$0
61	MTA New York City Transit	bus	ls		Forest Av	1995	one-way	5	0			$0
62	MTA New York City Transit	bus	ls		Richmond Ter	1998	one-way	4	0			$0
63	MTA New York City Transit	bus	ls		Bay St/Father Capodanno Bl	2001	one-way	3	0			$0
64	MTA New York City Transit	bus	ls		Linden Bl	1988	two-way	15	0			$0
65	MTA New York City Transit	bus	ls		Merrick Bl	1988	one-way	9	0			$0
66	MTA New York City Transit	bus	ls		Kissena Bl/Horace Harding Exp	2003	two-way	12	0			$0
67	MTA New York City Transit	bus	ls		46th Av/Rocky Hill Rd/Springfield Bl	2001	two-way	15	0			$0
68	MTA New York City Transit	bus	ls		Hillside Av	1993	one-way	15	0			$0
69	MTA New York City Transit	bus	ls		Union Tpk	1974	two-way	20	0			$0
70	MTA New York City Transit	bus	ls		Liberty/Murdock Aves	1993	one-way	10	0			$0
71	MTA New York City Transit	bus	ls		Merrick Bl/Conduit Av	1994	one-way	8	0			$0
72	MTA New York City Transit	bus	ls		Ocean Av/Bedford Av/Rogers Av		two-way	4	0			$0
73	York Region Transit	bus	ls		Yonge Street	2005	two-way	24	10	50,000	E	
74	York Region Transit	bus	ls		Highway 7	2005	two-way	12	18	65,000	E	
75	Maryland Transit Administration	bus	ls		Route 40	2005	two-way	16	10			
76	Metro Transit	lrt	mt		34th Avenue	2003	two-way	8	6			
77	Lane Transit District	bus	mt		East 10th,	2005	two-way	12	12			

Individual Transit Preferential Treatment Applications

ID	Agency	Annual O/M Cost	Ridership	% Travel Time Savings	% Decrease in Travel Time Variability	Impact on General Traffic Operations
51	MTA New York City Transit	$0	43,426	8		
52	MTA New York City Transit	$0	6,029	8		
53	MTA New York City Transit	$1,400,000	217			
54	MTA New York City Transit	$0	4,337	12		
55	MTA New York City Transit		3,650			
56	MTA New York City Transit	$0	5,549	12		
57	MTA New York City Transit	$0	4,971	10		
58	MTA New York City Transit	$0	9,948			
59	MTA New York City Transit	$0	7,305	10		
60	MTA New York City Transit	$0	7,703	15		
61	MTA New York City Transit	$0	8,046	20		
62	MTA New York City Transit	$0	4,689			
63	MTA New York City Transit	$0	4,820	7		
64	MTA New York City Transit	$0	11,172	22		
65	MTA New York City Transit	$0	12,493	14		
66	MTA New York City Transit	$0	18,860	6		
67	MTA New York City Transit	$0	22,388	11		
68	MTA New York City Transit	$0	16,202			
69	MTA New York City Transit	$0	22,004	11		
70	MTA New York City Transit	$0	9,785	10		
71	MTA New York City Transit	$0	12,768	12		
72	MTA New York City Transit	$0	17,924	12		
73	York Region Transit		15,500			No impact
74	York Region Transit		10,000			no impact
75	Maryland Transit Administration		9,214			
76	Metro Transit					
77	Lane Transit District					Some parking removal was needed for this installation.

Individual Transit Preferential Treatment Applications

ID	Agency	Service	Treat-ment Type	Description (if Other)	Street	Year Built	Direction	Peak Hour Transit Volume	Offpeak Hourly Volume	Average Daily Traffic	Peak Hour LOS	Capital Cost
78	Lane Transit District	bus	mt		East 11th, Franklin Boulevard	2005	two-way	12	12			
79	New Orleans Regional Transit Authority	lrt	mt		Canal Street	2004	two-way	10	8			$161,000,000
80	New Orleans Regional Transit Authority	lrt	mt		St. Charles Avenue	1922	two-way	14	16			
81	Sound Transit	lrt	mt		Martin Luther King	2009	two-way	12	8			
82	Connecticut Department of Transportation	bus	mt		Interstate 84	1989	two-way	20	2	130,000	A	
83	Regional Transportation District	bus	mt		16th Street Mall	1982	two-way	96	48			$70,000,000
84	Regional Transportation District	bus	mt		North I-25 HOT Lanes	1994	two-way	50	12			$220,000,000
85	Central Florida Regional Transportation Authority (d/b/a LYNX)	bus	o	Signal Preemption	Revere Avenue	1997	one-way					
86	Central Florida Regional Transportation Authority (d/b/a LYNX)	bus	o	Signal Preemption	E Livingston St	1997	two-way					
87	Los Angeles County Metropolitan Transportation Authority	lrt	o	Pre-emption	3rd St. - East Los Angeles	2009	two-way	16	8			
88	King County Metro Transit	bus	o	Through Traffic Restrictions	3rd Ave	2005	two-way	114	58	8,100		
89	King County Metro Transit	bus	o	Parking Restriction	Aurora Ave N	2002	two-way	6	4	42,300		
90	King County Metro Transit	bus	o	Parking Restrictions	Delridge Way SW	2003	one-way	10	4	20,500		
91	King County Metro Transit	bus	o	HOV lane	SR-99		one-way	6	4			

Individual Transit Preferential Treatment Applications

ID	Agency	Annual O/M Cost	Ridership	% Travel Time Savings	% Decrease in Travel Time Variability	Impact on General Traffic Operations
78	Lane Transit District					Some left turns were removed or relocated to allow for the station at the intersection of Agate and Franklin.
79	New Orleans Regional Transit Authority	$6,000,000	4,317			Operation in the median allows the Canal Streetcar Line to avoid on street congestion, particularly in the Central Business District. Transit vehicles per hour and ridership reflect lower population post Hurricane Katrina.
80	New Orleans Regional Transit Authority	$8,900,000	7,555			Operation on the median allows the St. Charles Streetcar Line to avoid on street congestion. Transit vehicles per hour and ridership reflect lower population post Hurricane Katrina.
81	Sound Transit					The Seattle area Link light rail line will enter revenue service in July 2009. Capital and O&M costs associated with this section of the overall limne are not available. Daily ridership of this line section is not available.
82	Connecticut Department of Transportation		3,000	50	90	None. Note: Ridership figure is bus ridership only. The lane is shared with carpools, vanpools, taxis and intercity buses.
83	Regional Transportation District	$250,000	45,000	25	50	
84	Regional Transportation District		9,000	50	75	
85	Central Florida Regional Transportation Authority (d/b/a LYNX)					Traffic volume is light on Revere Avenue. General traffic has the green phase at all times except when the transit vehicle approaches the light. The transit vehicle is then given the green phase to allow it to cross the general lane. Impact is minimal.
86	Central Florida Regional Transportation Authority (d/b/a LYNX)					General traffic has a continual green phase, until arrival of the transit vehicle. The signal changes to a green phase for the transit vehicle in the exclusive lane with red hase for eneral traffic to allow the transit vehicle to cross the general traffic lane. The impact on general traffic is minimal.
87	Los Angeles County Metropolitan Transportation Authority					This is a new application on the Metro Gold Line Eastside Extension (ROD June 2009), allowing for LRT vehicles to pass through without stopping for a section of the alignment that has steep grades. I do not have access to Daily Traffic Volume, LOS, Capital Cost. Annual O & M Costing not available until next year. Travel time savings is 0%, as the project was planned with this treatment. Likewise, the reduction in travel time variability is 0%.
88	King County Metro Transit		51,690			Through traffic shifted to other streets. Local access still provided on 3rd Ave. Enforcement is challenging.
89	King County Metro Transit		5,000			Loss of on-street parking during peak hours. Improvement to general traffic during peak hours.
90	King County Metro Transit		3,180			Loss of on-street parking during peak hours. Improvement to general traffic during peak hours.
91	King County Metro Transit		2,040			New Construction.

Individual Transit Preferential Treatment Applications

ID	Agency	Service	Treat-ment Type	Description (if Other)	Street	Year Built	Direction	Peak Hour Transit Volume	Offpeak Hourly Volume	Average Daily Traffic	Peak Hour LOS	Capital Cost
92	King County Metro Transit	bus	o	HOV Lane	SR-99		two-way	10	8			
93	Mountgomery County [MD] Transit aka Ride On	bus	o	semi-exclusive lanes	Viers Mill Road [MD 586]	2007	one-way	24	12		D	
94	Miami-Dade Transit	bus	o	Bus on Shoulder	SR 874	2007	two-way	16	0	75,833		$7,500
95	Miami-Dade Transit	bus	o	Bus on Shoulders	SR 878	2007	two-way	36	0	51,255		$7,500
96	Capital District Transportation Authority	bus	qj		River Street	2005	one-way	20	15	15,000	C	
97	Halifax Regional Municipality - Metro Transit	bus	qj		Portland Street WB	2005	one-way	8	2			
98	Halifax Regional Municipality - Metro Transit	bus	qj		Portland Street EB	2005	one-way	22	11			
99	Halifax Regional Municipality - Metro Transit	bus	qj		Wyse Road	2008	one-way	24	12			
100	Halifax Regional Municipality - Metro Transit	bus	qj		Wyse Road		one-way	58	27			
101	Halifax Regional Municipality - Metro Transit	bus	qj		Windmill Rd/Magazine Hill	2005	one-way	13	4			
102	Halifax Regional Municipality - Metro Transit	bus	qj		Windmill Rd./Akerley Bl.	2005	one-way	14	4			
103	Halifax Regional Municipality - Metro Transit	bus	qj		Windmill Rd./Wright Av	2005	one-way	13	4			
104	Halifax Regional Municipality - Metro Transit	bus	qj		Windmill Rd./Wright Av	2005	one-way	14	4			
105	Lane Transit District	bus	qj		Franklin Boulevard	2005	one-way	12	12			
106	Pierce Transit	bus	qj		Garfield/SR-7	2008	one-way					
107	King County Metro Transit	bus	qj		NE 45th St	2004	one-way	9	5	35,900		$15,000
108	King County Metro Transit	bus	qj		NE Pacific St		one-way	20	14			
109	King County Metro Transit	bus	qj		Montlake Blvd NE		one-way	32	13	56,800		

Individual Transit Preferential Treatment Applications

ID	Agency	Annual O/M Cost	Ridership	% Travel Time Savings	% Decrease in Travel Time Variability	Impact on General Traffic Operations
92	King County Metro Transit		4,050			New Construction
93	Mountgomery County [MD] Transit aka Ride On		10,000			In an intense, but routine, paving project, the southbound (only) curb lane was painted 'buses and right turn only' by State highways (no one told us; it just showed up one day! Their [contract] engineer thought it was a good idea. We agree.) There is no enforcement, per se. It is somewhat self-enforcing as many drivers do avoid the lane -- but a significant number do not. There has been no savings in scheduled running time but operators report (an undocumented) improvement in reliability. Average daily ridership represents the ridership (in this direction only) on the portions of the 5 routes that operate over this segment.
94	Miami-Dade Transit		2,321			The buses can access the shoulders of the roadway when the regular traffic flow drops below 25 mph. Buses cannot exceed 35 mph on the shoulders. The only construction was new signage. It is estimated that 50% of the bus trips would operate in conditions to allow shoulder operations.
95	Miami-Dade Transit		4,485			please see information on SR 874 for operational details.
96	Capital District Transportation Authority		1,000			Minimal
97	Halifax Regional Municipality - Metro Transit		715			MetroLink BRT Only
98	Halifax Regional Municipality - Metro Transit		4,254			
99	Halifax Regional Municipality - Metro Transit		6,006			
100	Halifax Regional Municipality - Metro Transit		17,323			
101	Halifax Regional Municipality - Metro Transit		2,015			
102	Halifax Regional Municipality - Metro Transit		2,015			
103	Halifax Regional Municipality - Metro Transit		2,015			
104	Halifax Regional Municipality - Metro Transit		2,015			
105	Lane Transit District					
106	Pierce Transit					
107	King County Metro Transit		2,410			
108	King County Metro Transit		6,490			
109	King County Metro Transit		6,890			

Individual Transit Preferential Treatment Applications

ID	Agency	Service	Treat-ment Type	Description (if Other)	Street	Year Built	Direction	Peak Hour Transit Volume	Offpeak Hourly Volume	Average Daily Traffic	Peak Hour LOS	Capital Cost
110	King County Metro Transit	bus	qj		2nd Ave Ext S		one-way	88	13	15,800		
111	King County Metro Transit	bus	qj		Howell St		one-way	10	3	42,300		
112	King County Metro Transit	bus	qj		Olive Way	2005	one-way	46	7			
113	OC Transpo	bus	qj		Kakulu & Eagleson		one-way	8	0	2,413	D	$1,000
114	OC Transpo	bus	qj		Highway 417 EB Off Ramp and Moodie Dr.	1995	one-way	54	5	2,324	C	
115	OC Transpo	bus	qj		Merivale and Leikin	1999	one-way	9	2	1,833	C	$10,000
116	OC Transpo	bus	qj		Albert & Transitway	1998	one-way	12	8	10,866	E	
117	OC Transpo	bus	qj		Baseline & Prince of Wales	2001	one-way	11	4	17,935	F	
118	OC Transpo	bus	qj		Carling & Holland	2005	one-way	9	3	2,686	D	$1,000
119	OC Transpo	bus	qj		Carling & Holland	2007	one-way	4	4	16,447	F	
120	OC Transpo	bus	qj		Carling & Bronson	2005	one-way	9	5	9,513	E	
121	Capital Metropolitan Transportation Authority	bus	qj		Lamar Blvd	2009	one-way	10	10	15,000		
122	York Region Transit	bus	qj		Yonge Street	2005	two-way	24	8	50,000	E	
123	York Region Transit	bus	qj		Highway 7	2005	one-way	6	4	65,000	E	
124	Mountgomery County [MD] Transit aka Ride On	bus	qj		Viers Mill Road [MD 586]	2007	one-way	18	9		D	

Individual Transit Preferential Treatment Applications

ID	Agency	Annual O/M Cost	Ridership	% Travel Time Savings	% Decrease in Travel Time Variability	Impact on General Traffic Operations
110	King County Metro Transit		8,150			
111	King County Metro Transit		1,360			
112	King County Metro Transit		9,150			
113	OC Transpo	$0	540	5	5	Bus turns left from Right Turning Lane at T-intersection; Minimal impact on other traffic; Travel Time Savings and Reduction in Travel Time Variability are in minutes (not percentage)for each time bus recieves priority
114	OC Transpo		2,912	75	70	Minimal impact on other traffic; Bus exists from highway only when signalled by waiting passengers
115	OC Transpo	$0	604	3	3	Daily traffic volume shown is for EB direction; Buses recieve priority using Transit Priority Signal Indicator (TPSI) or White Vertical Bar; Travel Time (TT) Savings and Reduction in TT Variability shown are in minutes; Minimal impact on other traffic
116	OC Transpo	$0	1,347	4	8	Traffic volume shown is for WB direction; Travel Time (TT) Savings and Reduction in TT Variability shown are in minutes; Stop bar for general traffic relocated allow buses to merge in front of queue; No impact on general traffic
117	OC Transpo			3	3	Traffic Volume shown is for WB direction Travel Time Savings & Reduction in TT Variability shown are in minutes and for each time bus recieve priority Curb Lane designated as Bus Lane. Buses recieve priority using Transit Priority Signal Indicator (TPSI) or White Vertical Bar Some capacity removed from general traffic
118	OC Transpo		1,618	3	3	Daily Traffic Volume shown is for SB direction; LOS shown is for SB approach; Bus continues in Right Turn laneto bypass congested Left Turn + Straight lane; Minimal impact on other traffic
119	OC Transpo		819	3	3	Traffic volume shown is for WB direction; Travel Time (TT) Savings and Reduction in TT Variability shown are in minutes and for each time bus recieves priority; bus has seperate lane with Transit Signal Priority Indicator (TPSI) or White Vertical Bar; minimal impact on other traffic
120	OC Transpo		1,751	5	5	Traffic volume shown is for EB direction; LOS service is for EB approach; Travel Time (TT) Savings and Reduction in TT Variability shown are in minutes each time bus recives priority; Right Turn traffic queue relocated to centre lane;
121	Capital Metropolitan Transportation Authority		7,500	5		None for traffic. This is part of a "pull-off lane" that was constructed adjacent to Metro-Rail's Crestview station to allow train to bus transfers. The lane is coordinated with a traffic signal to allow buses to proceed ahead of SB traffic. For some inputs above, I do not have the exact figures (LOS, Capital, Annual O&M, Travel Variability).
122	York Region Transit	$0	15,500			No impact
123	York Region Transit		10,000			No impact
124	Mountgomery County [MD] Transit aka Ride On		7,500			These were put in along with the lane previously described. The paving was on 586 from Twinbrook Parkway south. While the lane is SB, the bypass lanes (one of which is shared, but striped in a way that does effectively keep most cars out) are NB.

Individual Transit Preferential Treatment Applications

ID	Agency	Service	Treat-ment Type	Description (if Other)	Street	Year Built	Direction	Peak Hour Transit Volume	Offpeak Hourly Volume	Average Daily Traffic	Peak Hour LOS	Capital Cost
125	regional transportation commission of Washoe County	bus	qj		Virginia Street	2009	two-way	12	6		E	
126	Regional Transportation District	bus	qj		E Alameda Ave & Colorado Blvd	1998	one-way	12	4			
127	Regional Transportation District	bus	qj		E Colfax Ave & Colorado Blvd	1990	two-way	32	20			
128	Metro Transit	bus	sts		Cedar Avenue	2008	one-way	20				
129	Lane Transit District	bus	sts		East 11th/Mill	2006	two-way	12	12			
130	King County Metro Transit	bus	sts		Grady Way	2004	one-way	52	39	43,000		
131	King County Metro Transit	bus	sts		Winona Ave N	2005	one-way	8	4			
132	King County Metro Transit	bus	sts		SR-900	2008	one-way	20	13			
133	OC Transpo	bus	sts		Richmond & DuMaurier	1999	one-way	2	2		D	$3,000
134	Capital District Transportation Authority	bus	tsp		NY5	2004	two-way	12	10	35,000	D	
135	Halifax Regional Municipality - Metro Transit	bus	tsp		North Street to MacDonald Bridge		one-way	42	19			
136	Halifax Regional Municipality - Metro Transit	bus	tsp		Mumford Road @ Terminal Exit		one-way	46	22			
137	Halifax Regional Municipality - Metro Transit	bus	tsp		Beaverbank Connector/Old Sackville Rd	2005	one-way	6	2			
138	Halifax Regional Municipality - Metro Transit	bus	tsp		Windmill Rd./Akerley Bl.	2005	two-way	12	4			
139	Halifax Regional Municipality - Metro Transit	bus	tsp		Windmill Rd./Wright Av	2005	two-way	12	4			
140	Halifax Regional Municipality - Metro Transit	bus	tsp		Windmill Rd/Victoria Rd	2005	two-way	12	4			
141	Halifax Regional Municipality - Metro Transit	bus	tsp		Portland @ Spring / Portland Estates Bl	2005	two-way	16	4			
142	Halifax Regional Municipality - Metro Transit	bus	tsp		Portland @ Carver/Eisener	2005	two-way	16	4			

Individual Transit Preferential Treatment Applications

ID	Agency	Annual O/M Cost	Ridership	% Travel Time Savings	% Decrease in Travel Time Variability	Impact on General Traffic Operations
125	regional transportation commission of Washoe County					both the TSP and QJ/BL on Virginia is in the planning stage. The planning will be completed by the end of 2009. Implementation will take place when funding is available, 2010-2012? The form above would not allow a future year for "year built". Also the AADT for this street is 32,000. When I entered that number in the daily traffic volume it gives me an error message of "please enter a valid integer", so I left it blank.
126	Regional Transportation District		2,000			
127	Regional Transportation District		22,000			
128	Metro Transit					Bus only left turn to WB TH62. Buses not subject to queue for congested loop from NB Cedar. Minimal impact on SB traffic from Cedar Ave.
129	Lane Transit District					Minimal impact on traffic operations.
130	King County Metro Transit		3,443			
131	King County Metro Transit		2,810			LT signal can be used by general traffic.
132	King County Metro Transit		1,240			New Construction.
133	OC Transpo	$0	216	50	50	LOS shown is for the approch road. Double Loops installed for 1/2 signal operation. Minimal impact on general traffic
134	Capital District Transportation Authority		9,500			Forced entries above do not present an accurate picture. The 17-mile corridor varies in traffic volume from 12000 to 45000 ADT; some intersections are at A, some are at F. 0's on benefits because we don't know. Issues with our AVL system reliability have stymied the data collection.
135	Halifax Regional Municipality - Metro Transit		19,575			
136	Halifax Regional Municipality - Metro Transit		13,438			
137	Halifax Regional Municipality - Metro Transit		762			MetroLink BRT Only
138	Halifax Regional Municipality - Metro Transit		1,524			MetroLink BRT Only
139	Halifax Regional Municipality - Metro Transit		1,524			MetroLink BRT Only
140	Halifax Regional Municipality - Metro Transit		1,524			MetroLink BRT Only
141	Halifax Regional Municipality - Metro Transit		1,429			MetroLink BRT Only
142	Halifax Regional Municipality - Metro Transit		1,429			MetroLink BRT Only

Individual Transit Preferential Treatment Applications

ID	Agency	Service	Treat-ment Type	Description (if Other)	Street	Year Built	Direction	Peak Hour Transit Volume	Offpeak Hourly Volume	Average Daily Traffic	Peak Hour LOS	Capital Cost
143	Halifax Regional Municipality - Metro Transit	bus	tsp		Portland @ Highway 111 NB Ramp	2005	two-way	16	4			
144	Halifax Regional Municipality - Metro Transit	bus	tsp		Portland @ Sears Driveway/Evergreen	2005	two-way	12	4			
145	Halifax Regional Municipality - Metro Transit	bus	tsp		Portland @ Gaston	2005	two-way	12	4			
146	Halifax Regional Municipality - Metro Transit	bus	tsp		Portland @ Pleasant	2005	two-way	12	4			
147	Halifax Regional Municipality - Metro Transit	bus	tsp		Portland @ Prince Albert/Alderney	2005	two-way	12	4			
148	Metro Transit	lrt	tsp		Hiawatha Ave	2003	two-way	8	6	32,000		
149	Lane Transit District	bus	tsp		East 10th, East 11th, Franklin Boulevard	2005	two-way	12	12			
150	Valley Metro RPTA	bus	tsp		Main Street, Arizona Ave	2009	two-way	4	2	35,000	D	$37,000,000
151	Los Angeles County Metropolitan Transportation Authority	lrt	tsp	Synchronizatio n	Marmion Way	2003	two-way	16	8			
152	Los Angeles County Metropolitan Transportation Authority	lrt	tsp	Synchronizatio n	Washington Blvd. - Flower St.	1990	two-way	24	10			
153	Pierce Transit	bus	tsp		Pacific Avenue	2003	two-way					
154	Pierce Transit	bus	tsp		19th Street	2003	two-way					
155	Pierce Transit	bus	tsp		6th AVenue	2004	two-way					
156	Pierce Transit	bus	tsp		South Tacoma Way	2004	two-way					
157	Pierce Transit	bus	tsp		56th Street	2004	two-way					

Individual Transit Preferential Treatment Applications

ID	Agency	Annual O/M Cost	Ridership	% Travel Time Savings	% Decrease in Travel Time Variability	Impact on General Traffic Operations
143	Halifax Regional Municipality - Metro Transit		1,429			MetroLink BRT Only
144	Halifax Regional Municipality - Metro Transit		1,283			MetroLink BRT Only
145	Halifax Regional Municipality - Metro Transit		1,283			MetroLink BRT Only
146	Halifax Regional Municipality - Metro Transit		1,283			MetroLink BRT Only
147	Halifax Regional Municipality - Metro Transit		1,283			MetroLink BRT Only
148	Metro Transit	$0				TSP not running on Hiawatha due to unresolved issues. LRT now uses preemption at all signals along Hiawatha (except at Lake Street due to grade seperation). Traffic operations have been suffering due to preemption every 3 1/2 minutes during peak hours. Some movements can wait up to 7 minutes before they get a green.
149	Lane Transit District					Transit Priority has not adversely impacted general traffic operations
150	Valley Metro RPTA		2,000	33	10	We would anticipate that the impact on the general traffic would be in the vicinity of 15%
151	Los Angeles County Metropolitan Transportation Authority		24,000			Metro Gold Line. Street run segment on Marmion Way. Traffic Signals are set to detect a LRV, then phasing will start and carry through the seven block section for train movement at 20 mph. If two trains enter at the same time (opposite directions), there is good probability that the second train will be delayed for 15-20 seconds at an intersection while the systems cycles. Travel time savings and normal variability is 0%, as the system was designed with this feature.
152	Los Angeles County Metropolitan Transportation Authority		80,000	8	50	Signal synchronization was placed into service approximately 1993, after the Metro Blue Line opened in 1990. Traffic signals were phased to allow for trains to move from Washington Bl. and Long Beach Ave., on Washington Bl., then on Flower St., at a rate of approximately 33 miles per hour, for the most part without stopping. There is a section of the street run that has city blocks that cannot store a three car train...at those locations, the traffic signal system will detect the length of the train and momentarily hold the phasing if the train is delayed for whatever reason. This prevents trains that are delayed from blocking traffic at several intersections. Very successful. Saves 4 minutes running time in each direction (previous running time was 59 minutes)
153	Pierce Transit					
154	Pierce Transit					
155	Pierce Transit					
156	Pierce Transit					
157	Pierce Transit					

Individual Transit Preferential Treatment Applications

ID	Agency	Service	Treat-ment Type	Description (if Other)	Street	Year Built	Direction	Peak Hour Transit Volume	Offpeak Hourly Volume	Average Daily Traffic	Peak Hour LOS	Capital Cost
158	Pierce Transit	bus	tsp		Bridgeport Way	2005	two-way					
159	Pierce Transit	bus	tsp		SR-7	2005	two-way					
160	King County Metro Transit	bus	tsp		Lake City Way NE	2007	two-way	20	4	37,000		
161	King County Metro Transit	bus	tsp		Rainier Ave S	1999	two-way	14	7	33,000		
162	King County Metro Transit	bus	tsp		1st Ave S	2004	two-way	14	6	24,000		
163	King County Metro Transit	bus	tsp		Rainier Ave / Grady Way	2004	two-way	52	39	44,000		
164	King County Metro Transit	bus	tsp		Aurora Ave N	2001	two-way	8	4	40,000		
165	King County Metro Transit	bus	tsp		NE 124th St	2008	two-way					
166	King County Metro Transit	bus	tsp		Bellevue Way SE	2006	two-way	16	12	38,700		
167	OC Transpo	bus	tsp		Highway 417 EB Off Ramp and Moodie Dr.	1999	one-way	54	5	2,324	C	$5,000
168	OC Transpo	bus	tsp		Holly Acres and Tranistway	2000	one-way	21	10	6,996	A	$4,000
169	OC Transpo	bus	tsp		Iris and Transitway	1994	two-way	78	29	6,675	A	$15,000
170	OC Transpo	bus	tsp		Woodroffe & Meadowlands	2000	one-way	58	14	16,701	E	$10,000
171	OC Transpo	bus	tsp		Woodroffe & Knoxdale	2005	two-way	48	10	31,672	F	$15,000
172	OC Transpo	bus	tsp		Heron & Bronson	2001	one-way	29	11	12,400	C	
173	OC Transpo	bus	tsp		St. Joseph & Place D' Orleans	2001	one-way	8	8	8,296	B	$7,500
174	OC Transpo	bus	tsp		Richmond & Golden	2005	one-way	6	5	7,224	A	$8,500

Individual Transit Preferential Treatment Applications

ID	Agency	Annual O/M Cost	Ridership	% Travel Time Savings	% Decrease in Travel Time Variability	Impact on General Traffic Operations
158	Pierce Transit					
159	Pierce Transit					
160	King County Metro Transit		8,280			
161	King County Metro Transit		1,820			
162	King County Metro Transit		6,340			
163	King County Metro Transit		5,720			
164	King County Metro Transit		5,720	5		
165	King County Metro Transit					
166	King County Metro Transit		6,230	20		This intersection is the only stop between freeway to the South and two arterials that "y" into the road. Anytime this signal stops mainline it causes some queues that during peak can extend up both arterials. TSP hasn't seemed to drastically impact this queue length.
167	OC Transpo	$0	2,912	75	70	NS traffic is affected to some extent due to Signal pre-emption for buses
168	OC Transpo	$0	3,449	15	15	Minimal impact due to low traffic volume on intersecting street
169	OC Transpo	$0	27,978	25	25	Advance detection and green extension for buses; Peak hour & Off Peak Hr transit volumes shown are for per direction; Traffic volume shown is for E&W directions for intersecting street; traffic on intersecting street is impacted when buses recieve priority
170	OC Transpo	$0	14,160	10	10	Buses recieve priority using Transit Priority Signal Indicator (TPSI) or White Vertical Bar; Buses operate on exclusive bus lanes; Daily Traffic Volume shown is for NB direction only; When bus recieves priority, SBL traffic is penelized which is heavy during PM Peak Period
171	OC Transpo	$0	28,267	15	15	NS buses are detected in advance and Green extension is provided to give priority to buses; Transit volume shown is for one direction; Daily Traffic volume shown is for NS directions
172	OC Transpo			2	2	Traffic volume shown is for EB direction; Travel Time (TT) Savings and Reduction in TT variability shown are in minutes (not percentage) each time bus recieves priority; Buses move from right lane to left lane on dedicated transit signal phase; some capacity removed from general traffic
173	OC Transpo	$0	1,063			Traffic volume shown is for EB direction;
174	OC Transpo	$0	1,136	2	2	Traffic volume shown is for EB direction; Travel Time (TT) Savings and Reduction in TT variability shown are in minutes and for each time bus recieves priority; EB curb lane designated as Right Turn Lane with Buses excepted

Individual Transit Preferential Treatment Applications

ID	Agency	Service	Treat-ment Type	Description (if Other)	Street	Year Built	Direction	Peak Hour Transit Volume	Offpeak Hourly Volume	Average Daily Traffic	Peak Hour LOS	Capital Cost
175	OC Transpo	bus	tsp		Woddroffe & Sportsplex South	2005	one-way	41	8	21,084	E	$7,500
176	OC Transpo	bus	tsp		Richmond & Island Park	2006	two-way	6	4	6,697	C	$10,000
177	OC Transpo	bus	tsp		March & Herzberg	2008	one-way	4	0	12,339	B	$2,500
178	Utah Transit Authority	lrt	tsp		400 South Corridor - University Line	2001	two-way	8	10	22,000		
179	Fort Worth Transportation Authority	bus	tsp		Lancaster Ave.	2008	two-way	7	5			$250,000
180	Memphis Area Transit Authority	lrt	tsp		Main Street	2006	two-way	12	12	3,500	A	$53,000
181	Memphis Area Transit Authority	lrt	tsp		Madison Avenue	2004	two-way	12	6	8,000	A	$100,000
182	Memphis Area Transit Authority	lrt	tsp		Front St. & Tennessee (Riverfront Line)	1997	one-way	6	6	0	A	$60,000
183	Community Transit	bus	tsp		State Route 99	2003	two-way	10	6	37,500	D	$2,789,700
184	Chicago Transit Authority	bus	tsp		Western Ave.	2009	two-way	24	12			$500,000
185	York Region Transit	bus	tsp		Yonge Street,	2005	two-way	24	10	50,000	E	$825,000
186	York Region Transit	bus	tsp		Highway 7	2005	two-way	12	8	65,000	E	$1,170,000

Individual Transit Preferential Treatment Applications

ID	Agency	Annual O/M Cost	Ridership	% Travel Time Savings	% Decrease in Travel Time Variability	Impact on General Traffic Operations
175	OC Transpo		5,949	45	70	Traffic volume shown is for NS directions; buses are detected in advance and traffic signal is pre-empted to provide priority to buses; NS traffic is impacted as a result of pre-emption
176	OC Transpo		963	15	15	Daily Traffic Volume shown is for E&W traffic; minimal impact on other traffic; buses are detected in advance and green extension is provided in order to give priority to buses
177	OC Transpo		43	40	40	Daily Traffic Volume shown is for NS direction; DOuble loop is provided to detect SBL turning buses and signal is pre-empted to provide priority to buses; minimla impact on other traffic
178	Utah Transit Authority		20,000	20		Impacts vary from intersection to intersection. The 400 South corridor is a major arterial with 6 traffic lanes plus left turn and dual left turn lanes. Shared left turn lanes exist in 5 locations. The 400 South corridor is also a coordinated corridor with cross coordination in many locations. Most trains follow the green-band along the corridor and receive background TSP. Impacts to traffic include, early termination for cross streets, green extensions at most locations, swapping of lead/lag left turns, queue jumps, and shared left turn lane treatements. Because the streets are very wide, pedestrian crossing times are high, dictating a high cycle length and limiting the amount of priority that can be given within that cycle. Locations near the CBD which a
179	Fort Worth Transportation Authority					
180	Memphis Area Transit Authority	$1,500	1,300	5	10	The project results in very minor impacts on general traffic operation. However, it aids transit vehicle operation during downtown special events, such as concerts and NBA basketball games when the roadway and transit system experience high volumes of vehicular and tranist use. The transit signal priority allows transit vehciles (LRT Streetcars) to navigate congested intersections and helps maintain time schedules and headways.
181	Memphis Area Transit Authority	$1,500	550	0	0	The City of Memphis has not programmed the signals to allow additional time for transit vehicles. Signal pre-emption is available for emergency vehicles.
182	Memphis Area Transit Authority	$1,000	1,200	0	0	Signal detection devices are used for safety warning devices for automobiles and railroad crossing detection and gate activation.
183	Community Transit	$30,000	4,200	16.3	27	
184	Chicago Transit Authority					Scheduled for implemenation Summer 2009
185	York Region Transit	$24,000	15,500	5		There are 55 signalized intersections with traffic signal priority. Negligable impact on traffic operations
186	York Region Transit	$36,000	10,000	5		There are 78 signalized intersections with traffic signal priority. Negligable impact on general traffic operations.

Individual Transit Preferential Treatment Applications

ID	Agency	Service	Treat-ment Type	Description (if Other)	Street	Year Built	Direction	Peak Hour Transit Volume	Offpeak Hourly Volume	Average Daily Traffic	Peak Hour LOS	Capital Cost
187	Chattanooga Area Regional Transportation Authority	bus	tsp		Shallowford/Gunbarrel	2001	two-way	5	3	22,575	D	$200,000
188	Maryland Transit Administration	lrt	tsp		Howard Street	2007	two-way					$2,000,000
189	regional transportation commission of Washoe County	bus	tsp		Virginia Street	2009	two-way				E	
190	SEPTA	lrt	tsp		Lancaster, Lansdowne, 63rd	2000	two-way					
191	SEPTA	lrt	tsp		girard	2005	two-way					
192	SEPTA	bus	tsp		52nd, 54th	2006	two-way					
193	Regional Transportation District	lrt	tsp		Stout St/California St	1994	two-way	18	16			$100,000,000

Individual Transit Preferential Treatment Applications

ID	Agency	Annual O/M Cost	Ridership	% Travel Time Savings	% Decrease in Travel Time Variability	Impact on General Traffic Operations
187	Chattanooga Area Regional Transportation Authority		1,800			
188	Maryland Transit Administration		33,000			
189	regional transportation commission of Washoe County					
190	SEPTA					
191	SEPTA					
192	SEPTA					
193	Regional Transportation District		50,000	25	50	

APPENDIX B

Traffic/Roadway Agency Survey and Responses

TRAFFIC/ROADWAY AGENCY SURVEY
TCRP J-7/SA-22 - Bus and Rail Preferential Treatments in Mixed Traffic Environments

This page shows all the questions on a single page to help your agency determine who should answer the survey. When you are ready to begin the survey, use the link here or at the bottom to go back to the start page

Page 1

Transit Preferential Treatment Applications

You will be asked to review a table of all transit preferential treatments that the transit agency has implemented. You are only asked to update information on treatments within your jurisdiction. A sample treatment is provided below.

Review treatment:

Information in this entry was provided by the transit agency using whatever data they had available. **If this treatment is in your jurisdiction**, please review the information below and correct, update, or fill in the missing information for each entry, if possible. Boxes with grey backgrounds cannot be edited.

Transit Type: Bus

Treatment Type: Exclusive Lanes (EL)

If other, Identify:

Street: SR 522

Year Built: 2005

Direction of Treatment: Two-way

Please answer the remaining questions with respect to the number of directions indicated above.

Peak Hour Transit Volume: 25 Transit *vph*

Off-Peak Transit Volume: 15 Transit *vph*

Daily Traffic Volume:

Peak Hour *LOS*:

Captial Cost: $

Annual *O & M* Cost: $

Travel Time Savings: 10.00 %

Reduction in Travel Time Variability: 30.00 %

Average Daily Ridership: 3000

Check the map below to see if this treatment is in your jurisdiction.

Impact on General Traffic Operations:

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2. What is the role of your agency related to transit preferential treatment development in your service area? (Check all that apply)

- ☐ Identifying and locating treatments
- ☐ Designing treatments
- ☐ Constructing treatments
- ☐ Operating and maintaining treatments
- ☐ Monitoring performance of treatments
- ☐ No role

3. What is your perception of the impact of different transit preferential treatments applied in your urban area on general traffic operations?

	Negligible Impact	Mild Impact	Major Impact
Median Transitway (MT)	○	○	○
Exclusive Lanes (EL)	○	○	○
Transit Signal Priority (TSP)	○	○	○
Special Turn Signals (STS)	○	○	○
Queue Jump/Bypass Lane (QJ/BL)	○	○	○
Curb Extension (CE)	○	○	○
Limited Stops (LS)	○	○	○
Other (O)	○	○	○

4. What is the minimum acceptable lane width and length for exclusive transit facilities on your street system?

Width of median transitway (one-directional): ____ feet

Width of median transitway (two-directional): ____ feet

Length of queue jump/bypass lane: ____ feet

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5. Identify the type of signal hardware and software applied in transit signal priority (TSP) implementations in your urban area, and the extent of application.

Bus

Controller Type: ____

Software: ____

Control of Priority: ○ *Centralized* ○ *Distributed* ○ Both

Priority Type (check all that apply):

- ☐ Early Green
- ☐ Green Extension
- ☐ Activated Transit Phases
- ☐ Phase Insertion
- ☐ Phase Rotation

What amount of time is given for early green TSP? ____ seconds

Is green extension time fixed or variable? ○ Fixed ○ Variable

What amount of time is given for green extension? ____ seconds

The amount of time given for green extension ranges between ____ and ____ seconds

Detection Type (check all that apply):

- ☐ Optical/Infrared
- ☐ *GPS*
- ☐ Inductive Loop

- ☐ Wi-Fi
- ☐ Wayside Reader
- ☐ Other

LRT/Streetcar

Controller Type:

Software:

Control of Priority: ○ *Centralized* ○ *Distributed* ○ Both

Priority Type (check all that apply):

- ☐ Early Green
- ☐ Green Extension
- ☐ Activated Transit Phases
- ☐ Phase Insertion
- ☐ Phase Rotation

What amount of time is given for early green TSP? ____ seconds

Is green extension time fixed or variable? ○ Fixed ○ Variable

What amount of time is given for green extension? ____ seconds

The amount of time given for green extension ranges between ____ and ____ seconds

Detection Type (check all that apply):

- ☐ Optical/Infrared
- ☐ *GPS*
- ☐ Inductive Loop
- ☐ Wi-Fi
- ☐ Wayside Reader
- ☐ Other

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6. Does your agency have a transit signal priority monitoring or reporting program?

- ○ Yes
- ○ No

Which events are monitored? (Check all that apply)

- ☐ Proper detection of transit vehicles
- ☐ Equipment functioning properly
- ☐ Use of queue jump/bypass lanes

Which of the following events are recorded? (Check all that apply)

- ☐ Number of possible TSP events
- ☐ Number of Actual TSP events
- ☐ Duration of TSP events

7. Are there any special signing/striping design treatments that are implemented for particular preferential treatments?

- Yes
- No

If yes, please describe:

8. Is there an agreement with the local transit agency with respect to developing transit preferential treatments?

- Yes
- No

What enhancements to this agreement would be desirable from your agency's perspective?

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9. What is your agency's level of support with respect to potential future implementation of different transit preferential treatments on your street system?

	No Support	Mild Support	Major Support
Median Transitway (MT)	○	○	○
Exclusive Lanes (EL)	○	○	○
Transit Signal Priority (TSP)	○	○	○
Special Turn Signals (STS)	○	○	○
Queue Jump/Bypass Lane (QJ/BL)	○	○	○
Curb Extension (CE)	○	○	○
Limited Stops (LS)	○	○	○
Other (O)	○	○	○

Notes:

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Traffic Agency Responses

ID	Agency	Name	Title	Q2 - Agency Role	Q3 - Perceived Treatment Impacts								Q4 Geometry		
					MT	EL	TSP	STS	QJ / BL	CE	LS	O	one-way	two-way	QJ min length
1	WSDOT	Jim Johnstone	Signal Operations Engineer	o/m,	major	major	mild	major	mild	major	major	major			
2	City of Tacoma Public Works	Chris Larson	Assistant Engineering Division Manager	construct, o/m,	major	major	mild	major	mild	mild	negligible	negligible			
3	City of Eugene	Tom Larsen	City Traffic Engineer	planning,o/m, performance,	negligible	negligible	negligible	negligible	negligible	negligible	major	major			120
4	City of Bellevue	Mike Whiteaker	ITS Manager	design, construct, o/m,	negligible	negligible	mild	mild	mild	mild	mild	negligible			
5	Los Angeles Department of Transportation	Chun Wong	Transportation Engineer	planning, design, construct, o/m, performance,	mild	mild	negligible	mild	mild	mild	mild	mild	10	14	
6	Utah Department of Transportation	Matt Luker	Assistant Signal Systems Engineer	design, o/m, performance,	major	major	major	mild	negligible	negligible	mild	negligible		30	
7	City of Everett	Dongho Chang	City Traffic Engineer	planning, design, construct, o/m, performance,	major	major	mild	mild	mild	mild	mild	negligible	11	22	100
8	Mn/DOT	Jennifer Conover	Team Transit Project Manager	planning, design, construct, o/m,	negligible	mild	major	negligible	negligible	negligible	negligible	negligible	10		300
9	Sacramento County DOT	Doug Maas	Senior Transportation Engineer	o/m, performance,	major	mild	mild	mild	mild	mild	negligible	negligible	1	1	1
10	City of Lynnwood	Paul Coffelt	ITS Engineer	o/m, performance,	major	mild	negligible	mild	major	mild	negligible	negligible	9	20	80
11	Philadelphia Streets Dept.	Charles Denny	Chief Traffic Engineer	design, o/m,	mild	major	mild	mild	mild	mild	negligible	negligible	12	24	
12	City of Ottawa	Tom Fitzgerald	Manager, Traffic Engineering	design, o/m, performance,	major	major	mild	mild	major	mild	mild	negligible	14	32	70

Traffic Agency Responses

ID	Agency	Q5 - Bus TSP Attributes								
		Controller Type	TSP Software	Priority Type	TSP Control	Early Green Time	Green Ext. Type	Green Ext. Min Length	Green Ext. Max Length	Detection Type
1	WSDOT	Traconex TMP 390	J8		centralized					optical,
2	City of Tacoma Public Works	LMD9200		early green, green ext.	centralized					optical,
3	City of Eugene	170	McCain	green ext., active transit phase	distributed		variable	1	2	loop,
4	City of Bellevue	Econolite ASC/2	35906v1.04	early green, green ext.	distributed	60	variable	0	0	loop,
5	Los Angeles Department of Transportation	2070	Los Angeles TPS Module software	early green, green ext., active transit phase	centralized	10	variable	0	10	loop,wifi,
6	Utah Department of Transportation	Econolite ASC/3	ASC/3	early green, green ext.	distributed	10	variable	0	10	optical,
7	City of Everett	currently Multisonic, will be upgraded this year to a new controller and central system	Opticom ID tag will be used for bus priority	early green, green ext.	centralized	10	variable	10	20	optical,
8	Mn/DOT	doesn't exist								
9	Sacramento County DOT	optical emitter	3m pre-emption w ACTRA signal system	early green, green ext.	distributed	10	variable	0	10	optical,
10	City of Lynnwood	Naztec 2070	Apogee	early green, green ext.	distributed	10	variable	5	10	wayside,
11	Philadelphia Streets Dept.	170	Bitrans	early green, green ext.,	distributed	10	variable	0	10	optical,
12	City of Ottawa	Multilek	DirX	early green, green ext., active transit phase, phase insertion, phase rotation	centralized	20	variable	2	20	loop, wayside,

Traffic Agency Responses

ID	Agency	Q5 - LRT/Streetcar TSP Attributes									Q6 - Monitor and Record Events?		
		Controller Type	TSP Software	Priority Type	TSP Control	Early Green Time	Green Ext. Type	Green Ext. Min Length	Green Ext. Max Length	Detection Type	Y/N	Monitored Events	Recorded Events
1	WSDOT	no_lrt									No		
2	City of Tacoma Public Works	no_lrt									No		
3	City of Eugene	no_lrt									No		
4	City of Bellevue	no LRT yet									No		
5	Los Angeles Department of Transportation	2070									Yes	detect_vehicles, equip_function,	possible, actual, and duration of tsp events
6	Utah Department of Transportation	Eagle M50 family	Siemens NextPhase	early green, green ext., active transit phase, phase insertion, phase rotation	distributed	15	variable	0	30	loop, other	No		
7	City of Everett	no_lrt									Yes	detect_vehicles, equip_function,	possible, actual, and duration of tsp events
8	Mn/DOT	don't know	don't know								No		
9	Sacramento County DOT	None									No		
10	City of Lynnwood	no_lrt									Yes	detect_vehicles, equip_function,	possible, actual, and duration of tsp events
11	Philadelphia Streets Dept.	170	bitrans	early green, green ext.,		10	variable	0	10	optical,	No		
12	City of Ottawa	multilek									Yes	detect_vehicles, equip_function, queue_jump_use	possible, actual, and duration of tsp events

Traffic Agency Responses

ID	Agency	Q7 - Special Signing/Striping/Design for Treatments?	
		Y/N	If Yes, Describe
1	WSDOT	No	
2	City of Tacoma Public Works	No	
3	City of Eugene	Yes	Queue jumps have separate signal heads and lanes. Exclusive bus lanes are signed appropriately. Rail type signals are used in block protected bi-directional exclusive lanes.
4	City of Bellevue	Yes	We mark the loop as "Bus Detector" and/or provide a blue light to let operator know we have detected them.
5	Los Angeles Department of Transportation	Yes	Signing and striping modifications to accommodate for far-side bus stops
6	Utah Department of Transportation	Yes	At all sites where left-turns are allowed from a parallel movement across LRT tracks, we have blankout warning signs which are lit with an image of a train when a train is approaching the intersection. Additionally, at sites where one of two dual left-turn lanes is shared with the LRT trackway, we have blankout signs warning motorists to stay off the track when a train is approaching from the rear. The signs are not lit if vehicles are already in the lane.
7	City of Everett	No	
8	Mn/DOT	Yes	Signs for the Bus Shoulders and for HOV bypasses. Special diamond striping and overhead changeable message signs for the HOT (high occupancy toll) lanes.
9	Sacramento County DOT	No	
10	City of Lynnwood	Yes	Signs indicate: Right Lane Must turn Right except for Bus.
11	Philadelphia Streets Dept.	Yes	Only where we have a separate marked area in the center of Girard Avenue for the route 15.
12	City of Ottawa	Yes	bus signal signing, experiment with painting lanes red

Traffic Agency Responses

ID	Agency	Q8 - Agency Agreement? Y/N	If Yes, Desired Enhancements	Q9 - Agency Support MT	EL	TSP	STS	QJ / BL	CE	LS	O
1	WSDOT	No		major	major	mild	major	mild	major	major	major
2	City of Tacoma Public Works	Yes	Not sure.	none	none	major	mild	mild	major	mild	mild
3	City of Eugene	Yes	The agreement is informal and based on mutual benefit.	major	major	major	major	major	major	mild	mild
4	City of Bellevue	Yes	Each agreement is more project specific and longer ranging and lacking consistancy. They seem to be highly variable depending on capital funding available and project manager.	major	mild	major	none	mild	none	mild	none
5	Los Angeles Department of Transportation	No		major	major	major	major	major	major	major	major
6	Utah Department of Transportation	Yes	The agreement at present is informal but is undergoing review with the transit agency and other traffic agencies. It will then be formalized. One enhancement desired by all the participating agencies (traffic and transit) is that no more sites will be constructed with shared trackway/left-turn lanes, since they have been problematic	mild	mild	mild	none	mild	none	mild	none
7	City of Everett	No		none	mild	major	major	major	major	major	major
8	Mn/DOT	Yes	The real answer is "no", not a written agreement. However, we have an interagency working group called Team Transit that develops ideas and is chaired by Mn/DOT. Our working group has developed nearly 300 miles of bus shoulders and many other transit advantages and seems to work well. We have a written policy to provide transit advantages applied to freeways and expressways as appropiate (is also in statute).	major	major	mild	mild	major	none	mild	major
9	Sacramento County DOT	No		mild	mild	major	major	major	mild	major	mild
10	City of Lynnwood	Yes	I can only comment on my personal viewpoint as we have not had any discussions to determine agency-wide desires. My personal desire would be to add training for central software operation to include analysis and reporting.	none	major	major	none	mild	mild	major	none
11	Philadelphia Streets Dept.	Yes	For each project there is an agreement. These three were pilots.	mild	mild	major	major	none	major	major	none
12	City of Ottawa	Yes	define the # of buses required for treatment levels.	mild	mild	major	major	major	major	major	major

APPENDIX C

Sample Intergovernmental Agreements

KING COUNTY METRO/CITY OF SHORELINE
INTERGOVERNMENTAL AGREEMENT ON AURORA CORRIDOR

Agreement Between the
City of Shoreline and King County for
Design and Construction of Aurora Corridor N 165th – N 200thStreet Improvements

THIS AGREEMENT is made and entered into this 17 day of May 2007, by and between King County, hereinafter called the "County," and the City of Shoreline, hereinafter called the "City," both of which entities may be collectively referred to hereinafter as "Parties."

WHEREAS, the City, via Council Resolution No. 39, October 24, 1995, executed an Agreement with the County to implement transit signal priority improvements as part of the King County Highway 99 Transit Priority Project; and simultaneously, after considering a County proposal to add right turn only/transit lanes and other amenities on segments of Aurora Avenue North, deferred roadway improvements until completion of a comprehensive plan for the Aurora Corridor;

WHEREAS, the Parties collaborated on the Aurora Corridor Multimodal Pre-design Study that was designed to optimize the person-carrying capacity of the roadway, improve roadway safety for pedestrians, bicycles, transit, and general traffic, and support both local and regional economic development objectives;

WHEREAS, the recommendations of the Aurora Corridor Multimodal Pre-design Study include a set of facility recommendations that will enhance transit speed, reliability and passenger access, and these recommendations are consistent with King County's Six Year Transit Improvement Program and the King County Regional Arterial Network; and,

WHEREAS, the City and the County previously entered into an agreement to design and build the improvements for the segment of Aurora Avenue N between N 145th Street and N 165th Street and the County committed $500,000 to this effort; and

WHEREAS, the City has since completed the design effort for the segment between N 145th and N 165th , secured all of the required construction funds, and will complete construction on this segment in 2007;

WHEREAS, the City is now ready to commence the environmental and design phases for the balance of the corridor, between N 165th and N 200th ; and

WHEREAS, the King County Executive recommended, and the County Council adopted, a 2006 capital budget appropriation that included an additional $1,000,000 in funding from the King County Highway 99 Transit Priority Improvement Project to help the City finance improvements on Aurora between N 165th and N 200th, consistent with the concepts outlined in the Aurora Corridor Multimodal Pre-design Study recommendations;

WHEREAS, the City and County now desire to enter into an AGREEMENT to finance and build a set of improvements on Aurora between N 165th and N 200th, hereinafter referred to as the "Project;"

NOW THEREFORE, in consideration of the mutual covenants contained herein, the sufficiency of which is hereby acknowledged, the Parties hereto agree as follows:

1.0 Project Overview

1.1 The Aurora Corridor Multimodal Pre-design Study is expected to be the basis for the design and reconstruction of Aurora Avenue North in the Project area. The Project's main improvements should include the following: continuous business access/transit lanes on the curb lane in both directions; curbs, gutters, landscaping/street furnishing strips and sidewalks on both sides of the roadway, and a landscaped center median safety lane with left turn and U-turn provisions; storm water management improvements; upgraded traffic signal control and coordination technology; traffic signal technology compatible with transit priority operations; illumination for traffic safety and pedestrian scaled lighting, and under grounding of overhead utility distribution lines.

1.2 This AGREEMENT is intended to define the parties' responsibilities for Project improvements which include the design and construction of all the Project features in the segment of Aurora Avenue North lying between N 165th Street and N 200th Street.

1.3 Any substantive changes to the scope of the Project described below and that are related to transit improvements must be approved by the County as set forth in Section 3.6 to this AGREEMENT. In any event, however, the Project shall include the following elements as a condition precedent to the County's obligations under this AGREEMENT, which are hereinafter referred to collectively as the "transit improvements":

1.3.1 Transit Stops: Upgrade all existing or new transit stops with bus zone facilities that are accessible under the Americans with Disabilities Act (ADA). The City shall coordinate with the County to assure that those facilities installed under this Project meet ADA design specifications. Exhibit 1 documents the current transit stops in the Project area and the needed improvements, including shelter footings and lighting, which shall be created under this Agreement. All stops shall be ADA accessible and shall include adequate provisions for security lighting. If the Parties subsequently agree to add new stops or relocate existing stops to new locations, the Project shall provide comparable levels of upgrades for these new stops.

1.3.2 Roadway Improvements: Replacement of the existing roadway to include landscaped center median improvements, continuous curb lanes designated for business access and transit use only, new sidewalks and curb ramps.

1.3.3 Transit Priority Request Equipment: Relocation or replacement, as necessary, of the Transit Priority Request (TPR) equipment previously installed by the County at five (5) intersections under the 1995 Highway 99 Transit Priority Project Agreement. Such equipment includes, but is not limited to, poles, antennas, readers, and the interconnect between the transit priority request generators and the readers. Exhibit 2 defines the components of the transit signal priority system.

1.3.4 Fiber Communication for Transit Signal Priority and Real Time Bus Information Systems: Provide two strands of fiber optic cable dedicated for use by King County Metro. These two strands shall be continuous along the length of the project, connected to the two strands of fiber optic cable allocated to the County in the section between N 145th and N 165th Streets, and accessible at each signal control cabinet along the Project and/or at each shelter or real time sign kiosk..

1.3.5 Transit Signal Priority Control Strategies: The Parties will mutually agree on future modification to transit signal priority control strategies as may be required due to the relocation or installation of new transit priority request (TPR) equipment relocation or the installation of new signal equipment with updated transit signal priority capabilities. Signal cabinets should be selected so as to accommodate TPR and related communication equipment.

2.0 Project Management

2.1 The Parties shall each designate project managers who have authority to administer all aspects of this AGREEMENT. The Parties shall notify each other in writing within 14 days of the execution of this AGREEMENT of these assignments. Written notice of any subsequent changes to these staff assignments must be provided to the Parties.

2.2 Any disputes between the parties may be elevated to the County's General Manager of the Transit Division and the City Manager for resolution.

2.3 The City Project Manager shall chair a Project Steering Committee composed of staff from the City, County and other public agencies who are responsible for any aspect of review, design, regulatory oversight and approval, construction or community relations related to Project improvements. This committee will meet as needed. The Parties shall coordinate their work with the work of the other agencies through the Project Steering Committee.

3.0 City Responsibilities

3.1 Unless otherwise agreed to by the Parties, the City shall be responsible for the design of all Project improvements, including the transit improvements, in accordance with professional engineering standards and practices.

3.2 The City shall be the lead agency for the environmental process for Project covered by this AGREEMENT. The City upon consultation with the Washington State Department of Transportation (hereinafter referred to as WSDOT), shall take all steps necessary to complete the environmental process in accordance with the State Environmental Policy Act (SEPA) and the National Environmental Policy Act (NEPA). The City shall provide the County with an opportunity to review all environmental documents prior to publication. The City shall complete the environmental process for the balance of the corridor between N 165th Street and N 200th Street.

3.3 The City shall conduct all of the required community outreach and public notification required for this Project.

3.4 The City shall issue regular written status reports on the Project to the County. The schedule and format of these reports will be agreed upon by the Parties.

3.5 The City shall submit all Project engineering and design documents at agreed upon submittal completion levels, but not fewer than at 30%, 60% and 100% levels, for County review and comment. The duration of each review and comment period will be jointly established by the Parties.

3.6 The City, at its option, may determine that it must design and/or construct the Project in two or more phases. However, the City shall not advertise any phase of the Project for bid without written approval from the County as to the sufficiency of the contract documents regarding incorporation of the relevant transit improvements. The County shall not unreasonably withhold its review comments or approvals. Neither the provisions of this AGREEMENT, nor any County approvals or assistance provided throughout the course of design and construction, whether of change orders, progress inspections, final acceptance inspections or otherwise, shall create any responsibility or liability on the part of the County to the City, its officials, employees, agents and contractors or any third parties.

3.7 The City shall construct or cause to be constructed all Project improvements, including the transit improvements. If construction requires that existing TPR equipment be relocated or replaced, the City agrees to reinstall or replace said equipment with equipment that meets the County's requirements, both as to location and function. Any TPR equipment damaged or lost during construction will be replaced or repaired at the City's expense using comparable equipment. Similarly, connections between the readers and the transit priority request generators and the TPR interconnect shall be maintained or replaced, as needed.

3.8 Unless otherwise agreed to by the Parties, if new traffic signals are installed with the Project, these signals shall be designed and constructed with TPR equipment meeting the County's specifications. The City shall continue to specify and install traffic controllers which provide transit signal priority control strategies in a form that both the City and the County endorse and which are compatible with the TPR system. Upon completion of the Project, the City agrees to enroll all new transit signal priority installations under the Operations and Maintenance Agreement for Transit Signal Priority that the parties executed on May 4, 2003.

3.9 The City shall confer with the County during its design of the fiber communication network to ensure that fiber connections to the signal cabinets and/or stand alone cabinets at the bus stops are built so as to support the future delivery of real time bus information and communication between the transit priority request generators in the transit signal priority system.

The City shall be responsible for final inspection and acceptance of all Project improvements. However, prior to final acceptance, the City shall consult with the County to ensure that the transit signal priority improvements and the fiber infrastructure have been adequately installed, tested and determined to be fully operational. Additionally, the City shall request written approval from the County that all of the transit improvements have been constructed. The County agrees not to unreasonably withhold its approval. Upon agreement of the parties, the City shall issue formal written notice to the County of its acceptance of the Project improvements. This notice shall include authorization for transit buses to begin to utilize the business access and transit lanes. The date of the written notice shall serve to commence the fifteen-year amortization period, as described in Section 8.1

If the Project is constructed in phases, the acceptance and approval requirements of section 3.10 shall apply to each phase as construction of the phase is completed; provided, for all phases, the fifteen year amortization period as described in Section 8.1 shall commence upon written notice of acceptance of the final phase.

The City shall participate with the County in evaluating the effectiveness of the Transit Signal Priority system operating in conjunction with the new business access and transit lanes plan. An evaluation report will be jointly issued by the parties within 120 days of City acceptance of the Project improvements, per Section 3.10. If the Project is constructed in phases, it may be necessary to complete more than one evaluation effort. However, the first evaluation effort will not be undertaken until a meaningful segment of the Project has been completed. For purposes of this AGREEMENT, a meaningful segment must be at least one mile or longer in length.

4.0 County Responsibilities

4.1 The County agrees to include in its contract with the vendor of TPR equipment a provision that requires the vendor to enter into a contract with the City to provide such equipment at the same prices as the County and will ensure that the equipment purchased is compatible with the regional standard for this technology. The City must still execute a contract with this vendor, in accordance with City purchasing procedures, for the equipment required to implement this AGREEMENT.

4.2 The County will assist the City in the design of the TPR installation for the Project, including assisting in the siting of antenna and readers, the testing and acceptance of TPR communication, the relocation of bus zones, if required, and the development of control strategies to implement transit signal priority. The County will supply the City with equipment specifications and typical drawings for installation of the TPR equipment. However, the City will be responsible for preparing and assembling final contract documents, including survey and site specific drawings for transit signal priority installations along Aurora Avenue North.

4.3 The County will assist the City in developing the scope of work for the bus stop improvements, including field work and sketch level documentation for lighting, ADA, and other zone related improvements. However, the City will be responsible for assembling final contract documents, including survey and site specific drawings for all bus zone improvements.

4.4 The County at its own expense will supply to the City or its contractor the bus shelters and other standard transit street furniture agreed upon in the final design documents for Project bus zone related improvements.

4.5 Within 120 days of written City acceptance of the Project improvements as outlined in Section 3.10, the County will lead and complete an effort to evaluate the impact of the business access and transit lanes, in conjunction with transit signal priority, on transit operations in the Project area. The County, with assistance and input from the City, will collect the necessary data, undertake the required analysis and prepare a draft Before and After evaluation report for review and approval by the City. The City and the County will jointly issue the final report.

5.0 Financing

5.1 County funding for Project improvements shall be a maximum of $1,000,000, not including funding for the County responsibilities described in Section 4.0 of this Agreement.

5.2 The City shall be responsible for all costs in excess of the $1,000,000 supplied by the County necessary to complete the design and construction of the entire Project as described in Section 1 of this AGREEMENT.

6.0 Completion Schedule

6.1 The City shall complete the work described in this AGREEMENT by December 31, 2012.

7.0 County Payments to City

7.1 The County agrees to pay the City a total of $1,000,000 following receipt of an invoice from the City and sufficient documentation demonstrating completion of each of the milestones described in this section 7.0.

7.2 The County shall reimburse the City $100,000 upon completion of the environmental process for the Project; documentation for this milestone shall be the formal record of decision issued by the Federal Highway Administration under NEPA and the applicable SEPA documents and decision issued by the City. The environmental process must include the entire segment between N 165th Street and N 200th Street.

7.3 The County will pay the City a total of $300,000 for completion of final design and all related bid and contract documents for the Project; documentation for this milestone shall be the completed contract documents, advertisement for bids, and a contract award to the successful bidder. If the City elects to design the Project in phases, then it will be eligible for pro rata amount of the $300,000 [based on length of the segment it has designed as compared to the length of the entire Project between N 165th Street and N 200th Street.

7.4 The County will pay the City a total of $600,000 for construction of the Project; documentation for this milestone will be City acceptance of the Project, per Section 3.10. If the City elects to construct the Project in phases, then it will be eligible for a pro rata share of the $600,000 based on length of the segment it has constructed as compared to the length of the entire Project between N 165th Street and N 200th Street.

8.0 Ownership and Maintenance of the Improvements

8.1 The City agrees to adopt such ordinances as are necessary to restrict, at a minimum, the use of the outside lanes within the Project area between the hours of 6:00 A.M. and 7:00 P.M., Monday through Saturday, for transit vehicles or vehicles accessing businesses adjacent to the roadway. The City at its option may extend these restrictions to other hours of operation. All such restrictions shall be designated by the City through signage and pavement marking as mutually agreed between the Parties and the Washington State Department of Transportation (WSDOT), in recognition that Aurora Avenue is a state facility. The resulting signage and pavement markings shall be enforced by the City as part of its regular traffic code enforcement practices. Said restrictions shall not be terminated by the City for at least fifteen years from the date that the City's opens the business access and transit lanes for use.

The City shall be obligated to refund the County an amount as set forth below if the City ceases to so restrict the use of said outside lanes anytime within the first fifteen years of operation. The City shall initiate this fifteen-year period by providing written notice to the County of the date that continuous business access and transit lanes in both directions of travel are available for public transit buses to use

Removal of Restriction	Amount of Refund*
Year 1	$1,000,000
Year 2	$933,333
Year 3	$866,666
Year 4	$799,999
Year 5	$733,333
Year 6	$666,666
Year 7	$599,999
Year 8	$533,333
Year 9	$466,666
Year 10	$399,999
Year 11	$333,333
Year 12	$266,666
Year 13	$199,999
Year 14	$133,333
Year 15	$66,666

*The amount of refund will not be prorated within the year that it is due; this entire amount will be due if the business access and transit lanes or portions thereof are eliminated anytime within the subject year.

8.2 Upon the City's final acceptance of the construction and installation of the Project improvements, the City shall own, operate, maintain and repair all of the Project improvements, except for the bus shelters, bus signage, and other standardized street furniture supplied by the County for bus zone related improvements.

8.3 The County shall own and maintain any bus shelters, bus signage and other County-supplied street furniture installed in the Project area. The City shall issue all necessary permits for the County to designate bus stops in the Project area and maintain any shelters, signage or other County-supplied street furniture.

8.4 The operation and maintenance of the transit signal priority system will be governed by a separate Transit Signal Priority Operations and Maintenance Agreement that the parties executed in May 3, 2003.

9.0 Legal Relations

9.1 It is understood that this AGREEMENT is solely for the benefit of the Parties hereto and gives no right to any other party. No joint venture, agent-principal relationship or partnership is formed as a result of this AGREEMENT. No employees or agents of one party or any of its contractors or subcontractors shall be deemed, or represent themselves to be, employees of the other party.

9.2 To the maximum extent permitted by law, each party shall defend, indemnify, and hold harmless the other party and all of such party's officials, employees, principals, and agents from all claims, demands, suits, actions and liability of any kind, including injuries to persons or damages to property, which arise out of, are connected with, or are due to any negligent acts or omissions of the indemnifying party, its contractors, and/or officials, employees, agents and representatives in performing work under this AGREEMENT.; Each party specifically assumes potential liability for actions brought by its own employees against the other party, and for that purpose only each party specifically waives, as to the other party only, any immunity under the Worker's Compensation Act, RCW

Title 51; and the Parties recognize that this waiver was the subject of mutual negotiation and was specifically entered into pursuant to the provisions of RCW 4.24.115, if applicable.

9.3 The City shall comply and shall ensure its contractors comply with all federal, state and local laws, regulations and ordinances applicable to the work and services to be performed under this AGREEMENT.

9.4 In the event any party incurs attorney's fees, costs or other legal expenses to enforce provisions of this section against another party, all such fees, costs, and expenses shall be recoverable by the prevailing party.

9.5 This AGREEMENT shall be interpreted in accordance with the laws of the State of Washington in effect on the date of execution of this AGREEMENT. The Superior Court of King County, Washington shall have exclusive jurisdiction and venue over any legal action arising under this AGREEMENT.

9.6 The provisions of this section shall survive any expiration or termination of this AGREEMENT.

10.0 Contracting Services

10.1 If the City uses a contractor to perform work under this AGREEMENT, after taking into account the scope of work and services which may be performed by its contractor(s), the City shall require that the City's contractor maintain Commercial General Liability, Professional Liability if professional services are required, Automobile Liability insurance, Statutory Workers Compensation, Employers Liability/Stop and other insurance as may be required with prudent limits of liability as established by a City risk assessment.

10.2 Such contractor insurance shall insure the City, its contractor, and the County and its officers, officials, agents and employees against loss arising out of or in connection with activities, performed in furtherance of this agreement by, the City's contractor. Contractor's general and automobile liability insurance and other liability insurance as may be required shall include the County and its officers, officials, agents and employees as an additional insured and shall contain standard separation of insured's language. The City's contractor's insurance shall be primary to and not contributing with any insurance or self insurance that may be carried by the County.

Records and Audit:

11.1 During the progress of the design and construction of all improvements covered by this AGREEMENT and for a period not less than three (3) years from the date of completion of all improvements and the closeout of all grants and sub-grants to this Project, records and accounts pertaining to the work of this AGREEMENT and accounting therefor are to be kept available for inspection and audit by representatives of the County. Copies of the records shall be furnished to the County upon request and shall be maintained in accordance with the work order accounting procedure prescribed by the State Auditor's Office.

Termination

12.1 This AGREEMENT shall take effect upon execution by both Parties and shall terminate on December 31, 2012 unless the parties mutually agree to extend the AGREEMENT. The Parties agree to make reasonable extensions as may be required to complete the project so long as the City continues to make a good faith effort to secure the required funding to complete the Project.

12.2 Either party may terminate this AGREEMENT in the event the other party materially breaches this AGREEMENT. Written notice of such termination must be given via certified mail by the party terminating this AGREEMENT to the other party not less than fourteen (14) days prior to the effective date of termination.

12.3 Failure to require full and timely performance of any provision of this AGREEMENT at any time shall not waive or reduce the right of either party to insist upon complete and timely performance of such provision or any other provision thereafter.

Identification of Contacts at City and County

13.1 All official communication concerning this AGREEMENT should be directed to the following parties:

City
Mr. Kirk McKinley
City of Shoreline
17544 Midvale Ave. N
Shoreline, Washington 98133
(206) 546-6795

County:
Ms. Ellen Bevington
King County Department of Transportation
201 S Jackson Street, MS KSC-TR-0411
Seattle, Washington 98104-3856
(206) 684-1953

Any changes in agency contacts from those noted above must be communicated in writing to all parties.

14.0 Entire AGREEMENT

14.1 This document contains all terms, conditions and provisions agreed upon by the Parties hereto and shall not be modified except by written amendment. Such amendments may be made to this AGREEMENT within the previously approved budget or other applicable authority for and on behalf of the City by its City Manager, and for and on behalf of the County by its General Manager of the Transit Division.

Severability

15.1 If any provisions of this AGREEMENT are held invalid by a court of competent jurisdiction, the remainder of this AGREEMENT shall not be affected thereby if such remainder would continue to serve the purposes and objectives originally contemplated by the Parties.

IN WITNESS WHEREOF, the parties hereto have executed this AGREEMENT this 17 day of May, 2007.

City of Shoreline

By ______________________ 2007
Robert Olander, City Manager — Date
City of Shoreline

King County

By ______________________ 5/17/07
Kevin Desmond, General Manager — Date

King County Metro Transit Division

Approved as to form:

Ian R. Sievers, City Attorney

Scott Johnson, Prosecuting Attorney

Exhibit 1

SB	Aurora Ave. N.	FS	N. 175th St.	75760	Existing - Full	1		1	1
EB	N. 175th St.	FS	Aurora Ave. N.	75752	Existing - Full		1		
WB	N. 175th St.	NS	Aurora Ave. N.	75888	Existing - Full		1		
NB	Aurora Ave. N.	FS	N. 180th St.	75890	Existing - Half	1	1	1	1
SB	Aurora Ave. N.	FS	N. 180th St.	75750	Existing - Half	1	1	1	1
NB	Aurora Ave. N.	FS	N. 182nd St.	N/A	Proposed	N/A	N/A	N/A	N/A
SB	Aurora Ave. N.	FS	N. 182nd St.	N/A	Proposed	N/A	N/A	N/A	N/A
NB	Aurora Ave. N.	FS	N. 185th St.	75900	Existing - Full	1	1	1	1
SB	Aurora Ave. N.	FS	N. 185th St.	75740	Existing - Full	1	1	1	1
EB	N. 185th St.	FS	Aurora Ave. N.	75732	Existing - Full	1	1	1	1
WB	N. 185th St.	NS	Aurora Ave. N.	77805	Existing - Full		1		
EB	N. 185th St.	NS	Aurora Ave. N.	75009	Existing - Full	1	1	1	1
WB	N. 185th St.	FS	Aurora Ave. N.	75909	Existing - Full	1	1	1	1
NB	Aurora Ave. N.	FS	N. 192nd St.	75910	Existing - Full	1	1	1	1
SB	Aurora Ave. N.	FS	N. 192nd St.	75730	Existing - Full	1	1	1	1
NB	Aurora Ave. N.	FS	N. 195th St.	75920	Proposed		1		1
SB	Aurora Ave. N.	FS	N. 195th St.	75720	Proposed	1	1	1	1
NB	Aurora Ave. N.	FS	N. 200th St.	75930	Proposed	1	1	1	1
SB	Aurora Ave. N.	FS	N. 200th St.	75700	Proposed	1	1	1	1
						16	20	18	17

Notes:

1.) This table assumes that King County Metro will not install new stops at the intersection at N. 182nd Street when it is signalized, unless the existing signal at N. 180th were to be eliminated.

2.) This table includes improvements to the stop at NB Aurora Avenue North, farside of North 200th Street; in the event that King County Metro impliments its proposed Bus Rapid Transit service, this stop may be deleted in the future.

3.) City of Shoreline will be responsible for providing the following bus stop shelter improvements at the locations noted above: construction of F22 shelter footing with hand hold to support interior shelter lighting; power source; conduit and wiring to handhold; and conduit from handhold to shelter footing per King County Metro design details. Some of these shelter sites will be new. Others are expected to be existing shelters that will need to be relocated due to re-construction of the roadway.

4.) The City of Shoreline will locate and provide adequate pedestrian lighting in the vicinity of all bus stops; this can be provided by proper siting of street lighting or by installing pedestrian scale light fixtures.

5.) King County Metro will be responsible for providing the following at all sheltered stops: provide and install F-21 internally lit shelter when the stop meets shelter warrants; complete wiring hookup for interior shelter lighting; and supply and install interior benches and litter recepticles. If passenger loads warrant, King County Metro will have the option of installing a larger F22 shelter. The shelter footing that the City of Shoreline is supplying will support either model of shelter.

6.) [ ] : Denotes transfer point

7.) Given the extended timeframe that it may take to fully implement this AGREEMENT, the parties acknowledge that adustments to this table of bus stop improvements may be required to address changed conditions or to respond to new information from the design process.

8.) In general, there is a desire to relocate all existing nearside stops to a new farside location, if feasible.

9.) Requirements for shelter footings may change based on the implimentation of the Rapid Ride project in the Aurora corridor and the development and introduction of a new shelter design

Exhibit 2

Transit Signal Priority Definitions

"Interface Panel" means the electrical terminal strip located in the traffic controller cabinet that provides a point of demarcation between the TSC System and the TPR System.

"Traffic Signal Control System" (otherwise referred to as the "TSC System") means the system of traffic control maintained and owned by the City for the purpose of managing and controlling vehicular traffic, including, but not limited to, intersection street equipment (traffic signal heads, poles, detectors, conduit, interconnect, traffic controllers and cabinets), and supporting Traffic Management Center (TMC) software and/or hardware.

"Transit Priority Request Detection System" (otherwise referred to as the "TPR Detection System") means the on-street Radio Frequency (RF) antenna based detection system required to detect Metro buses equipped with the Radio Transponder. The TPR Detection System includes any antenna, mast arm, pole mounted reader cabinet, conduit and conductor back to a traffic controller cabinet.

"Transit Priority Request Interconnect" (otherwise referred to as the "TPRI") means the conduit and conductors used to provide communication between multiple TPR Generators within a system.

"Transit Priority Request Field Equipment" means all equipment that is physically used in the field to support TSP, inclusive of the TPR Generators, TPRI, TPR Detection System, and Interface Panels.

"Transit Priority Request Generator" (otherwise referred to as the "TPR Generator") means the portion of the TPR System co-located in the traffic signal cabinet that provides the conditional priority request. The Master TPR Generator includes a modem for direct dial-up by the TPR Management System.

"Transit Priority Request Management System" (otherwise referred to as the "TPR Management System") means the TPR Management Server, modem bank, phone lines and other central system hardware and applications located at the King Street Center County Offices that are used to manage and communicate with the TPR Generators in the field, inclusive of the phone drop located at the master TPR Generator. It also includes any TPR Remote Workstations that provide user input and system management and operational functions.

"Transit Priority Request System" (otherwise referred to as the "TPR System") means the technology that has been selected by the County, in consultation with local traffic engineers throughout King County, to identify transit buses as they approach a signalized intersection for the purpose of requesting priority treatment from the signal controller. The system is comprised of (i) on-board components including Radio Frequency (RF) transponder (King County Metro Transit supplied), (ii) the TPR Detection System, (iii) the TPR Generator, (iv) TPR interconnect, (v) Interface Panel and the TPR Management System and (vi) TPR remote work stations.

"Transit Signal Priority" (otherwise referred to as "TSP") means the ability of a traffic signal control system, generally within the traffic controller functional capability, to grant special priority treatment to buses by adjusting traffic controller settings so as to reduce signal delay for transit buses. This term is synonymous with "TSP functionality."

"Transit Signal Priority System" (otherwise referred to as the "TSP System") means the functional integration of the TPR System with the TSC System through which TSP is provided.

"TPR Testing and Acceptance Plan" means the methodology that will jointly be developed and approved by the City and the County to test the accuracy, function, reliability and connectivity of the TPR System that is installed under this Memorandum of Understanding and in conjunction with the Project.

KING COUNTY METRO/CITY OF SEATTLE INTERGOVERNMENTAL AGREEMENT

Agreement Between the City of Seattle and King County for the Improvement of Transit Speed and Reliability within the City of Seattle

This AGREEMENT is made and entered into this 18 day of May, 2006 by and between the City of Seattle, hereinafter referred to as the "City," and King County, hereinafter referred to as the "County," both of which may be collectively referred to as the "Parties."

WHEREAS, the City and the County are both committed to improving the speed and reliability of transit service within the City of Seattle; and

WHEREAS, the County has an interest in contracting with the City to perform certain services for the purpose of improving the ability of transit vehicles to travel on surface streets within the City of Seattle; and

WHEREAS, the City has an interest in performing certain services that will improve the speed, reliability and safety of transit operations, subject to agreement by the Parties on the scope schedule and budget for such services on a project basis; and

WHEREAS, a Work Order based agreement would enable the parties to define and complete projects in an efficient and timely manner.

NOW THEREFORE, in consideration of the mutual covenants contained herein, the sufficiency of which is hereby acknowledged, the parties hereto agree as follows:

1 Identification of Improvements for Work Orders

1.1 The City and the County shall work together in analyzing transit vehicle delays within the City of Seattle and identifying locations for improvements that would eliminate or reduce such delays.

1.2 The City may plan, design and construct identified transit speed and reliability improvements without seeking reimbursement by the County.

1.3 The County may plan, design and construct transit speed and reliability improvements by contracting with entities other than the City.

1.4 Potential projects undertaken pursuant to this AGREEMENT may be drawn from any of the following sources: Seattle Transit Plan; Seattle Transportation Strategic Plan; all candidate improvement areas listed in the City's Center City Access Study; the County's Six Year Transit Development Plan; the County's adopted Capital Improvement Plan; the City's adopted Transportation Capital Improvement Program; and other projects as may be identified by the County by other means.

1.5 When the Parties have a mutual interest in a project and when the County elects to contract with the City to perform all or a portion of the work related to this project, orders may be issued by the County under the terms and conditions of this AGREEMENT for that work, hereinafter referred to as "Work Orders".

2. Work Order Process

2.1 When the City and the County jointly agree to pursue a project under the terms of this AGREEMENT for services for which the City seeks reimbursement from the County in whole or in part, the City and the County shall first jointly agree on the scope of work for these services. The City shall then supply the County with a written cost estimate to provide these services and a schedule for completion of these services. If the cost estimate is acceptable to the County, the County shall issue a Work Order that will be signed by both parties before becoming effective.

2.2 The types of services that may be covered by a Work Order include the following:

a) Transportation planning and pre-design

b) Design and engineering

c) Right-of-way acquisition

d) Construction

e) Traffic operations improvements

f) Community relations

2.3 The maximum amount of any individual Work Order will be $250,000.

2.4 Payment terms will be negotiated and stipulated in writing for each individual Work Order. Unless the parties agree otherwise, the payment terms for all work orders will be by lump sum not-to-exceed amounts paid in installments. The installment payments shall be due upon completion of agreed upon milestones as determined from the scope of work. For Work Orders valued at less than $25,000, there will typically be a single payment due upon County acceptance of the work. For Work Orders over $25,000, there may be multiple payments with intermediate milestones prior to project completion.

2.5 An executed Work Order will be considered formal Notice to Proceed unless otherwise stated in the Work Order.

2.6 Upon receipt of an executed Work Order from the County's project manager, the City shall perform all of the required work. The County shall have the right to review all deliverables to insure that they comply with the terms of the Work Order.

2.7 For the duration of the AGREEMENT, Work Orders will be numbered sequentially as they are issued. The County will prepare an annual report on the status of all active Work Orders and make this report available to the City.

3. Implementation of Improvements

3.1 Work Orders issued under this AGREEMENT shall stipulate the responsible party for obtaining all permits, licenses, easements and approvals necessary to perform the work.

3.2 When procuring equipment, materials, or services in support of Work Orders, the City will utilize procurement practices in accordance with applicable State and local laws.

3.3 The City will design and construct improvements funded under this AGREEMENT consistent with best professional engineering practices and applicable codes.

3.4 Unless otherwise agreed to by the Parties, the City shall be responsible for conducting community outreach activities, according to city community outreach guidelines, for work covered under each Work Order. The County shall be responsible for notifying its customers of construction related impacts in cases where the City's outreach activity is deemed by the County as insufficient to meet the needs of its transit customers.

4. Change Orders

4.1 The City shall not alter the terms of any approved Work Order without prior written approval from the County in the form of a change order except in situations where changes are deemed urgent by the City. In these situations, the City will make every reasonable effort to coordinate with Metro's Construction Coordinator prior to making such changes. If prior written approval is not obtained, the City will coordinate with the County to obtain written approval after the fact.

4.2 Change orders shall document all modifications to the scope, schedule or budget of the previously approved Work Order, and must be signed by the Parties.

5. County Acceptance of Work

5.1 The City shall notify the County in writing upon completion of each Work Order.

5.2 When physical improvements have been designed and constructed or when traffic operations modifications have been made, as part of a Work Order, the County shall have the right to inspect, prior to making final payment, all of the completed improvements for conformance with the Work Order.

5.3 When technical studies, pre-design or design documents are produced as part of a Work Order, the County shall have the right to review City drafts prior to finalization. The City shall establish reasonable review schedules based on the importance and complexity of the documents that are being reviewed. The County shall adhere to the City's review schedule.

5.4 If the County finds work that does not meet the terms of the Work Order, the County will prepare a punch list of such items and submit it to the City for correction. The City shall correct the deficiencies at no cost to the County; provided the County was not responsible for such deficiencies.

5.5 A written notice of acceptance issued by the County's project manager shall constitute acceptance of the work. Where work is not fully accepted under Section 5.4, the County may choose to identify and accept a portion of the work while corrective action is being taken in addressing punch list items.

6. Ownership and Maintenance

6.1 Unless otherwise agreed to in writing by the parties, all improvements implemented under this AGREEMENT shall become the property of the City upon their completion and final acceptance. The City shall be responsible and liable thereafter for ongoing maintenance, repair and replacement of said improvements except that joint-use trolley poles, Metro bus shelters, bus zone furniture and transit signal priority equipment are excluded from this provision and are covered under separate operating and maintenance practices and/or agreements.

7. Invoices

7.1 The City shall submit invoices for completed work directly to the County's contact identified in Section 14 (or his or her designee or successor) for reimbursement. Each invoice shall reference the Work Orders for which reimbursement is sought. Payment amounts requested and the timing of these payments will be determined by the payment schedule outlined for each individual Work Order.

8. County Payments

8.1 The County shall make payment within thirty (30) days after the receipt of an invoice for work that is determined to be performed in accordance with the terms of each Work Order.

9 Contracting Services

9.1 If the City uses a contractor to perform work under this AGREEMENT, after taking into account the scope of work and services which may be performed by its contractor(s), the City shall require that the City's contractor maintain Commercial General Liability, Professional Liability if professional services are required, Automobile Liability insurance, Statutory Workers Compensation, Employers Liability/Stop and other insurance as may be required with prudent limits of liability as established by a City risk assessment.

9.2 Such contractor insurance shall insure the City, its contractor, and the County and its officers, officials, agents and employees against loss arising out of or in connection with activities, performed in furtherance of this agreement by, the City's contractor. Contractor's general and automobile liability insurance and other liability insurance as may be required shall include the County and its officers, officials, agents and employees as an additional insured and shall contain standard separation of insureds language. The City's contractor's insurance shall be primary to and not contributing with any insurance or self insurance that may be carried by the County.

10. Legal Relations

10.1 It is understood and agreed that this AGREEMENT is solely for the benefit of the parties hereto and gives no right to any other party. No joint venture or partnership is formed as result of this AGREEMENT. No employees or agents of one party or any of the City or any of its contractors or subcontractors shall be deemed, or represent themselves to be, employees of the County.

10.2 The City shall comply, and shall insure that its contractors comply, with all federal, state and local laws, regulations and ordinances applicable to the work and services to be performed under this AGREEMENT.

10.3 To the maximum extent permitted by law, each party shall protect, defend, indemnify and save harmless the other party, its officers, officials, employees and agents while acting within the scope of their employment as such, from any and all suits, costs, claims, actions, losses, penalties, judgments, and/or awards of damages, of whatsoever kind arising out of, or in connection with, or incident to the services associated with this Agreement caused by or resulting from each party's own negligent acts or omissions. Each party agrees that it is fully responsible for the acts and omissions of its own subcontractors, their employees and agents, acting within the scope of their employment as such, as it is for the acts and omissions of its own employees and agents. Each party agrees that its obligations under this provision extend to any claim, demand, and/or cause of action brought by or on behalf of any of its employees, or agents. The foregoing indemnity is specifically and expressly intended to constitute a waiver of each party's immunity under Washington's Industrial Insurance act, RCW Title 51, as respects the other party only, and only to the extent necessary to provide the indemnified party with a full and complete indemnity of claims made by the indemnitor's employees. The parties acknowledge that these provisions were specifically negotiated and agreed upon by them. Each party shall require similar indemnification language in all Agreements with subcontractors entered into in conjunction with this Agreement.

10.4 The Parties' rights and remedies in this AGREEMENT are in addition to any other rights and remedies provided by law.

10.5 This AGREEMENT shall be interpreted in accordance with the laws of the State of Washington in effect on the date of execution of this AGREEMENT. Subject to the provisions contained herein, The Superior Court of King County, Washington shall have exclusive jurisdiction and venue over any legal action arising under this AGREEMENT.

10.6 The provisions of this section shall survive any expiration or termination of AGREEMENT.

1. Records and Audit

11.1 During the progress of the design and construction of all improvements covered by this AGREEMENT and for a period not less than three (3) years from the date of completion of all improvements or for the retention period required by law, whichever is greater, records and accounts pertaining to the work of this AGREEMENT and accounting therefore shall be kept available for inspection and audit by representatives of the parties. Copies of the records shall be furnished upon request. Records and accounts shall be maintained in accordance with applicable state law and regulations.

12. Duration and Extension

12.1 This AGREEMENT shall take effect upon the latest date on which one of the parties executes this AGREEMENT, and shall expire December 31, 2010 unless extended by mutual agreement of the parties.

13. Termination

13.1 Either Party may terminate this AGREEMENT for its convenience. Written notice of such termination must be given by certified mail by the Party terminating the AGREEMENT. Upon receipt of the notice, the Parties will meet to determine the disposition of any outstanding Work Orders. The Parties can either negotiate a close out to all outstanding Work Orders or the Parties can agree to complete all outstanding work. In any case the AGREEMENT will terminate at the latest completion date agreed upon for all outstanding approved Work Orders in place at the time the termination notice is received.

13.2 Either Party may terminate this AGREEMENT in the event that the other Party materially breaches this AGREEMENT. Written notice of such termination and a description of the breach must be given via certified mail by the Party terminating this AGREEMENT to the other Party not less than sixty days prior to the effective date of termination. The breaching Party shall be given this sixty days in which to cure its material breach. If the breaching party fails to cure within sixty days, the AGREEMENT is immediately terminated. Upon termination, the Parties shall determine final costs and payments to be made by each Party.

13.3 Failure to require full and timely performance of any provision at any time shall not waive or reduce the right to insist upon complete and timely performance of any other provision thereafter.

14. Identification of Contacts at the City and County

14.1 The contacts for the administration of this AGREEMENT are as follows:

King County Metro
Ellen Bevington
401 S Jackson Street
KCS-TR-0411
Seattle, WA 98104
206-684-1953

Seattle Department of Transportation
Traffic Management Division
Ron Atherley
Key Tower, Suite 3768
700 Fifth Avenue
Seattle, WA 98104
206-684-5054

14.2 Signature authority for individual work orders will be determined by each agency depending on the level of authority required to authorize expenditures or to accept funds.

15. Entire Agreement and Amendments

15.1 This document contains all terms, conditions and provisions agreed upon by the parties hereto, and shall not be modified except by written amendment.

15.2 Except as otherwise provided for in this AGREEMENT, amendments may be made to this AGREEMENT within the previously approved budget or other applicable authority for and on behalf of the City by its Transportation Department Director, and for and on behalf of the County by its General Manager of the Transit Division and shall be in writing and executed by such duly authorized representative of each party.

16. Severability

16.1 If any provisions of this AGREEMENT are held invalid by a court of competent jurisdiction, the remainder of the AGREEMENT shall not be affected thereby if such remainder would then continue to serve the purposes and objectives originally contemplated by the parties

IN WITNESS WHEREOF, the parties hereto have executed this AGREEMENT on the date affixed to their signatures.

City of Seattle
By

Grace Crunican, Director of Transportation — Date: 5/15/6
City of Seattle

Approved as to Form
By

John Groh, Attorney, Contracts Section, — Date: 5-8-06
City of Seattle Law Department

King County
By

Kevin Desmond, General Manager — Date: 5/18/06
King County Metro Transit

Approved as to Form
By

Scott Johnson — Date: 5-18-06
King County Prosecuting Attorney

KING COUNTY METRO SPEED AND RELIABILITY PARTNERSHIP
SAMPLE INTERGOVERNMENTAL AGREEMENT

TRANSIT SERVICE SPEED AND RELIABILITY PARTNERSHIP AGREEMENT
BY AND BETWEEN
KING COUNTY
AND
XXX (SERVICE PARTNER)

THIS TRANSIT SERVICE SPEED AND RELIABILITY PARTNERSHIP AGREEMENT (the "Agreement") is made by and between King County, a political subdivision of the State of Washington and home rule charter county with broad powers to provide public transportation within the County's geographic boundaries, by and through the King County Department of Transportation, Metro Transit Division, (the "County" or "Metro Transit") and [*insert name and description of contracting entity; e.g., the City of XXX, a Washington municipal corporation (the "City" and/*or "Service Partner")], both of which entities may be referred to hereinafter individually as "Party" or collectively as the "Parties."

WHEREAS, in September, 2006 the King County Council adopted Ordinance 15582, the Transit Now Ordinance, directing the submission of a proposition to King County voters to fix and impose an additional sales and use tax of one-tenth of one percent to fund expansion of the King County Metro public transportation system and a variety of transit service improvements; and

WHEREAS, the Transit Now ordinance identified a number of transit service measures to be implemented using the one-tenth of one percent sales and use tax collected through Transit Now that focus on capital, operating, and maintenance improvements that are expected to expand and improve bus service on local streets and arterials within King County; and

WHEREAS, mutually beneficial contractual arrangements with other public and private entities ("Service Partnerships") that leverage public and private funds to provide both new and better bus service to cities and major employers is one of four key strategies (the "Service Partnership Program") identified in the Transit Now proposition approved by King County voters in the general election on November 7, 2006; and

WHEREAS, the Service Partnerships Program is also designed and intended to support the service development objectives and financial strategies of the 2002-2007 Six-Year Transit Development Plan (or its successor plans); and

WHEREAS, Service Partner has submitted an application for a Speed and Reliability partnership and has met the criteria established by the County for awarding such partnerships; and

WHEREAS, the proposal submitted by Service Partner has been projected to meet or exceed the required performance requirements; and

WHEREAS, the proposal submitted by Service Partner has been approved by the King County Council,

NOW, THEREFORE, IN CONSIDERATION OF THE MUTUAL PROMISES, COVENANTS AND AGREEMENTS SET FORTH HEREIN, AND FOR OTHER GOOD AND VALUABLE CONSIDERATION, THE RECEIPT AND SUFFICIENCY OF WHICH ARE HEREBY ACKNOWLEDGED BY BOTH PARTIES, THE PARTIES AGREE AS FOLLOWS:

1. PURPOSE OF AGREEMENT

The purpose of this Agreement is to enter into a mutually beneficial contractual relationship for enhanced and improved transit services consistent with the goals and directives of the Transit Now ordinance and initiative as authorized by King County Council Ordinance 15582 (approved in September, 2006) and passed by the voters of King County as Transit Now in the general election on November 7, 2006. The primary goal of Transit Speed and Reliability Partnerships, including this Agreement, is to encourage local jurisdictions to develop, implement and sustain traffic improvements that improve transit speeds by at least ten percent (10%) for routes operating on arterial core service connections, as identified in Metro Transit's 2002-2007 Six-Year Transit Development Plan. In exchange for implementing improvements that are projected to achieve a 10% or greater improvement in transit speed on an eligible core service connection, the Service Partner and Metro will work together to agree on where 5,000 additional annual service hours will be dedicated to benefit Service Partner's jurisdiction, either on a core connection or elsewhere.

This Agreement establishes the responsibilities of both Parties in relation to this transit service partnership, including methods for monitoring, improving and terminating the Service Partnership.

2. COUNTY'S RESPONSIBILITIES

2.1 In exchange for Service Partner's investment in certain transit speed and reliability improvements as described with particularity in Attachment A, which is attached hereto and incorporated into this Agreement by this reference, the County will reserve an additional _______ annual service hours of bus service. Service Partner will be eligible to receive these reserved bus service hours when all of the required actions or projects specified in Attachment A have been implemented. Once this service is implemented and continues to perform well, Metro will continue this service as long as the traffic improvements implemented by Service Partner remain in place.

The County will operate the enhanced transit service provided for herein in accordance with its regular procedures. Service Partner understands and agrees that the transit service referenced herein is and will continue to be open to the general public.

2.2 The County will include the new transit service enhancements provided for under this Agreement in its annual route performance monitoring. Enhanced transit service provided for via Service Partnerships will be expected to perform at or above the subarea average for its particular type of service in at least three of the four standard indicators monitored in Metro's annual *Route Performance Report*:

a) Rides per revenue hour;
b) The ratio of fare revenue to operating expense;
c) Passenger miles per revenue hour; and
d) Passenger miles divided by platform miles.

2.3 The specific benchmarks applicable to the enhanced transit service provided for herein are set forth in Attachment A. Three (3) years after implementation of the enhanced transit service provided for herein and annually thereafter, the County will make a determination as to the productivity and viability of the service. The County will notify Service Partner of its assessment of the service's productivity, performance, and ongoing viability. If the County deems that changes can be made to improve the service, the County and Service Partner will discuss possible modifications and may agree on any decisions to modify the service enhancements provided for herein; provided, however, that any such modifications shall be consistent with the requirements set forth in KCC 28.94.020(B)(2). After consultation with Service Partner, if the County determines that the enhanced service provided for herein is not viable based upon performance, and proposed changes are insufficient to boost productivity beyond a minimum threshold as may be established and the Parties cannot agree on a substitute investment on a different route or a different corridor, then the County will notify Service Partner of its intention to terminate the Agreement.

2.4 The County, in cooperation with Service Partner, will monitor transit performance on core routes that are targeted for speed and reliability improvements, starting with the execution of this Agreement and extending for a minimum of five (5) years after all of the improvements described in Attachment A have been completed. The County will also, for the duration of the Agreement, monitor the improvements completed by Service Partner to ensure they are still in place.

2.5 The Parties have made their best faith effort to develop a list of actions and projects that they believe will achieve a ten percent (10%) or greater core route performance improvement. However, if the actual improvement in transit speed is less than ten percent after implementation, the County will continue to supply the agreed upon service hours as part of the ongoing system as long as the Service Partner maintains the agreed upon physical improvements and makes ongoing traffic operations decisions throughout the core connection, consistent with the intent of Attachment A, and in a manner that maintains the travel time advantage for transit; provided, however, that the County reserves the right to exercise the option of terminating the service pursuant to Section 2 of this Agreement.

3. SERVICE PARTNER'S RESPONSIBILITIES

3.1 Service Partner agrees to undertake the set of actions and projects identified with particularity in Attachment A; namely, certain capital projects and/or implementation of traffic operations changes, and has established a completion date of______(date.) In any case, all of the actions and projects must be completed no later than five (5) years from the execution of this Agreement. Service Partner will provide official notice to the County in writing when its projects have been completed. The County will then have 30 days to inspect the work and determine if the requirements set forth in Exhibit A have been satisfied.

3.2. Once implemented, Service Partner agrees to sustain the agreed upon physical improvements and make ongoing traffic operations decisions throughout the core connection, consistent with the intent of Attachment A, and in a manner that maintains the travel time advantage for transit.

3.3 Any substantive modifications or changes to the required activities and improvements set forth in Attachment A, as deemed by either the Service Partner or the County, must be jointly approved in writing in advance by the Parties.

4. TERM OF AGREEMENT

4.1 This Agreement shall commence upon signing by both Parties and shall continue unless terminated pursuant to the terms of this Agreement, as provided in Section 8; provided, however, that Service Partner must complete the agreed upon traffic improvements within five (5) years in order to receive the reserved service hours from the County and, provided further, that if such improvements are not satisfactorily completed within five years of the execution date of this Agreement, this Agreement may be terminated by the County.

4.2 This Agreement is subject to review and approval by the King County Council.

5. INDEMNIFICATION AND LEGAL RELATIONS

5.1 It is understood and agreed that this Agreement is solely for the benefit of the Parties hereto and gives no right to any other person or entity. No joint venture or partnership is formed as a result of this Agreement. No employees or agents of one Party or its contractors or subcontractors shall be deemed, or represent themselves to be, employees, agents, contractors or subcontractors of the other Party.

5.2 Each Party shall comply, and shall ensure that its contractors and subcontractors, if any, comply with all federal, state and local laws, regulations, and ordinances applicable to the work and services to be performed under this Agreement.

5.3 Each Party shall protect, defend, indemnify and save harmless the other Party, its elected officials, officers, officials, employees and agents while acting within the scope of their employment as such, from any and all costs, claims, judgments, and/or awards of damages, arising out of or in any way resulting from each Party's own negligent acts or omissions. Each Party agrees that it is fully responsible for the acts and omissions of its own subcontractors, their employees and agents, acting within the scope of their employment as such, as it is for the acts and omissions of its own employees and agents. Each Party agrees that its obligations under this provision extend to any claim, demand, and/or cause of action brought by or on behalf of any of its employees or agents. The foregoing indemnity is specifically and expressly intended to constitute a waiver of each Party's immunity under Washington's Industrial Insurance Act, RCW Title 51, as respects the other Party only, and only to the extent necessary to provide the indemnified Party with a full and complete indemnity of claims made by the indemnitor's employees. The Parties acknowledge that these provisions were specifically negotiated and agreed upon by them.

5.4 Each Party's rights and remedies in this Agreement are in addition to any other rights and remedies provided by law.

5.5 This Agreement shall be interpreted in accordance with the laws of the State of Washington. The Superior Court of King County, Washington, located in Seattle, Washington, shall have exclusive jurisdiction and venue over any legal action arising under this Agreement.

5.6 The provisions of this Section shall survive any termination of this Agreement.

6. CHANGES AND MODIFICATIONS

This Agreement may be amended or modified only by prior written agreement signed by the Parties hereto.

7. TERMINATION OF AGREEMENT

7.1 Either Party may terminate this Agreement, in whole or in part, in writing, if the other Party substantially fails to fulfill any or all of its obligations under this Agreement through no fault of the other, including, but not limited to, Service Partner's failure to satisfactorily complete the traffic improvement requirements set forth in Attachment A within five (5) years of the execution date of this Agreement; provided, however, that, insofar as practicable, the Party terminating the Agreement will give notice of its intent to terminate not less than 135 calendar days prior to the County's February, June or September service change, delivered by certified mail, return receipt requested.

7.2 Within the first five (5) years of the Agreement and prior to implementation of the service improvements outlined in Attachment A, if the Service Partner determines that it will be unable to implement all of the improvements specified in Attachment A, it will provide written notice of this to the County. The Parties will then have 90 calendar days to attempt to reach agreement upon a set of alternative improvements. If the Parties cannot agree upon an alternative set of improvements, at the end of the 90 day period, the County shall provide Service Partner notice of its intent to terminate. The County will provide such notice in writing by certified mail, return receipt requested.

7.3 The County may terminate this Agreement pursuant to the provisions of Section 2.0 of this Agreement, in whole or in part; provided that Service Partner will be given notice of the County's intent to terminate not less than 135 calendar days prior to the County's February, June or September service change, delivered by certified mail, return receipt requested.

8. FORCE MAJEURE

Either Party shall be excused from performing its obligations under this Agreement during the time and to the extent that it is prevented from performing by a cause beyond its control, including, but not limited to: any incidence of fire, flood, earthquake or acts of nature; strikes or labor actions commandeering material, products, or facilities by the federal, state or local government; and/or national fuel shortage, when satisfactory evidence of such cause is presented to the other Party, and provided further that such non-performance is beyond the control and is not due to the fault or negligence of the Party not performing. In no event should this provision eliminate the need to make any required payment to the County to the extent any such payment is required pursuant to this Agreement.

9. WAIVER OF DEFAULT

Waiver of any default shall not be deemed to be a waiver of any subsequent default. Waiver of breach of any provision of this Agreement shall not be deemed to be a waiver of any other or subsequent breach and shall not be construed to be a modification of the terms of this Agreement unless stated to be such in writing, signed by authorized Parties and attached to the original Agreement.

10. ASSIGNMENT

This Agreement shall be binding upon the Parties, their successors and permitted assigns; provided, however, that neither Party shall assign any portion of this Agreement without the other's prior written consent.

11. NO THIRD PARTY BENEFICIARIES

Nothing in this Agreement, express or implied, is intended to confer on any person or entity other than the Parties hereto and their respective successors and assigns any rights or remedies under or by virtue of this Agreement.

12. MUTUAL NEGOTIATION AND CONSTRUCTION

This Agreement, and each of the terms and provisions hereof, shall be deemed to have been explicitly negotiated between, and mutually drafted by, both Parties, and the language in all parts of this Agreement shall, in all cases, be construed according to its fair meaning and not strictly for or against either Party.

13. ALL TERMS AND CONDITIONS

This Agreement merges and supersedes all prior negotiations, representations and agreements between the Parties related to the subject matter hereof and constitutes the entire Agreement between the Parties.

This Agreement contains all the terms and conditions agreed upon by the Parties. No other understandings, oral or otherwise, regarding the subject matter of this Agreement shall be deemed to exist or to bind any of the Parties hereto.

14. CONTACT PERSONS

The County and Service Partner shall designate a contact person for purposes of sending inquiries and notices regarding the execution and fulfillment of this Agreement.

	Service Partner
Contact Name	
Title	
Address	
Telephone	
Fax	
E-Mail	

	King County
Contact Name	
Title	
Address	
Telephone	
Fax	
E-Mail	

IN WITNESS WHEREOF the Parties hereto have executed this Agreement on the ______ day of ___________________, 2007.

KING COUNTY	**SERVICE PARTNER**
By: ________________________________	By: __________________________
Title: ________________________________	Title: ________________________
Date: ________________________________	Date: ________________________

ATTACHMENT A
Speed and Reliability Partnership Scope of Work

A. <u>Transit Speed Improvement Measures to be Undertaken by Service Partner</u>

1. Service Partner agrees to make, at a minimum, the following capital investments and/or traffic operations changes to create a projected transit speed and reliability benefit of ___% along ______ the core connection on ________ between ________ and __________, in support of the eligible core route #_____.

   List/describe the improvements in detail with graphics/drawings, as required.

B. <u>Additional Supporting Actions to be Undertaken by Service Partner</u>

1. Service Partner further agrees to implement the following supporting actions:

   As described in the evaluation criteria for Speed and Reliability Partnerships, complementary actions can include any or all of the following:
   - *Instituting innovative transit signal phasing or timing strategies;*
   - *Providing infrastructure, preferably fiber, required to support communication between transit signal priority equipment in the field and from the field back to the Service Partner and to Metro Transit;*
   - *Adding curb space for transit terminal or layover;*
   - *Establishing parking management to increase the attractiveness of ridesharing;*
   - *Implementing pass subsidy and promotional programs to achieve higher ridership;*
   - *Taking other actions that improve the pedestrian environment.*

   [list/describe the supporting actions the Service Partner has agreed to undertake]

C. <u>Timing for Service Investment</u>

If Service Partner completes the required traffic speed improvement measures set forth in Section A above, by the completion date of ____x date, as outlined in Section 3.1 of this Agreement, the County will program the service described in Section 2.1,to begin with the _____, 20__ service change.

If this completion date is not met, Service Partner must complete the required set of actions no later than five (5) years from the execution of this Agreement in order to retain eligibility for enhanced transit service under this Service Partnership. However, if the original completion date is changed, the time frame for initiating the enhanced transit service will have to be renegotiated with the County once a revised completion date is established.

D. <u>Service Description</u>

<u>This section will include a description of the agreed upon service; the specificity of this description is expected to vary by agreement. The level of detail will be impacted by the amount of time that is projected between executing this Agreement and qualifying for the additional service investment. If the service description must remain fairly general at the time this Agreement is executed, the Parties will be able to ratify a more detailed service understanding through a letter of agreement, as a planned addendum that can be administratively ratified</u>

E. <u>Benchmarks for Evaluating Service Performance</u>

Metro Transit has a consistent, formal route performance evaluation process to identify individual routes that may require modification, expansion or termination. Routes are grouped by sub-area and time period for similarity in operating conditions. Each Service Partnership route will be compared by time period to other routes in its sub-area to ascertain performance level. Data for a particular year is typically available by the middle of the following year. The comparison will be made at the time the data is available.

A group of routes will have both “strong” and “below minimum” performance routes, as defined by thresholds based on the average performance of the group. Routes at the extremes of performance are considered for changes. Routes with “strong performance” are considered for expansion; “below minimum performance” routes are evaluated for changes to improve performance, or for discontinuation if performance does not improve after changes are tried.

The specific benchmarks for service additions applicable to this Agreement will be selected so as to be appropriate for the type of service that is being provided, the sub-area in which its operates, and the time of day it is offered. These will be finalized at the time that the service additions are agreed upon by the Parties.

COMMUNITY TRANSIT/SNOHOMISH COUNTY INTERGOVERNMENTAL AGREEMENT ON TSP DEVELOPMENT

Misc. Contracts & Agreements
No. 17,221

LOCAL AGENCY AGREEMENT
HIGH PRIORITY PROJECT
Signal Priority Project

THIS AGREEMENT is made and entered into by and between THE STATE OF OREGON, acting by and through its Department of Transportation, hereinafter referred to as "State"; CITY OF PORTLAND, hereinafter referred to as "Agency"; and TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT OF OREGON, hereinafter referred to as "Tri-Met".

RECITALS

1. By the authority granted in ORS 190.110, 366.770, and 366.775, State may enter into cooperative agreements with the counties, cities, and units of local government for the performance of work on certain types of improvement projects with the allocation of costs on terms and conditions mutually agreeable to the contracting parties.

NOW THEREFORE, the premises being in general as stated in the foregoing recitals, it is agreed by and between the parties hereto as follows:

TERMS OF AGREEMENT

1. Under the provisions of this agreement, including all attachments, Agency and Tri-Met plan and propose to equip all transit vehicles in Portland with signal priority emitters, install signal priority receiver units on key arterials, and upgrade traffic signal control equipment to support priority equipment, hereinafter referred to as "project". The initial proposed locations, as chosen by the Technical Advisory Committee (TAC, made up of representatives from the State, City of Portland and Tri-Met) included in this project are as follows:

SW Macadam Blvd. (Ross Island Br. To Sellwood Br.)
SW Barbur Blvd. (4th/Sheridan to South City Limits)
SW Beaverton-Hillsdale Hwy. (Capitol to West City Limits)
SE Hawthorne (Willamette River to 50th)
SE Division St. (7th to East City Limits)
SE Powell/Foster (Willamette River to I-205)
SE/NE Grand/MLK (Clay to Columbia)
NE Sandy (Grand to I-205)

This is a preliminary list that is subject to changes by the TAC.

Key #'s 11062 & 11063

2. Tri-Met's pro-rata share of the total project cost is estimated to be $300,000. Tri-Met guarantees the availability of Tri-Met funding in an amount required to fully fund Tri-Met's pro-rata share of their portion of the project plus any of their portion not covered by federal funding.

Agency's pro-rata share of the total project cost is estimated to be $740,300. Agency guarantees the availability of Agency funding in an amount required to fully fund Agency's pro-rata share of their portion of the project plus any portion of the project not covered by federal funding.

Agency and Tri-Met guarantee that adequate funds are or will be available prior to advertisement for bids to accommodate 110 percent of the engineer's estimate. If Agency determines that sufficient Agency funding, appropriation, limitation or other expenditure authority is not available, Agency may in writing delay work prior to State programming the preliminary engineering or right of way with the Federal Highway Administration, pending amendment of this agreement by the parties to delete or modify work, or pending mutual termination of this agreement by the parties. Agency may, for the same reasons, also request delay of work prior to advertisement of bids for the construction portion of the project, but if agreement cannot be reached on modification or deletion of the work, Agency must reimburse State for any funds received prior to such notice. State shall not unreasonably deny any request by Agency to modify or delete work after Agency's good faith determination that it has insufficient funds to undertake the original scope of work. Moreover, Agency shall only be liable for reimbursement of specific, identified funds to State in such situations where State is legally responsible because of Agency's actions, to reimburse those same funds to the Federal Provider pursuant to any contract, grant or award. Nor shall Agency be liable for interest or other costs in any refund situation absent the express imposition of such costs by the Federal Provider against State.

3. The project shall be conducted as a part of the Transportation Equity Act for the 21st Century (TEA-21), Subtitle F, Section 117, High Priority Projects. The total project cost is estimated at $4,500,000 as described in the chart below. The Federal Funds are limited to $4,000,770, subject to annual obligation authority imposed by the appropriations bill. $1,200,000 (fixed amount) will go directly to Tri-Met through FTA for the installation of emitters on all Tri-Met buses. Tri-Met shall be responsible for the match for its portion of the federal funds. The remaining funds, at approximately $2,800,770 (subject to annual limitation) will, when available, go to Agency for use on the remaining portions of the project. The Federal pro-rata share funding on this project is 80 percent. Agency shall be responsible for the match for its portion of the federal funds and any portion of the project not covered by federal funding. No State Gas Tax Funds allocated to ODOT shall be used on this project. The estimate for the total project cost is subject to change.

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ITS
KEY #S 11082 & 11083
($4.5 Million Fed $ over 6 yrs)

YEAR	TOTAL FED $ FOR PROJECT	YEAR'S % ALLOCATION	TOTAL FED $ FOR YEAR	CUMULATIVE TOTALS	ANTICIPATED LIMITATION FOR THE YEAR	TOTAL FED $ FOR YEAR W/ LIMITATION	CUMULATIVE TOTALS	20% MATCH	TOTAL DOLLARS
1998	$ 4,500,000	11%	$ 495,000	$ 495,000	** 89.1%	$ 441,045	$ 441,045	$ 110,261	$ 551,306
1999	$ 4,500,000	15%	$ 675,000	$ 1,170,000	** 88.3%	$ 596,025	$ 1,037,070	$ 149,006	$ 745,031
2000	$ 4,500,000	18%	$ 810,000	$ 1,980,000	** 87.1%	$ 705,510	$ 1,742,580	$ 176,378	$ 881,888
2001	$ 4,500,000	18%	$ 810,000	$ 2,790,000	89.0%	$ 720,900	$ 2,483,400	$ 180,225	$ 901,125
2002	$ 4,500,000	19%	$ 855,000	$ 3,645,000	89.0%	$ 760,950	$ 3,224,430	$ 190,238	$ 951,188
2003	$ 4,500,000	19%	$ 855,000	$ 4,500,000	89.0%	$ 760,950	$ 3,985,380	$ 190,238	$ 951,188
TOTALS		100%	$ 4,500,000			$ 3,985,380		$ 996,345	$ 4,981,725

** ACTUAL/CONFIRMED LIMITATION FOR THE YEAR
SHADED AREAS INDICATE UNCONFIRMED PROJECTIONS FOR FEDERAL DOLLARS WITH LIMITATION

4. The work is to begin on the date all required signatures are obtained. Funding for the project must be obligated no later than September 30, 2003 and construction shall be completed no later than December 31, 2005, on which date this agreement automatically terminates unless extended by a fully executed amendment.

5. This agreement may be terminated by mutual written consent of all parties.

State may terminate this agreement effective upon delivery of written notice to Agency and Tri-Met, or at such later date as may be established by State, under any of the following conditions:

a. If Agency or Tri-Met fail to provide services called for by this agreement within the time specified herein or any extension thereof.

b. If Agency or Tri-Met fail to perform any of the other provisions of this agreement, or so fails to pursue the work as to endanger performance of this agreement in accordance with its terms, and after receipt of written notice from State fails to correct such failures within 10 days or such longer period as State may authorize.

c. If Agency or Tri-Met fail to provide payment of its share of the cost of the project.

d. If State fails to receive funding, appropriations, limitations or other expenditure authority at levels sufficient to pay for the work provided in the agreement.

e. If Federal or state laws, regulations or guidelines are modified or interpreted in such a way that either the work under this agreement is prohibited or State is prohibited from paying for such work from the planned funding source.

Any termination of this agreement shall not prejudice any rights or obligations accrued to the parties prior to termination.

6. The Special and Standard Provisions attached hereto, marked Attachments 1 and 2, respectively, are by this reference made a part hereof. The Standard Provisions apply to all federal-aid projects and may be modified only by the Special Provisions. All references to "Agency" in Attachment No. 2 are deemed to refer to both Agency (City of Portland) and Tri-Met. The parties hereto mutually agree to the terms and conditions set forth in Attachments 1 and 2. In the event of a conflict, this agreement shall control over the attachments, and Attachment 1 shall control over Attachment 2.

7. Agency and Tri-Met, as recipients of grant funds, pursuant to this agreement with the State, shall each assume sole liability for their respective breaches of the conditions of the grant, and shall each, upon breach of grant conditions that requires the State to return funds to the Federal Highway Administration, the grantor, hold harmless and indemnify the State for an amount equal to the funds each received under this agreement; or if legal limitations apply to the indemnification ability of Agency and Tri-Met, the indemnification amount shall be the maximum amount of funds available for expenditure, including any available contingency funds or other available non-appropriated funds, up to the amount each received under this agreement.

8. Agency certifies that it entered into and executed this agreement during a duly authorized session of its City Officials.

9. Tri-Met certifies that it entered into and executed this agreement during a duly authorized session of its Board of Directors.

10. This agreement and attached exhibits constitute the entire agreement between the parties on the subject matter hereof. There are no understandings, agreements, or representations, oral or written, not specified herein regarding this agreement. No waiver, consent, modification or change of terms of this agreement shall bind either party unless in writing and signed by both parties and all necessary approvals have been obtained. Such waiver, consent, modification or change, if made, shall be effective only in the specific instance and for the specific purpose given. The failure of State to enforce any provision of this agreement shall not constitute a waiver by State of that or any other provision.

IN WITNESS WHEREOF, the parties hereto have set their hands and affixed their seals as of the day and year hereinafter written.

M C & A No. 17,221
CITY OF PORTLAND

Pursuant to Subdelegation Order 5 dated December 17, 1997, the Region Manager approved on March 10, 1999 adding this project as an amendment to the 1998 -2001 Statewide Transportation Improvement Program.

The Oregon Transportation Commission on October 13, 1999, approved this project as a part of the 2000 – 2003 Statewide Transportation Improvement Program, Key No.'s 11062 and 11063.

The Oregon Transportation Commission on March 18, 1999, approved Subdelegation Order No. 2 in which the Director grants authority to the Executive Deputy Director/Chief Engineer to approve and execute agreements over $75,000 when the work is related to a project included in the Statewide Transportation Improvement Program.

APPROVAL RECOMMENDED

By ______________________
Region 1 Manager

APPROVED AS TO
LEGAL SUFFICIENCY

By ______________________
Assistant Attorney General

Date 9/5/00

APPROVED AS TO
LEGAL SUFFICIENCY
APPROVED AS TO FORM

By ______________________
City Attorney
CITY ATTORNEY

Date 8/17/00

APPROVED AS TO
LEGAL SUFFICIENCY

By ______________________
Tri-Met Attorney

STATE OF OREGON, by and through its Department of Transportation

By ______________________ For Tom Lulay
Executive Deputy Director/Chief Engineer

Date 9/6/00

CITY OF PORTLAND, By and through its Elected Officials

By Vera Katz
Mayor

By Gary Blackmer by PR
Auditor

Date 8/29/00

TRI-MET

By ______________________ McFarlane
for General Manager

Date 8/11/00

ATTACHMENT NO. 1 TO AGREEMENT #17,221
SPECIAL PROVISIONS

1 Agency and Tri-Met or consultant, shall conduct the necessary preliminary engineering and design work required to produce final plans, specifications and cost estimates; purchase all necessary right-of-way; obtain all required permits; arrange for all utility relocations or reconstruction; perform all construction engineering, including all required materials testing and quality documentation; and prepare necessary documentation to allow State to make all contractor payments.

2. Tri-Met shall be totally responsible for the installation of the emitters on all Tri-Met buses.

3. Agency and Tri-Met shall, at their own expense, maintain and operate their portion of the project upon completion at a minimum level that is consistent with normal depreciation and/or service demand.

4. Agency and Tri-Met shall maintain and account for the federal and/or state financial interest in project property and assets.

5. Agency understands that the federal funding is allocated over a six-year period. If Agency wishes to construct the project prior to the sixth year, which is Federal Fiscal Year 2003, Agency must deposit sufficient funds to State to cover all project costs in excess of currently available federal funds. As federal funds become available, Agency will be reimbursed that portion of the advance deposit. These funds must be deposited per paragraph 23 of the Standard Provisions.

6. Maintenance and power responsibilities shall survive any termination of this agreement.

STANDARD PROVISIONS are included in this agreement but not scanned. If you need a copy of them, please contact Program and Funding Services, 731-8277

ORDINANCE NO. 174771

*Amend the Local Agency Agreement between the City, State of Oregon and Tri-Met for work related to signal priority project. (Ordinance)

The City of Portland ordains:

Section 1. The Council finds:

1. The Council adopted Ordinance No. 174566 on June 21, 2000, which authorized the City to enter into a cooperative agreement with ODOT and Tri-Met for the performance of work on TEA-21 Transit Signal Priority Project.

2. ODOT Legal Council has recommended removal of paragraph 5 of that agreement to be replaced with the following language:

   "If Agency determines that sufficient Agency funding, appropriation, limitation or other expenditure authority is not available, Agency may in writing delay work prior to State programming the preliminary engineering or right of way with the Federal Highway Administration, pending amendment of this agreement by the parties to delete or modify work, or pending mutual termination of this agreement by the parties. Agency may, for the same reasons, also request delay of work prior to advertisement of bids for the construction portion of the project, but if agreement cannot be reached on modification or deletion of the work, Agency must reimburse ODOT for any funds received prior to such notice. ODOT shall not unreasonably deny any request by Agency to modify or delete work after Agency's good faith determination that it has insufficient funds to undertake the original scope of work. Moreover, Agency shall only be liable for reimbursement of specific, identified funds to ODOT in such situations where ODOT is legally responsible because of Agency's actions, to reimburse those same funds to the Federal Provider pursuant to any contract, grant or award. Nor shall Agency be liable for interest or other costs in any refund situation absent the express imposition of such costs by the Federal Provider against ODOT."

3. The City Attorney's Office has reviewed and approved this amendment. receiver units on key arterials and upgrade traffic signal control equipment to support priority equipment; and

NOW THEREFORE, the Council directs:

a. The Commissioner of Public Safety and the Auditor are authorized to amend the Local Agency Agreement with the State of Oregon, and Tri-Met, substantially in accordance with the Agreement attached as Exhibit 'A' to the original of this ordinance, and by reference made a part hereof.

Section 2. The Council declares that an emergency exists because delay in executing these agreements would delay the related economic and safety benefits to be derived from completion of these projects; therefore, this ordinance shall be in full force and effect from and after its passage by the Council.

Passed by the Council,
AUG 23 2000

Commissioner Charlie Hales
Janice Newton:slg
August 16, 2000

GARY BLACKMER
AUDITOR OF THE CITY OF PORTLAND

BY [signature]
DEPUTY

Misc. Contracts & Agreements
No. 17,221

AMENDMENT No. 1
HIGH PRIORITY PROJECT
Signal Priority Project

The State of Oregon, acting by and through its Department of Transportation, hereinafter referred to as State, the City of Portland, hereinafter referred to as Agency, and Tri-County Metropolitan Transportation District of Oregon, hereinafter referred to as "Tri-Met", entered into entered into Local Agency Agreement No.17,221 on September 6, 2000. Said agreement covers equipping all transit vehicles in Portland with signal priority emitters, installing signal priority receiver units on key arterials, and upgrading traffic signal control equipment to support priority equipment, hereinafter referred to as "Project."

It has now been determined by State, Agency, and Tri-Met that the agreement referenced above, although remaining in full force and effect, shall be amended by this agreement to increase the amount of funding going directly to Tri-Met and decrease the amount of funding going to the Agency. Therefore the above mentioned agreement shall be amended as follows:

Terms of Agreement, Page 2, paragraph 3, which reads:

"3. The project shall be conducted as a part of the Transportation Equity Act for the 21st Century (TEA-21), Subtitle F, Section 117, High Priority Projects. The total project cost is estimated at $4,500,000 as described in the chart below. The Federal Funds are limited to $4,000,770, subject to annual obligation authority imposed by the appropriations bill. $1,200,000 (fixed amount) will go directly to Tri-Met through FTA for the installation of emitters on all Tri-Met buses. Tri-Met shall be responsible for the match for its portion of the federal funds. The remaining funds, at approximately $2,800,770 (subject to annual limitation) will, when available, go to Agency for use on the remaining portions of the project. The Federal pro-rata share funding on this project is 80 percent. Agency shall be responsible for the match for its portion of the federal funds and any portion of the project not covered by federal funding. No State Gas Tax Funds allocated to ODOT shall be used on this project. The estimate for the total project cost is subject to change."

Key #'s 11062, 11063 & 12458

M C & A No. 17,221
CITY OF PORTLAND & TRI-MET

Shall be amended to read:

"3. The project shall be conducted as a part of the Transportation Equity Act for the 21st Century (TEA-21), Subtitle F, Section 117, High Priority Projects. The total project cost is estimated at $4,500,000 as described in the chart below. The Federal Funds are limited to $4,000,770, subject to annual obligation authority imposed by the appropriations bill. $1,200,000 (fixed amount) will go directly to Tri-Met through FTA for the installation of emitters on all Tri-Met buses. Tri-Met shall only be responsible for providing the matching funds for the $1,200,000 federal funds. An additional $320,000 federal funds from Agency's share, shall go directly to Tri-Met for a total of $1,520,000. Agency will provide Tri-Met the $80,000 match for the $320,000 moved from Agency's share of the federal funds. The remaining funds, approximately $2,480,770 (subject to annual limitation) will, when available, go to Agency for use on their portions of the project. The Federal pro-rata share funding on this project is 80 percent. Agency shall be responsible for the match for its portion of the federal funds; the match on the $320,000 going to Tri-Met; and any portion of the project not covered by federal funding. No State Gas Tax Funds allocated to ODOT shall be used on this project. The estimate for the total project cost is subject to change."

Page 4, Paragraph 7 of Terms of Agreement which reads:

"7. Agency and Tri-Met, as recipients of grant funds, pursuant to this agreement with the State, shall each assume sole liability for their respective breaches of the conditions of the grant, and shall each, upon breach of grant conditions that requires the State to return funds to the Federal Highway Administration, the grantor, hold harmless and indemnify the State for an amount equal to the funds each received under this agreement; or if legal limitations apply to the indemnification ability of Agency and Tri-Met, the indemnification amount shall be the maximum amount of funds available for expenditure, including any available contingency funds or other available non-appropriated funds, up to the amount each received under this agreement."

Shall be amended to read:

"6. Agency, as a recipient of federal funds, pursuant to this agreement with the State, shall assume sole liability for Agency's breach of any federal statutes, rules, program requirements and grant provisions applicable to the federal funds, and shall, upon Agency's breach of any such conditions that requires the State to return funds to the Federal Highway Administration, hold harmless and indemnify the State for an amount equal to the funds received under this agreement; or if legal limitations apply to the indemnification ability of Agency, the indemnification amount shall be the maximum amount of funds available for expenditure, including any available contingency funds or other available non-appropriated funds, up to the amount received under this agreement."

M C & A No. 17,221
CITY OF PORTLAND & TRI-MET

IN WITNESS WHEREOF, the parties hereto have set their hands and affixed their seals as of the day and year hereinafter written.

The Oregon Transportation Commission on October 13, 1999, approved Unit 1 of this project as a part of the 2000 – 2003 Statewide Transportation Improvement Program, Key No.'s 11062 and 11063.

This project is in the 2002-2005 Statewide Transportation Improvement Program that was approved by the Oregon Transportation Commission on February 13, 2002. Page 19, Key #12458.

The Oregon Transportation Commission on January 16, 2002, approved Delegation Order No. 2, which authorizes the Director to approve and execute agreements for day-to-day operations when the work is related to a project included in the Statewide Transportation Improvement Program or a line item in the biennial budget approved by the Commission.

On January 31, 2002, the Director of the Oregon Department of Transportation approved Subdelegation Order No. 2, in which the Director delegates authority to the Executive Deputy Director for Highways, to approve and execute agreements over $75,000 when the work is related to a project included in the Statewide Transportation Improvement Program.

M C & A No. 17,221
CITY OF PORTLAND & TRI-MET

APPROVAL RECOMMENDED

By Kay Van Sickel
Region 1 Manager

Date 1-23-03

By Thomas A. Lauer for
Tech Services Mgr/Chief Engr

Date 3/25/03

STATE OF OREGON, by and through its Department of Transportation

By John E. Rosenberger
Executive Deputy Director for Highways

Date 3-26-03

APPROVED AS TO LEGAL SUFFICIENCY

By Dale K. Hormann
Assistant Attorney General

Date 3/20/03

TRI-MET

By Fred Hansen
General Manager

Date

APPROVED AS TO LEGAL SUFFICIENCY

By
Tri-Met Attorney

Date 3/12/03

CITY OF PORTLAND, By and through its Elected Officials

By Vera Katz
Mayor

By Gary Blackmer
~~Recorder~~ AUDITOR

Date 3/7/03

APPROVED AS TO LEGAL SUFFICIENCY

APPROVED AS TO FORM

By Jeffrey A. Rogers
~~Deputy Attorney~~ CITY ATTORNEY

Date 1/29/03

ORDINANCE No. 177291

* Amend agreement with Oregon Department of Transportation to install bus signal priority equipment at various intersections (Ordinance; amend Contract No. 51389)

The City of Portland ordains:

Section 1. The Council finds:

1. The City of Portland, in partnership with TriMet, is implementing the Streamline Program to improve selected bus routes in order to give Tri-Met bus riders faster, more convenient, comfortable and reliable services.

2. The City of Portland and TriMet have developed a range of traffic management and transit operations strategies to improve transit service, including Intelligent Transportation Systems (ITS) applications that provide priority for buses at traffic signals.

3. The City of Portland and Tri-Met have implemented Phase I of the project, which provided bus priority at nearly 250 signalized intersections in the City. The project included installation of Opticom detection devices and improved traffic signal controllers. The Opticom devices not only provide priority operation for buses, but also provide full emergency vehicle preemption for fire vehicles at signalized intersections.

4. Phase II of the project will install Opticom devices and improved traffic signal controllers at an additional 60 to 80 signalized intersections in the City of Portland.

5. The City of Portland has received $4 Million in federal TEA-21 transportation funds for the project. The 20% required local match has been provided by TriMet.

6. ODOT has prepared an amendment to the existing Intergovernmental Agreement that was used in Phase I.

NOW, THEREFORE, the Council directs:

a. The Mayor and the Auditor are hereby authorized to enter into an agreement amendment similar in form to the agreement attached to the original of this ordinance, and by this reference made a part hereof.

Section 2. The Council declares that an emergency exists because a delay in executing this agreement would delay the planning process and related safety benefits to be derived from completion of this project; therefore, this ordinance shall be in full force and effect from and after its passage by the Council.

Passed by the Council, MAR 05 2003

Commissioner Jim Francesconi
Bill Kloos
March 5, 2003
S:\TEA21 Bus Priority Ph 2\IGA ORDINANCE 20030219.doc

GARY BLACKMER
AUDITOR OF THE CITY OF PORTLAND
By Susan Parsons
Deputy

Oregon Revised Statutes 815. 445: Use of traffic control signal operating devices; usage and costs.

Title 59. Oregon Vehicle Code
Chapter 815. Vehicle Equipment Generally
Enacted 2003.

(1) The owner of a traffic control signal may authorize use of a traffic control signal operating device by the following persons for the following purposes:

(a) An authorized operator in an emergency vehicle, in order to improve the safety and efficiency of emergency response operations.

(b) An authorized operator in a bus, in order to interrupt the cycle of the traffic control signal in such a way as to keep the green light showing for longer than it otherwise would. As used in this paragraph, “bus” has the meaning given that term in ORS 184.675.

(c) An authorized operator in a traffic signal maintenance vehicle, in order to facilitate traffic signal maintenance activities.

(2) The owner of a traffic control signal who authorizes additional uses of a traffic control signal operating device, as authorized by this section, shall allocate the incremental costs, if any, of such additional uses to the additional users.

(3) A traffic control signal operating device used by an authorized person in an emergency vehicle shall preempt and override a device operated by any other person.

(4) A traffic control signal operating device used as authorized under this section must operate in such a way that the device does not continue to control the signal once the vehicle containing the device has arrived at the intersection, regardless of whether the vehicle remains at the intersection.

AFTER RECORDING RETURN TO:
Barbara Sikorski
Snohomish County Council
3000 Rockefeller Avenue MS 609
Everett, WA 98201

Parties: Community Transit and Snohomish County
Tax Account No.: Not Applicable
Legal Description: Not Applicable
Reference No. of Documents Affected: Not Applicable
Filed with the Auditor pursuant to RCW 39.34.040
Document Title: Agreement For Transit Signal Priority Maintenance

INTERLOCAL AGREEMENT BETWEEN SNOHOMISH COUNTY AND COMMUNITY TRANSIT CONCERNING THE MAINTENANCE AND OPERATION OF TRANSIT SIGNAL PRIORITY SYSTEMS

This **AGREEMENT** made and entered into this 8th day of February, 2005, by and between Community Transit, 7100 Hardeson Rd, Everett, Washington, 98203, hereinafter called "**CT**", and Snohomish County, 2930 Wetmore Ave. SE, Everett, Washington, 98201 hereafter the "**COUNTY**"; and

WHEREAS, Transit Signal Priority (TSP) systems provide priority passage to transit at signalized intersections with the objective of improving the on-time and overall performance of transit and maximizing the people moving capacity of intersections; and

WHEREAS, the **COUNTY** owns and operates certain traffic signal systems; and

WHEREAS, CT wishes to install Automatic Vehicle Identification (AVI) equipment that will connect to the **COUNTY** signal system for the purpose of implementing a Transit Signal Priority (TSP) system; and

WHEREAS, CT does not have an outside electronics crew; and

WHEREAS, it is the **COUNTY's** responsibility to operate and maintain the signal system within its respective jurisdiction and since there are possible impacts to the **COUNTY's** operational responsibilities and in assigning liability if **CT** were to have access to the traffic signal cabinets; and

WHEREAS, any modifications to signal system operations arising from implementation of TSP will be done in a manner that minimizes adverse effects to general purpose traffic including the avoidance of significant increases in vehicle delay, inordinate disruptions to flow, or degradation of level of service as compared to operation without TSP.

NOW THEREFORE, in accordance with RCW 47.28.140 and in consideration of the terms, conditions, covenants, and performance contained herein or attached hereto and made part of this Agreement, IT IS MUTUALLY AGREED AS FOLLOWS:

I. PURPOSE

1. The **COUNTY** agrees to perform maintenance and operation of **CT** owned TSP systems under the conditions outlined in this document.

2. The **COUNTY** Traffic Engineer and the **CT** Operations and Development Director are authorized to act on behalf of the **COUNTY** and **CT** respectively, and shall finalize working procedures associated with the conditions outlined in this document. **COUNTY** Traffic Engineer and the **CT** Operations and Development Director will jointly act as administrator for this Interlocal agreement. No separate legal or administrative entity is created under this agreement.

II. CT RESPONSIBILITIES

1. **CT** will be responsible for the full cost of replacement of the TSP System as a stand-alone system at the end of 10 years, unless the parties agree on a different term for the amortization of this equipment through a written contract AMENDMENT. However, if portions of the TSP System, particularly the TSP generator, is replaced or made redundant through an expansion of the capabilities of the **COUNTY**'s Traffic signal control system, then **CT** will not be responsible for the cost of those portions of the system or the traffic control system that replaced them.

2. If it becomes necessary to upgrade the TSP technology during the useful life of this system to address technological obsolescence of individual components, or to provide for upgrades as deemed necessary by **CT, CT** will pay for the cost of the replacement equipment or components and supply this equipment or components to the **COUNTY** for installation subject to the limits of RCW 36.77.065.

3. **CT** will retain ownership of all field hardware used for the TSP system. **CT** will maintain an inventory of spare parts for the TSP field equipment that the **COUNTY** requires for repairs. **CT** will pay the cost of replacement of any parts that the **COUNTY** uses out of this inventory. At **CT**'s option, replacement parts may be provided to the **COUNTY** for more immediate access.

4. **CT** will own, operate, maintain, and pay the full cost of the following:
   a) The TSP Management System, except for the TSP workstations that the **COUNTY** will use to access the system.

b) The cost of all phone drop services to operate the TSP Management System.
c) The Rf-based radio transponder tags on the transit fleet and the associated licenses.
d) The initial installation of pole attachment of the TSP System.;

5. **CT** will manage the TSP Management System on behalf of the **COUNTY** and all participating cities. This will include the following:
   a) Assigning a single System Administrator who is responsible for the TSP server. This employee shall remain an employee of CT and shall be supervised by CT staff.
   b) With the exception of the **CT** TSP System Administrator, only **COUNTY** personnel will have write access to the Time of Day Plans for each TSP intersection that determine when requests for priority can be issued based on day of week, time of day, passenger load, and schedule adherence. The read access for the **CT** TSP System Administrator is for maintenance purposes only. **CT** can make no changes to the Time of Day Plans unless specifically directed to do so by the Snohomish County Traffic Engineer or his/her designee.
   c) Only **CT** personnel will have write access to the Vehicle Eligibility Table for each TSP intersection.
   d) Both **COUNTY** and **CT** personnel will have write access to all settings and all the reports generated by the TSP system.
   e) **CT** will perform the following tasks:
      i. Review of daily logs;
      ii. Identification of equipment malfunctions, system diagnostics and troubleshooting
      iii. Preparation of work orders and coordination with **COUNTY** staff on system repair;
      iv. Management of TSP inventory and administration of ongoing contracts for TSP parts;
      v. Ongoing evaluation of the effectiveness of the transit signal priority response;
      vi. Ongoing coordination with **COUNTY** traffic engineers regarding signal timing and transit signal priority operational parameters;
      vii. Preparation of vehicle eligibility tables;
      viii. Identification of trips eligible for priority;
      ix. Archiving of system logs; and
      x. Administration of interagency agreement.

6. **CT** will convene regular meetings of a Regional Oversight Committee (ROC) composed of local traffic engineers from the **COUNTY** and cities that operate transit signal priority using the **CT**-sponsored TSP Management System. The ROC will function solely as a technical forum for discussing priorities for the continued development of hardware and software of the TSP System.

7. **CT** will prepare draft annual reports on TSP operations under this **AGREEMENT**. The parties will jointly agree upon the content of and jointly issue this report.

8. **CT** will convene a meeting with the **COUNTY** prior to each of the two annual scheduled adjustments. These meetings will typically be held in January and August of each year. The

meetings will accommodate representatives from the **COUNTY** and **CT** to review TSP strategies in relation to any planned changes in transit service, controller hardware, or control strategies. **CT** will prepare summary notes of each of the two annual meetings for review and approval by the **COUNTY**.

9. **CT** will create a configuration management plan. In creating the plan, **CT** will designate a staff person(s) to develop work processes, a work order tracking system and the content and format of the plan.

III. COUNTY RESPONSIBILITIES

1. The **COUNTY** will operate, maintain and pay for the cost of the operation of all of the TSP Field Equipment associated with the county signal system and the remote TSP workstation.

2. In the event of a malfunction of the TSP Detection System that is related to the TSP Field Equipment, **CT** will promptly notify the **COUNTY**. **CT** will identify a single point of contact to provide this notification. The **COUNTY** will identify a single point of contact to receive this information on an annual basis. The **COUNTY** will make a good faith effort to respond to each trouble call within two (2) working days.

3. The **COUNTY** will be responsible for replacing or repairing the following:
   i. Defects in the TSP Generator. **COUNTY** personnel will exchange a defective unit with a new, used, or reconditioned unit that has been properly configured for that location. Diagnostics and component repairs on a defective TSP Generator will be done on a test bench at **COUNTY** facilities.
   ii. Defects in the antenna, reader, interface panel or TSP Interface Unit. **COUNTY** personnel will generally make the necessary repairs by replacing defective components in the field.
   iii. The **COUNTY** will contact **CT** for replacement parts as needed, and CT will provide such parts as required by paragraph II, (3) of this agreement.

4. The **COUNTY** will collect and maintain a list of the hardware and software in use at each installation. Such information will be submitted to **CT**, as needed, to become part of the TSP configuration management plan.

5. The **COUNTY** will be responsible for preparation and update of the time of day plans and transit signal priority settings for all transit signal priority installations covered by this **AGREEMENT**. The **COUNTY** and **CT** will review these settings at least two times each year in conjunction with transit service changes.

6. The **COUNTY** will be responsible for maintaining the power connections to the TSP equipment and for the cost of power to operate the TSP field equipment.

7. The **COUNTY** will be responsible for any pole attachment fees for the TSP equipment except for the cost of the initial installation.

8. The **COUNTY** will participate in the Regional Oversight Committee.

9. In the event of system damage or malfunction resulting from a storm, known or unknown third parties, or other reasons, the **COUNTY** may of their own volition, remove any obvious and immediate traffic hazards before notification by the **CT.** The **COUNTY** will provide **CT** with all information it possesses pertaining to any third party damage to **CT**'s TSP field equipment.

10. If major repairs have to be made or major components of the TSP system have to be replaced that are not covered by the County Responsibilities as described in paragraphs 1 through 8 above, then the **COUNTY** and **CT** will address this work by jointly signing a TSP Assignment For Repair Or Replacement Form that is shown in **Exhibit C,** attached hereto and made part of this **AGREEMENT** by this reference.

11. If the **COUNTY** assigns signal operations and maintenance to another agency, the **COUNTY** shall assign TSP operations and maintenance along with the signal work.

IV. TSP ADDITION or DELETION

1. **Exhibit A,** attached hereto and by this reference made a part of this **AGREEMENT,** contains the list of signal locations where the TSP equipment will be installed and the County has agreed to maintain and operate such equipment under this AGREEMENT.

2. The TSP Addition/Deletion document, as shown in **Exhibit B** attached hereto and by this reference made a part of this **AGREEMENT,** shall allow the signal locations under this agreement to be altered by mutual agreement of CT and the County. The Signal Addition/Deletion document shall be signed on behalf of the **COUNTY** by the County Traffic Engineer, or his/her designee and on behalf of **CT,** by the Operations and Development Director, or his/her designee.

3. The **TSP Addition/Deletion** document shall include, as a minimum, a description of the signal(s) installation(s) or deletion(s) and location(s). The effective date of coverage or deletion shall also be defined in the Signal Addition/Deletion document.

V. DURATION

This **AGREEMENT** shall become effective on the date stated above and be renewed automatically for one calendar year on each 1st of January thereafter unless written notice of termination is given by either party by the preceding November 1 of any such year. Failure of either party to notify the other of such termination on or before November 1 of any such year shall cause this agreement to automatically be renewed for the next ensuing calendar year.

Renewal of this agreement is subject to the necessary appropriations by the Snohomish County Council and the failure of such an appropriation to be made will constitute an automatic termination.

VI. TERMINATION

This **AGREEMENT** may be terminated for any reason upon mutual agreement of the parties. Any mutual termination shall become effective sixty (60) days following written amendment to the **AGREEMENT** executed by both parties. Any amendments and termination shall be in writing and executed in the same manner as provided by law for the execution of this **AGREEMENT** receipt of notice. Termination of this **AGREEMENT** shall also constitute termination of all signal assignment documents.

VII. HOLD HARMLESS

The PARTIES to this **AGREEMENT** shall protect, defend, indemnify, and save harmless the other PARTY, its officers, officials, employees, and agents, while acting within the scope of their employment as such, from any and all costs, claims, judgment, and/or awards of damages, or liability of any kind including injuries to persons or damages to property arising out of, are connected to, or are in any way resulting from, any acts or omissions of the indemnifying Party.

No PARTY will be required to indemnify, defend, or save harmless the other PARTY if the claim, suit, or action for injuries, death, or damages is caused by the sole negligence of the PARTY seeking indemnification. Where such claims, suits, or actions result from concurrent negligence of the PARTIES, the indemnity provisions provided herein shall be valid and enforceable only to the extent of the PARTY's own negligence. Each of the PARTIES agrees that its obligations under this indemnification section extend to any claim, demand, and/or cause of action brought by, or on behalf of, any of its employees or agents. For this purpose, each of the PARTIES, by mutual negotiation, hereby waives, with respect to each of the other PARTY only, any immunity that would otherwise be available against such claims under the Industrial Insurance provisions of Title 51 RCW. In the event that any of the PARTIES or combination of the PARTIES incurs any judgment, award, and/or cost arising there from, including attorneys' fees, to enforce the provisions of this Section, all such fees, expenses, and costs shall be recoverable from the responsible PARTY or combination of the PARTIES to the extent of that PARTY's/those PARTIES' culpability. This indemnification shall survive the termination of this **AGREEMENT**.

VIII. SEVERABILITY

Should any phrase, clause, sentence, or paragraph of this **AGREEMENT** or its application be declared invalid or void by a court of competent jurisdiction, the remaining provisions of this **AGREEMENT** or application of those provisions not so declared shall remain in full force and effect.

The laws of the State of Washington shall govern this **AGREEMENT**. In the event that any party deems it necessary to institute legal action or proceedings to enforce any right or obligation under this **AGREEMENT**, the PARTIES hereto agree that any such action or proceedings shall be brought in a court of competent jurisdiction situated in Snohomish County, Washington.

IN WITNESS WHEREOF, the parties hereto have executed this **AGREEMENT** as of the day and year first above written.

SNOHOMISH COUNTY

By: ______________________
Aaron Reardon, County Executive
for
GARY WEIKEL
Deputy Executive

COMMUNITY TRANSIT

By: ______________________
Joyce Olson, Executive Director

Approved As To Form only:

____
Deputy Prosecuting Attorney

EXHIBIT A

AGREEMENT FOR TRANSIT SIGNAL PRIORITY (TSP) MAINTENANCE
SNOHOMISH COUNTY COMMUNITY TRANSIT

TSP ASSIGNMENT

In accordance with Section IV of the **AGREEMENT**, the parties mutually determined that the following signal locations shall be included in the list of signal installations at which the County will be providing maintenance of TSP detection:

No.	Signal Location	# of Readers
1.	Airport Rd & 100th St SW	2
2.	Airport Rd. & 112th St SW	2
3.	Airport Rd & Admiralty Wy	2
4.	Airport Rd & Gibson Rd	0
5.	128th St SW & 4th Ave W	2
6.	128th St SW & 8th Ave W	2
7.	164th St SW & 36th Ave W	4
8.	164th St SW & Swamp Crk P&R	2
9.	164th St SW & Ash Way	2
10.	164th St SW & Manor Way	2
11.	164TH St SW & Opus Entrance	2
12.	Airport Rd & Beverly Park	2
13.	Airport Rd & SR 99	3

EXHIBIT B

AGREEMENT FOR TRANSIT SIGNAL PRIORITY (TSP) MAINTENANCE SNOHOMISH COUNTY AND COMMUNITY TRANSIT

TSP ADDITION/DELETION

In accordance with Section IV of the **AGREEMENT**, the parties have mutually determined that the following signal locations shall be included in/deleted from the list of signal installations at which the County will be providing maintenance of TSP detection:

Signal Assignment

The work proposed under this TSP Assignment includes the operation and maintenance of TSP detection equipment that has been installed at the following locations:

[List of Signal Locations including the number of readers and interface units]

OR

Signal Deletion

The operation and maintenance of TSP detection equipment at the following signal location shall be discontinued:

[List of Signal Locations including the number of readers and interface units]

Effective Date

The effective date to activate/discontinue the above noted TSP operation and maintenance work is ____________, 20__.

SNOHOMISH COUNTY

By: ________________________

James H. Bloodgood, P.E.
County Traffic Engineer

COMMUNITY TRANSIT

By: ________________________

John Sindzinski
Director of Operations & Development

EXHIBIT C

AGREEMENT FOR TRANSIT SIGNAL PRIORITY (TSP) MAINTENANCE SNOHOMISH COUNTY AND COMMUNTY TRANSIT

TSP ADDITION FOR REPAIR OR REPLACEMENT

In accordance with Section II, titled "County Responsibilities", Paragraph 10 of the **AGREEMENT**, the parties have mutually determined that the following major repairs/ replacements shall be made:

1. Description and Location of Existing Facility:

2. Description of Work:

3. Cost (labor, materials and overhead):

4. The effective date to schedule this TSP equipment repair/replacement work is: ____________________, 20__.

SNOHOMISH COUNTY	**COMMUNITY TRANSIT**
By: ________________________	By: ________________________
James H. Bloodgood, P.E.	John Sindzinski
County Traffic Engineer	Director of Operations & Development

Abbreviations used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation