TRANSIT COOPERATIVE RESEARCH PROGRAM

SPONSORED BY

The Federal Transit Administration

TCRP Report 55

Guidelines for Enhancing Suburban Mobility Using Public Transportation

Transportation Research Board
National Research Council

TRANSIT COOPERATIVE RESEARCH PROGRAM

Report 55

Guidelines for Enhancing Suburban Mobility Using Public Transportation

URBITRAN ASSOCIATES, INC.
New York, NY

in association with

MULTISYSTEMS, INC.
Cambridge, MA

SG ASSOCIATES, INC.
Annandale, VA

and

ROBERT CERVERO
Berkeley, CA

Subject Areas

Planning and Administration
Public Transit

Research Sponsored by the Federal Transit Administration in Cooperation with the Transit Development Corporation

TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL

NATIONAL ACADEMY PRESS
Washington, D.C. 1999

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 Urban Mass Transportation Administration—now the Federal Transit Administration (FTA). A report by the American Public Transit 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.

Research problem statements for TCRP are solicited periodically but may be submitted to TRB by anyone at any time. It is the responsibility of the TOPS Committee to formulate the research program by identifying the highest priority projects. As part of the evaluation, the TOPS Committee defines funding levels and expected products.

Once selected, each project is assigned to an expert panel, appointed by the Transportation Research Board. The panels prepare project statements (requests for proposals), select contractors, and provide technical guidance and counsel throughout the life of the project. The process for developing research problem statements and selecting research agencies has been used by TRB in managing cooperative research programs since 1962. As in other TRB activities, TCRP project panels serve voluntarily without compensation.

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.

TCRP REPORT 55

Project B-6 FY'94
ISSN 1073-4872
ISBN 0-309-06612-3
Library of Congress Catalog Card No. 99-71387

Price $29.00

NOTICE

The project that is the subject of this report was a part of the Transit Cooperative Research Program conducted by the Transportation Research Board with the approval of the Governing Board of the National Research Council. Such approval reflects the Governing Board's judgment that the project concerned is appropriate with respect to both the purposes and resources of the National Research Council.

The members of the technical advisory panel selected to monitor this project and to review this report were chosen for recognized scholarly competence and with due consideration for the balance of disciplines appropriate to the project. The opinions and conclusions expressed or implied are those of the research agency that performed the research, and while they have been accepted as appropriate by the technical panel, they are not necessarily those of the Transportation Research Board, the National Research Council, the Transit Development Corporation, or the Federal Transit Administration of the U.S. Department of Transportation.

Each report is reviewed and accepted for publication by the technical panel according to procedures established and monitored by the Transportation Research Board Executive Committee and the Governing Board of the National Research Council.

Special Notice

The Transportation Research Board, the National Research Council, the Transit Development Corporation, and the Federal Transit Administration (sponsor of the Transit Cooperative Research Program) do not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the clarity and completeness of the project reporting.

Published reports of the

TRANSIT COOPERATIVE RESEARCH PROGRAM

are available from:

Transportation Research Board
National Research Council
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

and can be ordered through the Internet at
http://www.nas.edu/trb/index.html

Printed in the United States of America

FOREWORD

By Staff
Transportation Research Board

These guidelines identify, assess, and document the current practices that transit operators use to enhance their bus networks to better serve suburban travel needs. Taking into consideration the range of environments implied by the term "suburb," the guidelines identify six types of suburban environments and the applicability of individual types of transit service to each. The guidelines provide information on modifications and improvements to the overall suburban transit framework, and information on support and complementary services to public transportation. There is discussion on transit center-based networks, express bus services, limited-stop routes, local area circulators, shuttle links, subscription buses, and vanpools. Operating techniques such as route deviation, point deviation, and demand-response services are also discussed. Included in the guidelines are 11 case studies. Using the information gathered from the case studies, the guidelines discuss each type of service, covering its description, applicability, performance range, and conditions of effectiveness. The intended audience includes transit planners, general managers, and project managers; transportation policy makers; and city and regional planners.

The impact of suburban development on America's transit industry has been dramatic. Where transit operators once had well-defined downtown cores and could provide radial networks that served them effectively, the environment now contains multiple origin/destination pairs. Some operators have adapted well, offering riders a "family of services" concept, such as local and express bus routes, crosstown services, demand-response community-based services, and ridesharing and vanpooling. Other suburban transit operators have not fared as well. The oldest form of public transit in suburban areas is radial commuter service supported by various feeder services. Because of the gradual dispersal of jobs to suburban centers over the last 30 years, there is a need to better link these radial services to suburban job and residential centers for both traditional commuters and reverse commuters. In order to improve effectiveness and provide greater mobility to their constituencies, transportation providers, public officials, and planners need to improve the connectivity of suburban transit services. Transit service providers need easy-to-use methodologies for analyzing changes. Improving connections between transit services would expand destination choice and reduce travel time, thereby contributing to improved mobility, productivity, and efficiency.

Urbitran Associates, Inc., in association with Multisystems, Inc.; SG Associates, Inc.; and Dr. Robert Cervero prepared the final report for TCRP Project B-6. To achieve the project objective of providing guidance to transit operators and regional policy makers on how to enhance suburban mobility through traditional and nontraditional services, the researchers conducted a comprehensive review of current practices related to improving transit connections. A detailed typology was developed to classify suburban areas. Based on the literature review and the detailed typology, case study sites were

selected that reflect the diversity of suburban types. The guidelines were developed on the basis of on-site visits and interviews with 11 transit operators from the United States and Canada, supplemented by reports and data for a select number of additional suburban transit services contacted during the course of the research.

CONTENTS

AUTHOR ACKNOWLEDGMENTS

The research reported herein was performed under TCRP Project B-6 by Urbitran Associates, in association with Multisystems, SG Associates, and Dr. Robert Cervero. Urbitran was the prime contractor for this project.

David J. Sampson, Vice President, Urbitran Associates, was the principal investigator and major author of the report. Contributors from Multisystems included Dan Fleishman, Principal; Susan Bregnan, Associate; and Rick Halvorsen, Associate. SG Associates staff were Frank Speilberg, President, and Randall Farwell, Associate. Dr. Robert Cervero of the University of California at Berkeley was a major contributor to the work effort and authored several sections of the final report. Design and layout of the report were created by Ron Vogel, Senior Art Director, Urbitran Associates.

Finally, the project team would like to thank the staff of each of the transit agencies, metropolitan planning organizations, and local governments who contributed their time and insights for the case studies used in this report.

GUIDELINES FOR ENHANCING SUBURBAN MOBILITY USING PUBLIC TRANSPORTATION

SUMMARY

Improving suburban mobility is a difficult national challenge, which is particularly acute for transit. Suburban development has had several major implications on the provision of transit services:

- Suburban regions are larger than traditional cities and have significantly lower densities. This means greater travel distances for most trips, fewer origins and destinations within walking distance of any single route, and more vehicle miles traveled to serve activities than in urban settings.
- The greater setback of buildings from roadways means that more deviations off the primary route may be required.
- Unless there are a diversity of uses in a suburban area, demand will be heavily peaked, with peaks at different times of day depending on trip purpose. Thus, to maintain reasonable levels of service effectiveness, services may have to be adaptable to different route patterns and configurations.
- In suburban settings, there are frequently several agencies involved in provision of transit services, and coordination of services and policies becomes a key issue in improving mobility.

The differences cited above with regard to travel patterns, land-use arrangements, and institutions suggest that not only service but also evaluation criteria need to be tailored to the suburban setting.

To provide a level of consumer appeal competitive with the private automobile, planning for mobility in suburban areas must embrace the family or services concept. Options must be created that are responsive to narrow market segments and special conditions of effectiveness. The challenge is significant.

STUDY OBJECTIVES

Suburban bus service planning needs to reflect the specific needs, patterns, and concerns of each local area. The purpose of the *Guidelines* is to provide those planning and

operating transit in the suburbs with information about the types of services being introduced, the relative effectiveness of the services, and their applicability to specific urban settings. The *Guidelines* identify, assess, systematize, and document the current practices that transit operators use to enhance their existing bus networks to better serve suburban travel needs.

The *Guidelines* are based on case studies developed from on-site visits and interviews of 11 transit operators from the United States and Canada, supplemented by pertinent reports and data for a select number of additional suburban transit services from other operators contacted during the course of the research.

SUBURBAN OPERATING ENVIRONMENTS

One of the first tasks was to identify the range of suburban environments and to identify to the extent possible how they influence travel patterns and the suitability of individual transit applications. Six types of suburban land-use environments were identified:

- Residential suburbs,
- Balanced, mixed-use suburbs,
- Suburban campuses,
- Edge cities,
- Suburban corridors, and
- Exurban corporate enclaves.

Each environment represents a distinct operating setting that poses unique challenges to America's public transit industry.

CLASSIFICATION OF SUBURBAN PUBLIC TRANSIT SERVICES

How does transit serve these environments? Based on a review of the 11 case studies and supporting materials from other operators, a classification scheme was developed for describing the range of transit applications identified. The classification scheme is as follows:

Actions to Modify and Improve the Overall Suburban Transit Framework

- Establishing a transit centers concept and timed-transfer program; and
- Enhancing line-haul services, express buses, and limited services.

Actions That Create Supporting/Complementary Services

- Internal, local area circulators;
- Shuttle links;
- Subscription buses; and
- Vanpools.

SUMMARY OF FINDINGS: KEYS TO SUBURBAN SUCCESS

The *Guidelines* provide useful policy insights regarding how future transit services might be designed to better serve suburban markets. Following are 12 key findings the

researchers believe to be some of the common features of successful transit strategies introduced for serving suburban transit markets:

1. Develop services around focal points.
2. Operate along moderately dense suburban corridors. Connect land-use mixes that consist of all-day trip generators.
3. Serve transit's more traditional markets such as lower income, blue-collar neighborhoods.
4. Link suburban transit services, especially local circulators and shuttles, to the broader regional line-haul network.
5. Target markets appropriately.
6. Economize on expenses.
7. Adapt vehicle fleets to customer demand.
8. Creatively adapt transit service practices to the landscape.
9. Obtain private sector support.
10. Plan with the community.
11. Establish realistic goals, objectives, and standards.
12. Develop supportive policies, plans, and regulations.

CHAPTER **1**

GUIDELINES FOR ENHANCING SUBURBAN MOBILITY: OVERVIEW AND SUMMARY OF FINDINGS

Improving suburban mobility is a difficult national challenge. For transit, the problem is particularly acute. Networks historically have been designed to serve downtowns and concentrated urban centers. Many are ill-suited for serving the lower density and dispersed travel patterns characteristic of suburban patterns of development.

Suburban traffic congestion has grown tremendously over the past two decades, and it has become the increasing focus of the transportation profession. Mobility planning in the 1990s has shifted from emphasizing the automobile to enhancing transit services and transportation demand management (TDM). With passage of the Intermodal Surface Transportation Efficiency Act (ISTEA), and its emphasis on intermodalism, and the Clean Air Act Amendments of 1990, the need for expanding public transportation options and increased cooperation between the public and private sectors has been heightened.

The impact of suburban development on America's transit industry has been dramatic. Where operators once had well-defined downtown cores and could provide radial networks that served them effectively, the environment now contains multiple centers, lower overall densities, and multiple origin/destination pairs. Some operators have adapted well, offering riders a "family of services" concept, such as local and express bus routes, crosstown services, demand response community-based services, and ridesharing and vanpooling. Transit operators have reached out to work with transportation management associations, local governments, and private employers in efforts to expand mobility choices and also to act as partners in meeting the needs of the community, including addressing the Clean Air Act requirements.

SUBURBANIZATION AND MOBILITY

During the 1980s, America's suburbs experienced a third wave of growth. The first wave of suburban development, which began earlier in the century, consisted largely of middle- and upper-income households leaving the urban core in search of more spacious living conditions. This was followed by a second wave, with retail businesses migrating outward closer to their customer base and locating along commercial strips, in regional shopping malls, and everywhere in between. Decentralization of jobs marked the third wave of growth.

As a result of these trends, many of today's suburbs feature the same activities found in traditional cities, though often spread over a much larger area. More Americans now are living, shopping, and working in lower density settings that are less and less conducive to transit riding.

Average residential and employment densities today are not only much lower than a decade or more ago, but trip origins and destinations are also far more spread out. Nationwide, the share of work trips both beginning and ending in the suburbs, for instance, increased from 38 percent in 1970 to 52 percent in 1990. Traditional commuting paths are being replaced by a patchwork of radial, crosstown, lateral, and reverse-direction travel. Increasingly, there is a mismatch between the geometry of traditional highway, bus, and rail networks, which mostly follow a hub-and-spoke pattern, and the geography of commuting, which seemingly moves in all directions. This has led to more circuitous trip making and increased suburban congestion.

Suburban development patterns have several implications on how transit services are provided:

- Unless there are a diversity of uses in an area, demand will be heavily peaked, and these peaks will be at different times of day. In a traditional central city, the mix of employment, retail, and service activity means that demand exists along a route throughout the day. In a suburban setting, an office park will have high employment-related peaks, whereas a shopping center will have midday and evening peaks. To maintain reasonable levels of service effectiveness, vehicles may need to operate quite different routes and service patterns at different times.
- Suburban regions encompass far more land area than traditional cities. For example, Washington, D.C., covers about 75 mi^2 (194.25 km^2), whereas suburban Fairfax County, Virginia, with a slightly larger population, is almost 400 mi^2 (1,036 km^2). Suburban densities are lower than those of traditional urban centers.
- The lower average densities of suburban areas means not only that fewer origins or destinations are within walking distance of any transit route but also that the distances

traveled between points, on average, are longer. In addition, the lack of an interconnected street system results in less direct routings and more vehicle miles traveled to serve activities than in urban settings (Figure 1).
- The greater setbacks of buildings from roadways means that more deviation off the primary route may be required (Figure 2).

In suburban settings, several agencies frequently are involved in providing transit services (e.g., the regional bus service, one or more local suburban area bus services, and, in some places, a rail operator). The service policies and fare structures of these multiple operators may or may not be coordinated. The degree of coordination often depends on the funding policies of the specific state or locality.

Differences in trip patterns and in spatial and institutional arrangements between the suburb and the traditional city suggest not only that transit services be tailored to the new conditions but also that the criteria used to plan and evaluate services be different.

Encouraging and facilitating transit use in suburban settings requires recognizing that the automobile dominates travel and that the attributes that contribute to its dominance must be considered when new services are being designed. These attributes should be considered in developing "conditions of effectiveness" for planning new services (e.g., the criteria that new services will need to consider in the planning process to ensure effectiveness). Consumer appeal is central to the ultimate success of these programs and thus must be central to the planning effort. The following attributes of consumer appeal need to be taken into account when considering mobility options to the automobile:

- Directness and comparative travel time;
- Comfort and service quality;
- Scheduling for convenience (e.g., flexibility, minimized transferring, connectivity);
- Pricing, including overall cost and simplification of payments; and
- Market coverage.

Figure 1. A moderate density suburb in Portland, Oregon, showing how the roadway network inhibits fixed-route transit service.

Figure 2. A corporate office campus in Dallas, Texas, set back from the street, is a typical example of suburban employment centers nationwide.

Transit planning must account for these and other factors and must respond with appropriate services and policies. For example, to be competitive with the private automobile, rail shuttles must be designed to (1) minimize travel time by ensuring well-timed connections; (2) provide these connections as effortlessly as possible with short walk distances, tight scheduling, and appropriate frequencies; (3) consider mechanisms for single pricing of the entire trip; and (4) provide a direct, comfortable link between the station and destination. Even with adherence to these quality-of-service criteria, planners and operators need to recognize that only a portion of the market will be served by any particular service option and that other types of action will likely be needed to meet the needs of other market segments.

Planning for mobility in suburban areas must embrace the family of services concept and segment markets in order to be successful. Options must be carefully delineated to reflect what is, in many cases, a narrow range of conditions of effectiveness. Operators and planners used to counting center-city oriented ridership in the hundreds and thousands per day need to be attuned to the special nature of many suburban services. Depending on local goals and objectives, options attracting as few as 30 to 50 trips per day, if tailored to meet very specific demands, may be considered successful; such is the case with many rail shuttle connections, community-based demand response feeders, and single run subscription buses to single employers/employment parks.

The challenges of making transit work in the suburbs are immense. Transit today finds itself competing with the automobile in suburban environments with extremely low densities, dispersed trip patterns, abundant free parking, and inhospitable walking environs. And, based on national statistics, transit is clearly losing the competition; its market share of commute trips has fallen from 6.4 percent in 1980 to 5.3 percent in 1990.

Clearly, short of massive new investments in transit, coupled with a fundamental policy shift toward the creation of

transit-oriented suburban development, transit will never achieve the level of usage found in most central cities. Nevertheless, effective planning and promotion of a range of market-oriented services should help to capture a greater share of the suburban travel market and thereby help communities address their mobility and environmental concerns. This document is designed to provide assistance in this planning effort.

THE GUIDELINES: AN OVERVIEW

Study Purpose and Objectives

The task of creating effective public transportation in the suburbs presents significant challenges. Transit in the suburban market, a market characterized by generally lower densities and more diverse travel patterns than the traditional urban transit market, has evolved gradually over the past two decades. The range of travel movements is broad but generally is characterized by three distinct patterns: trips from the suburbs to the urban core, reverse commute trips from the urban core to the suburbs, and suburb-to-suburb movements. Transit operators and planners are constantly working to adapt fixed-route services that work in urban settings to the suburbs, testing new and more flexible concepts taken from experiences with paratransit services, and broadening horizons to embrace vanpooling and other transportation demand management (TDM) techniques previously considered outside the realm of traditional transit operations.

Suburban bus service planning needs to reflect the specific needs, patterns, and concerns of each local area. Those planning and operating transit in the suburbs, therefore, need to have at their disposal a clear understanding of the local setting and types of service options available. As transit services are being upgraded or expanded nationally in the suburbs in response to local issues and objectives, better information needs to be made available to local planners and operators about the types of services being introduced, the relative effectiveness of the services, and their applicability to specific suburban settings.

The *Guidelines* focus on suburb-to-suburb and intrasuburban travel. The dissemination of information and a better understanding of transit service options for these trips will help local operators and service planners to make more informed choices for local services.

The purpose of these Guidelines is to identify, assess, systematize, and document the current practices that transit operators use to enhance their existing bus networks to better serve suburban travel needs. The suburban service strategies featured in these *Guidelines* concentrate on service modifications and innovations designed to create more effective networks. The presence of a suburban bus network is presumed.

Through survey research and case studies, the *Guidelines* bring together information on the range of contemporary practices to identify the types of enhancement strategies that have been used in different suburban transit markets to integrate transit into overall mobility strategies.

These *Guidelines* are directed to agencies, operators, and public officials in suburban areas who are involved in both short- and long-range mobility planning. The *Guidelines* are intended to be instructive in helping to upgrade and improve existing services and to restructure services to address the needs of the suburban traveler.

The Case Study Approach

The *Guidelines* are based on case studies developed from on-site visits and interviews during 1995 of 11 transit operators from the United States and Canada, supplemented by pertinent reports and data for a select number of additional suburban transit services from other operators contacted during the course of the research (Figure 3). Principal among these additional operators were New Jersey Transit (NJ Transit); Norwalk Transit District (NTD), Norwalk, Connecticut; Long Island Bus (LIBus), New York; Suffolk County Transit, New York; and Westchester County, New York.

The case study locations were selected by the research team, project panel, and TCRP staff based on information collected from a broader mail-out and telephone interview process during the first phase of the research. After a mailing to 140 transit agencies in the United States and Canada, interviews were conducted with the approximately 50 transit operators who contacted the team and agreed to participate.

The *Guidelines* used to select the case studies included consideration of the following:

- Selection of a group that would cover the full spectrum of suburban delivery methods;
- Distribution of agencies to include both small/medium, and large systems;
- Selection of operators both with and without rail systems;
- Broad geographic representation;
- Opportunities at each site to investigate multiple suburban actions;
- Selection from among those who responded affirmatively to the initial interview and indicated an interest in further participation.

One other criterion was used in the selection process: Cases already covered in *TCRP Synthesis No. 14*, "Innovative Suburb-to-Suburb Transit Practices," were not to be included as case studies. The agencies included PACE Suburban Bus Division of RTA (PACE), Grand Rapids Area Transit Authority (GRATA), Ottawa-Carleton Regional Transit Commission (OC Transpo), and New Jersey Transit (NJ Transit).

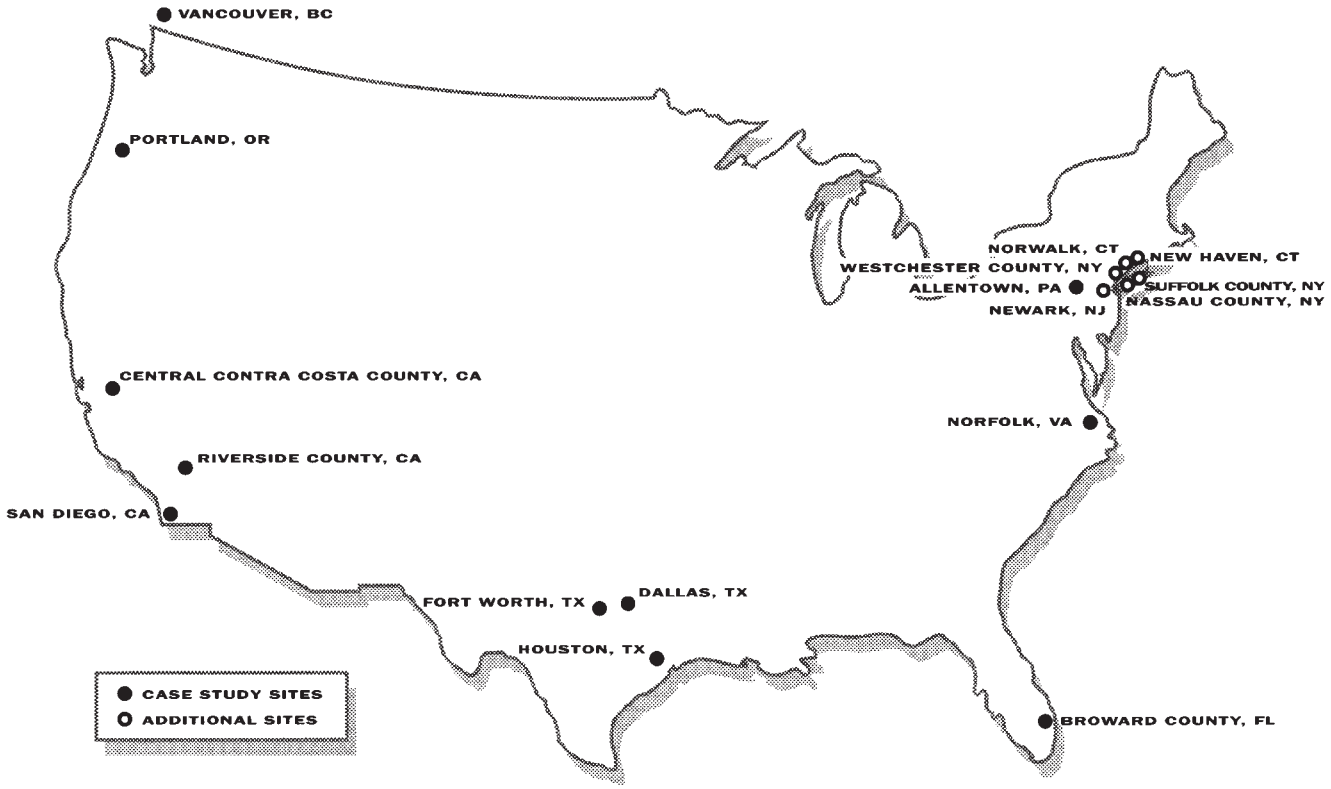


Figure 3. Location of study sites investigated for this research project.

Case study visits varied from 1 to 3 days on-site. During the visit, topics covered planning and project initiation, operating and financial performance, public policy, private sector participation, land-use and demographic profiles, and other pertinent information and issues. The intent of each case study was to develop materials to document performance and to study it in context to identify factors either contributing to good performance or creating conditions for failure (Table 1).

The case study data formed the basis for the development of these *Guidelines*, including observations on performance, conditions of effectiveness, and other planning-related issues. Even though a detailed protocol was developed for the case studies and 1 to 3 days was spent at each location, what is clearly evident from the research is the lack of uniformity in the data collected and reported from site to site, the inability of some operators to track individual suburban services separately from their larger program, and the unavailability of a consistent database about the market. To the degree that supportive data are available, evidence suggesting the influences of these service strategies on operating performance is reviewed.

However, it should be cautioned, attributing performance improvements or declines to service changes is fraught with difficulties. This is partly because few of the 11 case site systems had consciously sought to conduct *before and after* evaluations of service changes. Thus, no control sites were established by transit agencies within the 11 case study areas, nor were before and after performance data systematically compiled beyond basic operating and financial performance data. Nevertheless, although the *Guidelines* established in this research can only draw inferences from the associations between changes in suburban transit services and operating performance, and the influence of particular suburban settings, doing so has allowed the researchers to identify and categorize all types of services, to develop expected performance ranges, and to identify factors that contribute to success or failure.

Suburban Transit Services and Operating Environments

The term suburb is a generic identification applied to the developed areas surrounding traditional urban centers, and it implies a homogeneous type of settlement uniformly characterized by single-family houses and condominiums, strip development and malls, and campus business settings. The term does not suitably reflect the true heterogeneity of these areas, evolving patterns of development, and changing demographics.

One of the first tasks in this research was to identify the range of suburban environments and to identify as far as possible how they influence travel patterns and the suitability of individual transit applications. Research led to identification of six types of suburban land-use environments across the United States:

TABLE 1 General Characteristics—Case Study Systems (U.S. Systems)

	Service Area Population	Fleet Size	PM Peak Buses	Annual Vehicle Miles	Annual Vehicle Hours	Annual Unlinked Passenger Trips (non-rail)
Broward County Division of Mass Transit Ft. Lauderdale, FL	1,300,000	196	148	9,875,600	692,400	23,490,000
Central Costa County Transit Authority Concord, CA	360,000	112	97	4,305,900	298,600	4,648,000
Dallas Area Rapid Transit Dallas, TX	1,771,000	871	721	22,188,100	1,477,900	45,814,000
Fort Worth Transportation Authority Fort Worth, TX	475,000	150	110	5,532,000	370,600	5,811,000
Lehigh and Northampton Transportation Authority Allentown, PA	390,000	66	51	1,796,200	139,300	4,123,000
Metropolitan Transit Authority of Harris County Houston, TX	2,172,000	1198	851	42,774,800	2,714,100	83,840,000
Riverside Transit Agency Riverside, CA	1,508,318	63	47	3,347,200	204,800	5,350,000
San Diego Transit Corporation San Diego, CA	1,400,000	339	266	14,390,900	1,119,000	35,709,000
Tidewater Regional Transit Norfolk, VA	1,000,000	201	112	5,811,200	438,500	8,753,000
Tri-County Metropolitan Transportation District of Oregon Portland OR	1,200,000	587	490	23,664,800	1,716,000	55,291,000

Source: National Transit Database, 1994

- Residential suburbs,
- Balanced mixed-use suburbs,
- Suburban campuses,
- Edge cities,
- Suburban corridors, and
- Exurban corporate enclaves.

Each of these environments represents a distinct operating setting that poses unique challenges to America's public transit industry. It was hoped that relating these environments to the case studies and services being offered in the suburbs would lead to conclusions about the challenges and opportunities associated with serving each of these operating environments. Appendix A provides a detailed discussion of the six operating environments and the methods used for classifying America's suburbs, which are summarized here.

Residential suburbs, which occupy much of suburbia's land mass, range from large-lot, single-family tract subdivisions to more compact settings with a mixture of housing stock (Figure 4).

Balanced suburbs typically feature a mixture of housing, employment, and commercial land uses (Figure 5).

Suburban campuses, which proliferated during the 1980s, mainly comprise office parks, industrial estates, and low-density business centers. Most are master-planned projects configured like university campuses. All the case study sites had some degree of suburban campus development (Figure 6).

Edge cities, the massive suburban downtowns that blossomed throughout metropolitan America in the 1980s, feature many of the same land-use mixes and sometimes match the employment densities of traditional downtowns (Figure 7). According to one study, there were 181 edge cities in late 1994. Commute modal splits by transit among edge city employees have been as high as 30 to 35 percent in metropolitan Washington, D.C. (Crystal City, Rosslyn, and Ballston, Virginia; Silver Spring, Maryland) and as low as 0.2 percent in the Troy/Big Beaver Road Area outside of Detroit, Michigan, and the Boca Raton/I-95 area in south Florida. As they mature, America's edge cities are increasingly being vacated by large corporations, with smaller companies taking

Figure 4. Residential suburbs—newly developed single-family homes in Riverside County, California.

Figure 6. Suburban office campuses—a suburban campus outside Dallas shows the difficulties that buses encounter in trying to obtain access.

their places. Edge Cities in the San Francisco area are shown in (Figure 8).

Suburban corridors differ from many of the other operating settings in that they are linearly configured, often made up of an assemblage of land uses aligned along an axial thoroughfare or freeway (Figure 9).

Exurban corporate enclaves, the last class of operating environment, is largely a 1990s phenomenon. Research has documented the leapfrogging of new commercial developments into favored corridors and exurban frontiers in many growing parts of the country. Examples abound: Bishop Ranch is a major exurban enclave located in suburban Contra Costa County, California (Figure 10). Chrysler moved its corporate headquarters to Auburn Hills 25 mi (40.23 km) north of downtown Detroit; Sears moved its merchandising division to Hoffman Estates, 37 mi (59.5 km) from downtown Chicago and 12 mi (19.31 km) farther out than Schaumburg, where much of the region's office space located during the 1980s; and J.C. Penny opened its new 2 million ft^2 (185,806 m^2) corporate headquarters in Plano, 35 mi (56.33 km) north of downtown Dallas.

Classifying Suburban Public Transportation Services

How does transit serve these environments? Based on a review of the 11 case studies and supporting materials from other operators regarding suburban public transportation delivery methods, a classification scheme was developed for describing the range of applications identified. The classification system for suburban service strategies used for these *Guidelines* concentrates on service modifications and innovations designed to create more effective networks. After having reviewed the experiences from the case studies and supplementary programs noted earlier, a classification scheme has been developed that defines two major categories of actions used to improve existing suburban networks.

Figure 5. Pleasant Hill, within the CCCTA service area, contains a mix of housing, office, and commercial uses, which are beginning to form a transit village.

Figure 7. Walnut Creek, California, an edge city in the suburban San Francisco area, located in Contra Costa County.

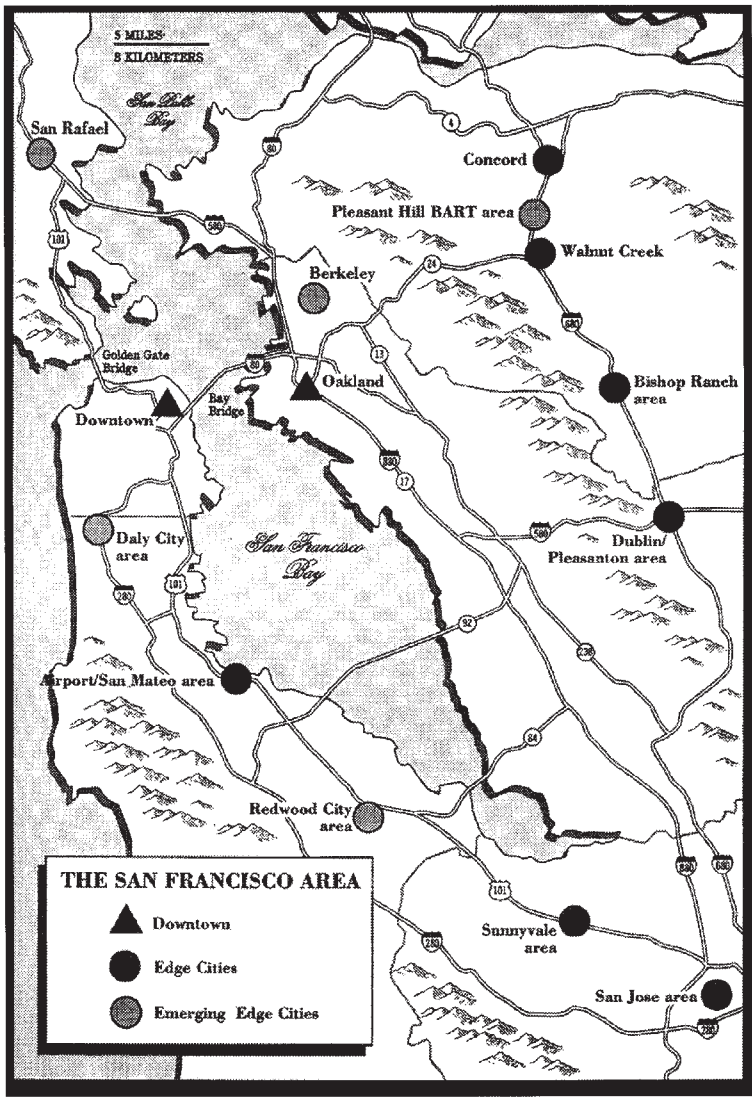


Figure 8. Edge cities in the San Francisco area. Source: Garreau, Edge Cities.

Actions to Modify and Improve the Overall Suburban Transit Framework

All the suburban areas studied in this project already have bus service provided in at least a portion of their local service areas. In some cases, the services are outward extensions of traditional urban core services; in other cases, the services are provided by an entirely new entity created solely to address suburban transit issues. What is important is to realize that the framework for the local bus network in most suburban areas has been in place for some time.

Suburban operators have sought ways to improve the overall design of their programs to foster better linkages and to create better alternatives to the single-occupant vehicle. *These actions represent the first step in mobility strategies of most suburban operators and are generally taken at a system level.* They include the following:

- Establishing a transit centers concept and timed-transfer program and
- Enhancing line-haul services, express buses, and limited services.

Actions That Create Supporting/ Complementary Services

The actions described above are those taken by an operator to ensure that the core program/network is operating effectively. The second set of actions represents those that create supporting or complementary actions. This group includes

Figure 9. A mixed-use suburban corridor along a major arterial in the Tidewater Transit District, Virginia.

those activities undertaken by transit operators to enhance and complete their network. These actions represent enhancements to the network—actions taken to meet localized needs, niche markets, low-density markets where fixed route services cannot be effective, and emerging markets outside the current fixed-route network. They can be operated as fixed routes, route deviation services, or demand response services in response to local issues and concerns. For the most part, these complementary actions are linked to the core network to create a coordinated program of services in the community. Featured among these actions are the following:

- Internal, local area circulators,
- Shuttle links,
- Subscription buses, and
- Vanpools.

Table 2 classifies, by transit system, each of the operating programs investigated for this research by the categories defined above.

SUMMARY OF FINDINGS: THE KEYS TO SUBURBAN SUCCESS

The *Guidelines* provide useful policy insights about how future transit services might be designed to better serve suburban markets. Clearly, conclusions based on the findings from about a dozen transit agencies risk oversimplifying matters, particularly given that transit's response to suburban growth is still largely embryonic and not documented in a systematic manner. However, some patterns were uncovered that provide useful guidance to those planning new services, whether they be core services forming the basic network of services provided or niche services aimed at meeting special/localized needs among smaller segments of the population.

This section outlines the key findings, what the researchers believe to be some of the common features of successful transit strategies introduced for serving suburban markets.

Figure 10. Bishop Ranch, a 585-acre exurban enclave located in Contra Costa County, California.

1. **Develop Services Around Focal Points**
   A distinguishing feature of the more successful suburban transit service strategies has been the servicing of *hubs*—that is, points that represent either concentrations of people or transit vehicles. A *people hub* is a large suburban employment center, like Bishop Ranch in Contra Costa County or the Texas Medical Center in Houston. A *transit hub* is a designated transit-transfer point, such as successfully defined and employed by Tidewater Regional Transit or park-and-ride terminuses operated by Houston METRO. Quite consistently, successful suburban transit services have focused on points where the concentration of activities generates relatively high ridership counts, allows for efficient routing, and eases the transfer process.
2. **Operate Along Moderately Dense Suburban Corridors: Connect Land-Use Mixes That Consist of All-Day Trip Generators**
   Suburbs present a rich mix of densities and land-use types, with transit services provided across a landscape featuring suburban downtowns and highly developed corridors as well as many low-density residential enclaves and developing, nearly rural fringe areas. The range of performance among routes serving these areas is equally large. The research findings support the long-held belief that compact, mixed-use development is a key determinant for introducing and sustaining healthy fixed-route transit services and therefore underscore the need to more carefully integrate land-use planning and transit service planning in coming years as a means of strengthening transit's presence in suburbia.
3. **Serve Transit's More Traditional Markets Such As Lower Income, Blue-Collar Neighborhoods**
   As the suburbs have matured, they have become increasingly diverse with respect to age, income, and employment classifications. Although the patterns of travel are more diverse and densities are lower in the suburbs, the profile and travel needs of the residents there largely mirror those of urban residents. As such, most transit services in the suburbs, and especially the

core services largely consisting of traditional fixed-route services, work best within the context of the traditional transit markets.

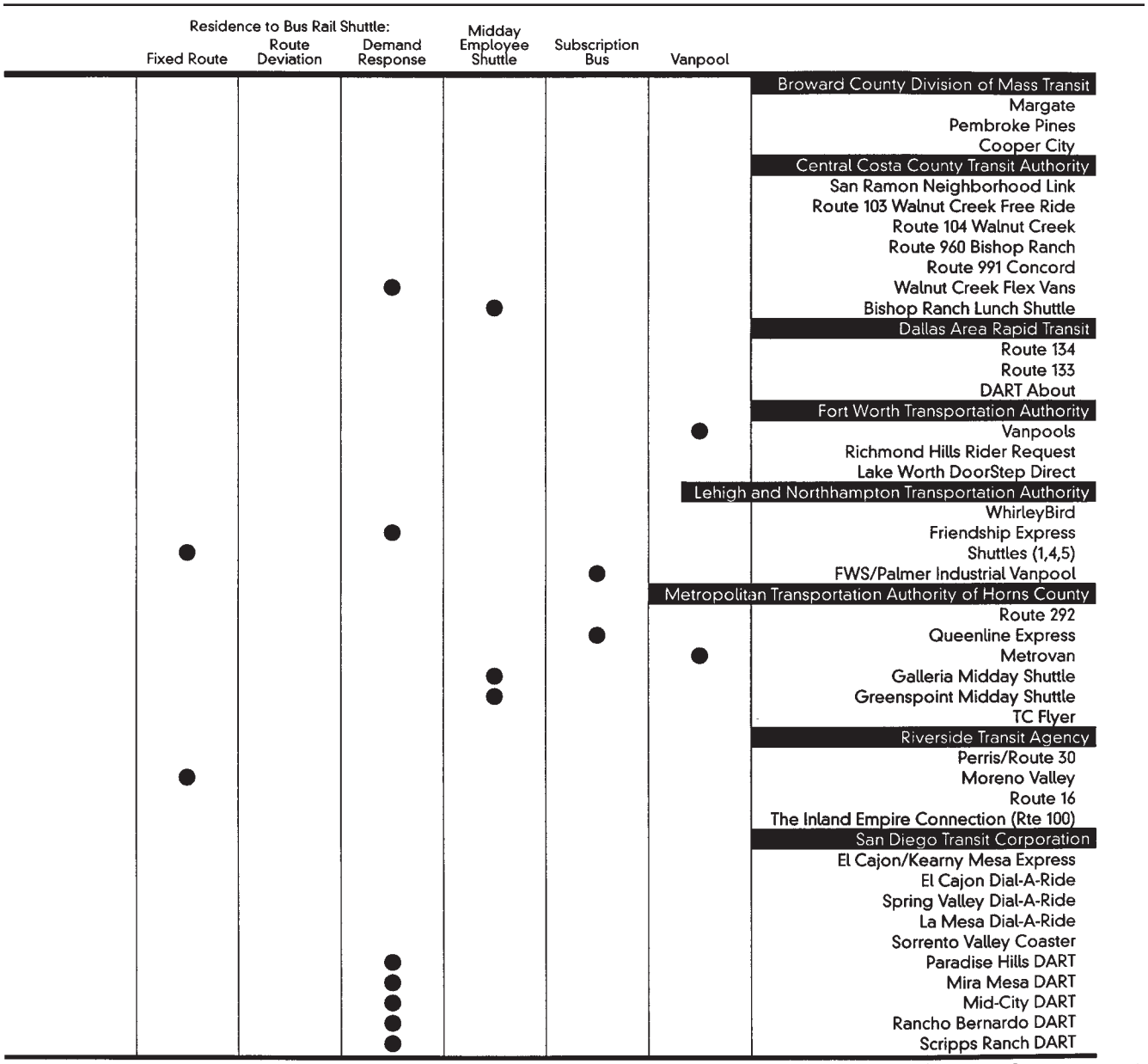
4. **Link Suburban Transit Services, Especially Local Circulators and Shuttles, to the Broader Regional Line-Haul Network**
   The most successful suburban services are those linked to transit centers and regional line-haul services. Routes serving regional rail stations are particularly successful, providing the link for central business district-oriented travel. Successful dial-a-ride and route-deviation services, which often are used to supplement the core network, work best when they operate within a limited territory and efficiently tie to mainline bus routes and rail lines. Operating strategies that combine these two elements can result in an effective network of flexibly routed services in low-density areas that are tied to lower-cost/higher-capacity fixed-route services in built-up areas.
5. **Target Markets Appropriately**
   There are many examples of suburban transit that successfully serves "choice" customers, most notably express shuttles and park-and-ride bus runs to large-scale employment centers, but these services are oriented to niche markets and have a greater chance for failure. Services targeted to choice riders succeed

TABLE 2 Classification of Programs by Service Type and System

	Express Bus	Limited Service	Fixed Route Circulator	Route Deviation Circulator	Demand Response Circulator	Rail Station to Employer Shuttle
Broward County Division of Mass Transit						
Margate				●		
Pembroke Pines				●		
Cooper City				●		
Central Costa County Transit Authority						
San Ramon Neighborhood Link			●			
Route 103 Walnut Creek Free Ride			●			
Route 104 Walnut Creek			●			
Route 960 Bishop Ranch						●
Route 991 Concord						●
Walnut Creek Flex Vans						
Bishop Ranch Lunch Shuttle						
Dallas Area Rapid Transit						
Route 134		●				
Route 133		●				
DART About					●	
Fort Worth Transportation Authority						
Vanpools						
Richmond Hills Rider Request				●		
Lake Worth DoorStep Direct				●		
Lehigh and Northhampton Transportation Authority						
WhirleyBird			●			
Friendship Express						
Shuttles (1,4,5)						
FWS/Palmer Industrial Vanpool						
Metropolitan Transportation Authority of Horns County						
Route 292	●					
Queenline Express						
Metrovan						
Galleria Midday Shuttle						
Greenspoint Midday Shuttle						
TC Flyer	●					
Riverside Transit Agency						
Perris/Route 30			●			
Moreno Valley						
Route 16						
The Inland Empire Connection (Rte 100)	●					
San Diego Transit Corporation						
El Cajon/Kearny Mesa Express	●					
El Cajon Dial-A-Ride					●	
Spring Valley Dial-A-Ride					●	
La Mesa Dial-A-Ride					●	
Sorrento Valley Coaster						●
Paradise Hills DART						
Mira Mesa DART						
Mid-City DART						
Rancho Bernardo DART						
Scripps Ranch DART						

only if they are appropriately supported and if they have an appropriate role to serve. Since choice riders would prefer to use their cars, highway congestion and high parking fees continue to be the most significant factors influencing transit choice. Without these factors, niche services have great difficulty in achieving success. Besides such environmental factors, which make the service competitive with the automobile, these services must have active private sector involvement as well as pubic financial support.

6. **Economize on Expenses**
   Given that suburban services invariably have lower productivities than their urban counterparts, operators recognize the need to keep the costs of these services down so that their overall cost per trip, generally the key measure of effectiveness, is reasonable and competitive with other services they offer. The most common strategy for cost containment is competitive contracting of services to private operators with significantly lower cost structures. Several transit agencies have worked in partnership with their operator unions to establish differential wage scales for nontraditional services, which provides a win-win situation for both. In other cases, services sponsored by the transit operator have been contracted to local communities, who then provide the service through



(*continued on next page*)

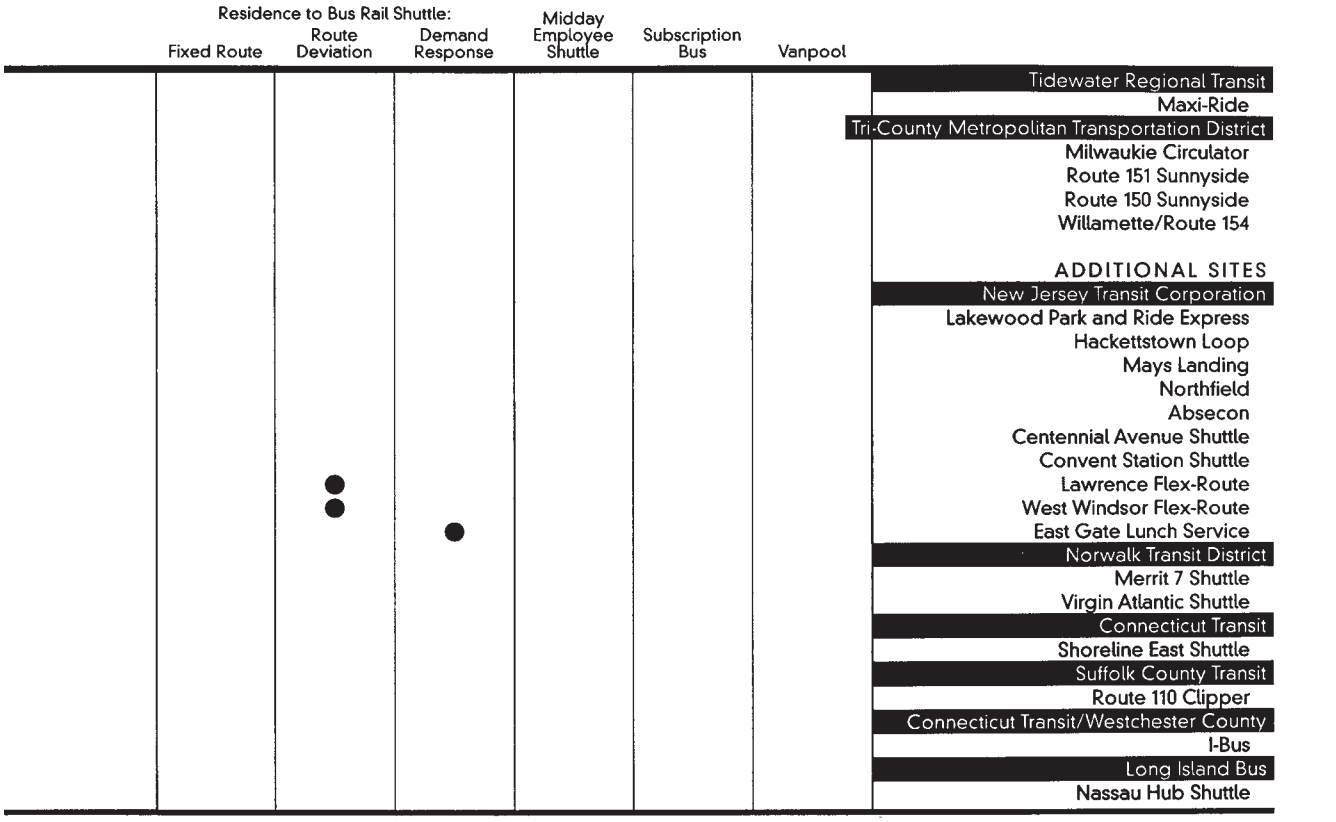
TABLE 2 (Continued)

	Express Bus	Limited Service	Fixed Route Circulator	Route Deviation Circulator	Demand Response Circulator	Rail Station to Employer Shuttle
Tidewater Regional Transit						
Maxi-Ride					●	
Tri-County Metropolitan Transportation District						
Milwaukie Circulator			●			
Route 151 Sunnyside			●			
Route 150 Sunnyside					●	
Willamette/Route 154			●			
ADDITIONAL SITES						
New Jersey Transit Corporation						
Lakewood Park and Ride Express	●					
Hackettstown Loop			●			
Mays Landing					●	
Northfield					●	
Absecon					●	
Centennial Avenue Shuttle						●
Convent Station Shuttle						●
Lawrence Flex-Route						
West Windsor Flex-Route						
East Gate Lunch Service						
Norwalk Transit District						
Merrit 7 Shuttle						●
Virgin Atlantic Shuttle						●
Connecticut Transit						
Shoreline East Shuttle						●
Suffolk County Transit						
Route 110 Clipper	●					
Connecticut Transit/Westchester County						
I-Bus	●					
Long Island Bus						
Nassau Hub Shuttle			●			

municipal departments at a lower cost. Finally, subscription vanpools have also been turned to as a cost-savings strategy, replacing more costly express bus and park-and-ride bus services in low-density suburban corridors.

7. **Adapt Vehicle Fleets to Customer Demand**
   In addition to using standard transit coaches on regular fixed routes, suburban operators need to diversify their fleets just as they need to diversify their services. Large, comfortable, over-the-road coaches have been essential in attracting choice riders on longer-haul express routes (Figure 11) whereas vans and minibuses have been the vehicle of choice for flexible services penetrating suburban residential communities, serving suburban downtowns, and providing shuttle services to regional rail systems.
8. **Creatively Adapt Transit Service Practices to the Landscape**
   Suburban transit services must be flexible to adapt to the divergent markets they serve. Operators need to use the full range of operating actions available to them, think creatively when seeking solutions, and link these solutions together into a cohesive transit network. Although middle- and high-density corridors and downtowns may be practical for traditional fixed-route services—possibly augmented by express services—where densities are very low, route deviation and door-to-door services are recognized as the only practical ways to provide the level of service and convenience that can compete with the automobile. Using all tools available, and acting as a "mobility manager" and not as a bus operator, is a hallmark of the most successful programs.

Figure 11. An over-the-road coach used to provide the Route 110 Clipper service in Suffolk County, New York.



9. **Obtain Private Sector Support**
   Because of the inherent risks involve in providing suburban transit services, the greatest inroads in establishing new and successful services have been made when the public and private sectors have worked closely together. The private sector can support new service initiatives in many ways: direct financial support; participation in employee subsidy programs; marketing and outreach; and a comprehensive TDM program offering flex-time, guaranteed-ride home, and other complementary actions. This support is a key component for successful introduction of niche services to the choice rider for work trip services.
10. **Plan with the Community**
    The best services are those that are initiated by transit operators working closely with the local community (i.e., customers, local planners and policy makers, and the private sector). Services initiated in this manner achieve broad-based support, are more responsive to real rather than perceived mobility needs, and in general are more responsive to the local issues, problems, and needs they are intended to satisfy.
11. **Establish Realistic Goals, Objectives, and Standards**
    Suburban transit ridership and productivity levels, even among core routes in a network (as opposed to niche market services) typically are significantly lower than for their urban counterparts. Expectations need to be realistic, and appropriate standards for success need to be set before services are initiated.
12. **Develop Supportive Policies, Plans, and Regulations**
    Land-use policies that foster transit-friendly environments and transit-supportive densities (e.g., concentrated development around suburban hubs) will contribute to the success of public transportation in the suburbs (Figure 12). Parking fees, mandatory automobile-occupancy standards, and other regulatory efforts will also contribute to the immediate success of many projects, but such actions need to be integrated into a well-developed and coordinated land-use, transportation, and growth strategy in order to provide for longer-term success for transit as a key component. Integrated fare structures to create seamless travel also need to be encouraged, along with TDM strategies to complement transit and provide flexibility and choice for consumers.

REPORT ORGANIZATION

Chapter 1 has provided the background for this research, including a discussion of suburban mobility issues, the objec-

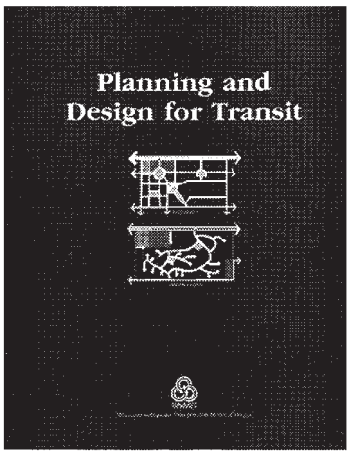


Figure 12. The cover of Planning and Design for Transit, guidelines for integrated land use and transportation development in Portland, Oregon.

tives of the project, and the case study approach. Furthermore, it has defined the classification scheme adopted for suburban transit strategies and presented a summary of the key findings taken from the research.

Chapter 2 places suburban transit development within the suburban planning context and identifies the relationships found in the case studies between suburban transit services and the operating environment. Specific strategies covered in some depth include transit-supportive guidelines, transit-oriented development, and regional growth management.

The next three chapters describe the suburban mobility strategies in detail, with information on specific services, performance levels, and applicability:

- Chapter 3 describes actions that modify and improve the overall suburban transit framework, including *transit centers* and *timed transfers*, *express buses*, and *limited services.*
- Chapter 4 describes experiences with *circulators* and *shuttles.*
- Chapter 5 describes *subscription bus* and *vanpool* programs.

Finally, Chapter 6 provides a synthesis of the findings, identifying what are believed to be some of the common features of successful as well as unsuccessful strategies introduced for serving suburban markets and future directions for continued research into this subject.

CHAPTER 2

SUBURBAN TRANSIT SERVICES: THE PLANNING CONTEXT

PLANNING FOR SUBURBAN TRANSIT SERVICES

The case studies reveal that the planning process used for designing suburban transit services is largely indistinguishable from traditional transit service planning. Most service planning takes place within the context of route-by-route performance evaluations carried out annually or semiannually as part of 5-year strategic plan updates. Routes are normally held against a performance standard, such as a minimum average number of revenue passengers per service hour. Poor performers are normally considered for either major service revisions or elimination.

New suburban services are normally instigated as part of a formal suburban service planning process. Once service options are proposed, designed, and evaluated, they are usually subjected to comprehensive review among stakeholders, including local transportation agencies and citizen interest groups. Other institutional forums were also introduced among the case study sites; some involved coordination among both public agencies and private organizations. An example is the Transpac (Transportation Partnerships and Cooperation) formed in Contra Costa County, a corporation that makes subregional transportation planning recommendations and promotes developing alternatives to private automobile travel.

Some transit agencies have carried out original research in designing suburban services. DART, for example, reviewed experiences with transit services in smaller communities across the United States to develop minimum population and employment density thresholds necessary to sustain various types of supply options.

SUBURBAN TRANSIT SERVICES AND OPERATING ENVIRONMENTS

In carrying out this research, the researchers identified six types of suburban land-use environments across the United States:

- Residential suburbs,
- Balanced mixed-use suburbs,
- Suburban campuses,
- Edge cities,
- Suburban corridors, and
- Exurban corporate enclaves.

Each represents a distinct operating setting that poses unique challenges to America's public transit industry. Appendix A discusses each of these six operating environments and the methods used in this research report for classifying America's suburbs.

Table 3 presents a matrix that cross-tabulates the different types of suburban service strategies reviewed in this report that have been applied to each of the six land-use environments. Several patterns are revealed by the matrix. The more traditional suburban settings—residential suburbs, mixed-use suburbs, and suburban campuses—have generally received the greatest variety of transit service strategies. Circulators and line-haul enhancements, in particular, have been concentrated in these settings. This likely reflects the fact that traditional suburban settings provide a more established and stable ridership base for designing and sustaining reasonably successful suburban services.

More flexible service options—route deviation and demand-responsive services—have been targeted predominantly at residential suburban markets. *Residential suburbs* also usually represent one end (the origin) of feeder links to rail stations and transit hubs. The reliance on more flexible and feeder types of services to accommodate residential markets reflects both the low densities and choice-rider characteristics of these markets.

Balanced, mixed-use suburbs have received very comparable suburban services as predominantly residential suburbs. In general, the market characteristics of these two settings appear to be similar enough that the same types of service offerings are provided.

Suburban campuses, like office parks, have likewise received a breadth of line-haul enhancements, like express routes to rail hubs, and supportive services, like midday runs between the campuses and nearby shopping centers. These more specialized services tend to rely on small vehicles (e.g., bubble-top vans), operate during limited hours, and cost nothing to eligible employees.

The types of services targeted at *edge cities* have largely paralleled those introduced to large-scale suburban campuses, with a few exceptions (e.g., circumferential services in Houston). In both of these instances, it has been the concentration of thousands of workers, regardless of whether they are spread out in campuses or contained in mid-rise buildings, that has given rise to these specialized transit services.

TABLE 3 Matrix of Suburban Transit Service Strategies and Land-Use Environments

	Residential Suburbs	Balanced Mixed-Use Suburbs	Suburban Campuses	Edge Cities	Suburban Corridors	Exurban Enclaves
Modifications to the Overall Framework						
Transit Centers	●	●	●	●	●	
Express Routes	●	●	●	●	●	●
Limited Routes			●	●	●	●
Actions Creating Complementary or Supporting Services						
Fixed Route Circulators	●	●	●	●		
Route Deviation Circulators	●	●				
Demand Response Circulators	●	●				
Rail Station to Employment Shuttles			●	●	●	●
Residence to Bus/Rail Shuttle: Fixed Route	●	●				
Residence to Bus/Rail Shuttle: Route Deviation	●					
Residence to Bus/Rail Shuttle: Demand Response	●					
Midday Employee Shuttles			●	●		●
Subscription Bus	●	●	●	●		●
Vanpools	●	●	●			

Moreover, transit services tailored to office parks and edges cities have also been spawned by mandatory trip reduction ordinances and TDM requirements. It has been in large part the critical masses of workers and institutional support from large companies that have helped sustain specialized feeder and shuttle services to large employment centers.

To date, *suburban corridors* have received both direct express and circumferentially configured bus services. Among the case sites, most suburban-corridor examples are in the Houston area. In cases of *exurban corporate enclaves*, like Plano north of Dallas (Figure 13) and the Woodlands north of Houston, express, crosstown bus connections from either residential neighborhoods or park-and-ride lots have been relied upon to serve these markets. The most ambitious transit program to date targeted at an exurban enclave is found not among the case sites but in the Chicago region, where PACE has introduced nearly 100 subscription vans to serve the new Sears merchandising center headquarters in the community of Hoffman Estates. The program has been highly successful, with around 30 percent of Sears's 5000 suburban workers currently commuting by some form of mass transit, compared with around 6 percent of suburban/exurban workers who transit-commute for the Chicago region at large.

Figure 13. DART Crosstown Limited bus services providing service to office parks in Plano, Texas.

Overall, the case studies provide glimpses into which service strategies work best in which kinds of operating environment settings. Low-density, single-use settings—like residential suburbs and suburban campuses—tend to receive point-to-point services, with buses often tying into a transfer hub or rail station, or else demand responsive services. Mixed-use suburbs and edge cities, because of their higher average densities and variety of activities, tend to receive both these as well as more specialized services (e.g., noontime shuttles) that are usually integrated into timed-transfer networks. Beyond these generalizations, however, it is apparent that considerable knowledge gaps remain regarding the relative success at adapting suburban transit services to different land-use environments. This is an area in which consideration should be given to targeting future research efforts.

LAND-USE STRATEGIES

Three different types of land-use strategies have been introduced as tools for promoting transit ridership in suburban settings: (1) development of transit-supportive design guidelines; (2) planning and formation of transit-oriented development (TOD); and (3) regional growth management. These strategies have sought to create built forms that are conducive to transit riding at three different grains of development. Design guidelines have focused at the site level, seeking to promote suburban designs that both facilitate walking access to transit stops and allow for efficient transit vehicular movements. TOD initiatives, on the other hand, have generally been

directed at the *community* level, aiming to create suburban neighborhoods that are compact, mixed-use, and pedestrian-friendly within close proximity to rail stations and major bus transit stops. Regional growth management efforts have generally sought to influence urban form at a *regional* level, such as through defining urban growth boundaries that hem in new development.

Transit-Supportive Design Guidelines

A 1993 national survey found that about 25 percent of transit agencies in the United States have some form of transit-supportive design guidelines. In general, these guidelines promote the physical development of properties and sites (and, to a lesser degree, subdivisions and corridors) in a manner that supports transit services. Besides imparting technical design information, guidelines promote coordination among stakeholders, encourage long-range planning for transit, emphasize the importance of transit design considerations during project review, and educate the general public about transit issues. Some of the more effective guidelines provide examples of "good design practices" that developers can emulate.

Among the case study sites, CCCTA, Tri-Met, San Diego Transit, and BC Transit have strongly promoted transit-supportive site designs by widely disseminating design manuals (and in the case of San Diego, videotapes). In 1982, CCCTA published one of the nation's first transit-supportive design guidelines, *Coordination of Property Development and Improvements.* The document makes recommendations on the designs of residential subdivisions, roadways (e.g., geometrics), and transit facilities (e.g., siting of bus shelters). CCCTA's planning department has distributed the guidelines to areawide developers and other interests, hoping to promote transit-sensitive designs at the project conceptualization stage. Although CCCTA planners review and comment on all major development projects within the agency's service area, they have never tried to block a project for design reasons; they view their role simply as one of education rather than enforcement.

In the Portland region, Tri-Met has published *Planning and Design for Transit.* The manual describes the many virtues of transit-supportive development and presents examples of designing for pedestrian districts, zoning for land uses, and laying out on-site road systems. Figure 14 presents an example of how to appropriately design bus stop amenities, taken from Tri-Met's manual.

One of the most effective campaigns to date to promote transit-sensitive site designs has been undertaken by Snohomish County Transit, or SNO-TRANS, which serves sprawling Snohomish County north of Seattle. SNO-TRANS guidelines, *A Guide to Land Use and Public Transportation,* makes liberal use of graphics and illustrations and has gained national recognition as one of the best how-to guidelines for designing transit-friendly projects. Figure 15 presents an exhibit from the manual showing how, over time, a typical automobile-oriented suburban strip might be retrofitted into a more compact, mixed-use, transit-oriented community. Key to this conversion are up-front public improvements that improve the quality of the neighborhood and, as a result, help to jump-start private sector improvements. Several of SNO-TRANS's board members regularly meet with developers to review the manual and an accompanying videotape, and the board annually awards a prize to the county's most transit-friendly new development.

TOD

TOD has gained currency in recent years to describe places conducive to transit riding—compact, mixed-use communities that, by design, invite residents, workers, and shoppers to drive their cars less and use transit more. TODs embrace many of the design principles from traditional American towns like Princeton, New Jersey; Savannah, Georgia; and Annapolis, Maryland. Among the hallmarks of a neighborhood-scale TOD is a commercial transit-served core within walking distance of several thousand residents, a well-connected grid-like street network, narrow roads with curbside parking (to buffer pedestrians) and back-lot alleys, diverse land uses, and various styles and densities of housing.

Among the 11 case study sites, four stand out for their leadership in promoting suburban TOD—San Francisco's East Bay (CCCTA), San Diego, Portland (Tri-Met), and Vancouver (BC Transit). All have consciously sought to create a new form of suburban environment that in the long run could dramatically increase transit ridership.

San Francisco's East Bay

Within the service jurisdiction of CCCTA is the emerging transit village surrounding Bay Area Rapid Transit's (BART's) Pleasant Hill station. Between 1988 and 1993, over 1,800 housing units and 1.5 million ft^2 (0.14 million m^2) of class A office space were built within one-quarter mi (0.4 km) of the Pleasant Hill station. Pleasant Hill's success is attributable to three key factors: (a) the creation of a specific plan in the early 1980s that served as a blueprint for targeting growth near the rail station over the next 15 years; (b) the existence of a proactive redevelopment authority whose staff aggressively sought to implement the plan by assembling irregular parcels into developable parcels and issuing tax-exempt bond financing for public and private improvements; (c) having a local elected official who became the project's political champion, working tirelessly and participating in innumerable public hearings to shepherd the project through to implementation. Current plans call for converting two BART parking lots at the Pleasant Hill station into structured replacement parking in order to open up land for restaurants, retail shops, and a regional cultural complex, activities that are currently missing but are widely viewed as vital toward creating a more village-like atmosphere.

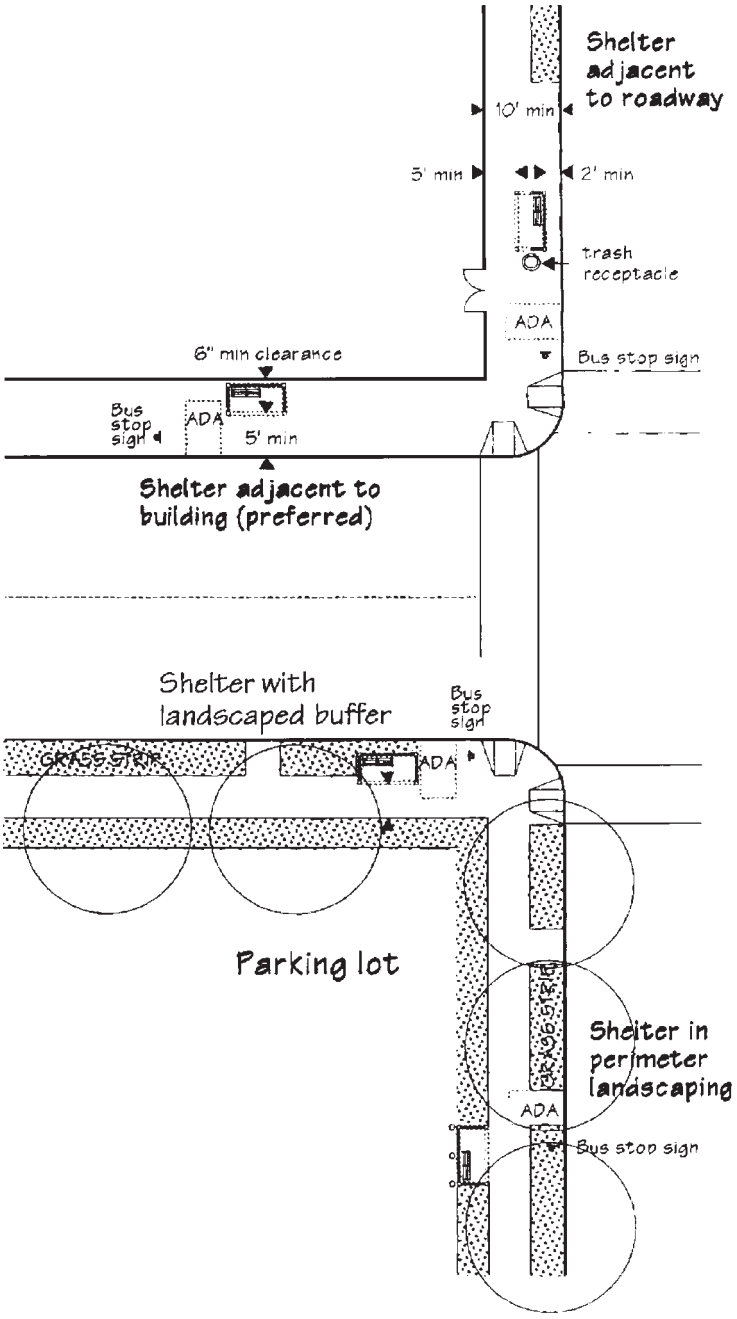


Figure 14. Designing bus stop amenities, one of the many guidelines provided by Tri-Met in Planning and Design for Transit.

Surveys of people living in Pleasant Hill's transit village reveal that 47 percent patronize some form of mass transit to work (either BART or the County Connection). This transit modal split is three times higher than for the entire city of Pleasant Hill and around five times higher than the Bay Area average. Tenants of the transit-oriented housing also own relatively fewer vehicles than the county average, in part because of the availability of BART and frequent CCCTA feeder services.

San Diego

In recent years, the city of San Diego has strongly promoted transit-oriented designs, adopting a formal policy "to direct growth into compact neighborhood patterns of development, where living and working environments are within walkable distances of transit systems" (City Council Policy 600–39). Since 1990, more than 380 modern apartment units have been built adjacent to the Amaya light-rail station in the

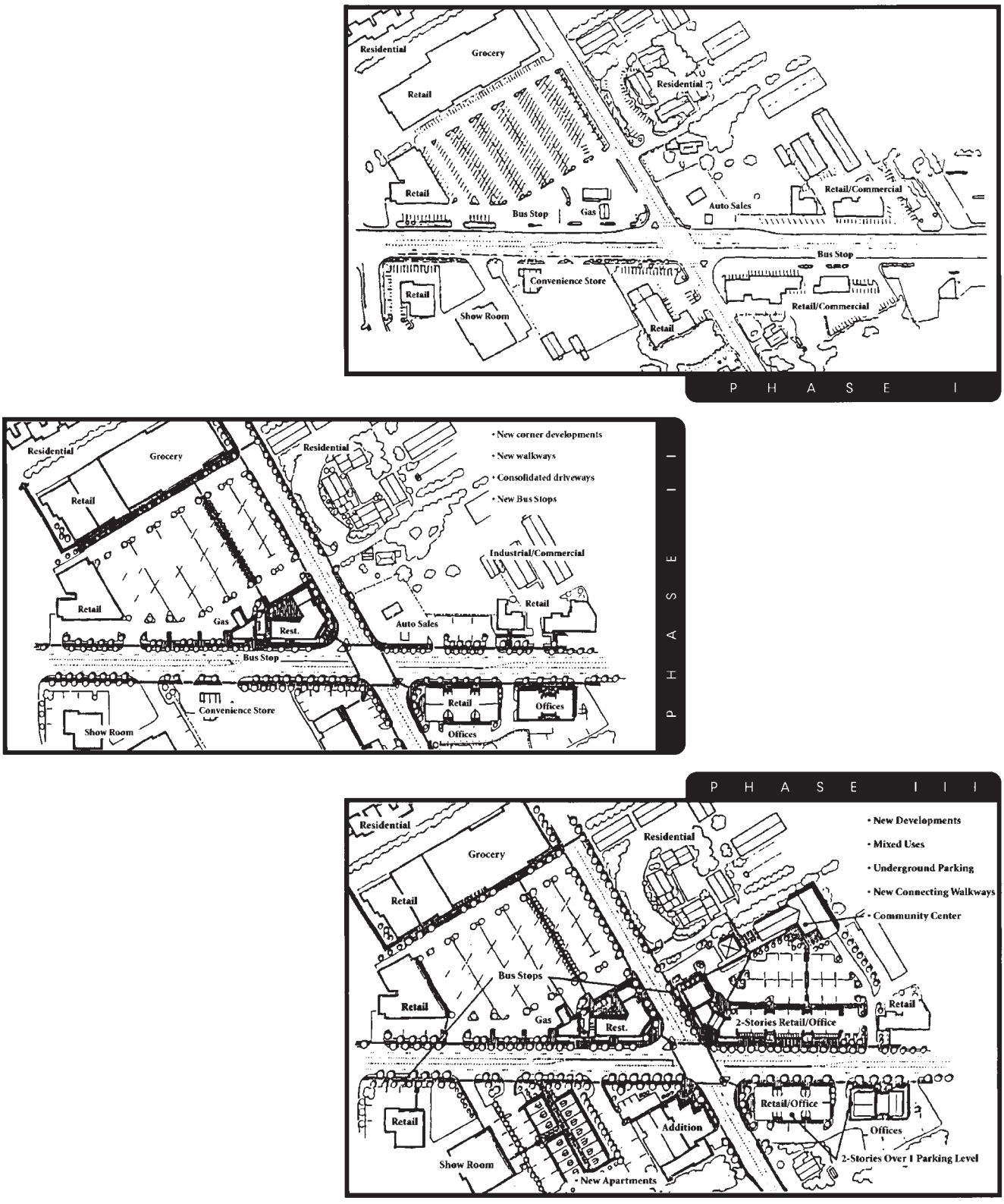


Figure 15. Automobile strip-to-transit conversion, in SNO-TRAN's Guide to Land Use and Public Transportation, Seattle, Washington.

San Diego suburb of La Mesa. Currently under construction is Otay Ranch, a master-planned community adjacent to the cities of San Diego and Chula Vista, which will feature five village clusters and will be served directly by an extension of the trolley line. The most ambitious TOD planning, however, is currently under way along the $240 million Mission Valley trolley line now under construction. Mission Valley has grown rapidly in recent years; it is the recipient of two regional shopping malls, several campus-style office parks, and San Diego's Jack Murphy Stadium. To effectively serve TOD, the Mission Valley crosses the San Diego River three times in order to serve site developments on the flat valley floors and preserve the sensitive hillsides that define the valley. Whereas earlier San Diego trolley lines were aligned along abandoned freight rail lines and freeway corridors to minimize land acquisition costs, San Diego officials have opted to align the Mission Valley corridor to maximize development potential, even if it means dramatically inflating the project's cost.

Portland, Oregon

Portland, Oregon, has gained a reputation as a national leader in promoting TOD. The MAX light-rail line is widely credited with stimulating redevelopment in downtown Portland and the Lloyd Center; however, to date little has happened along the east-side line that extends to the suburban community of Gresham. Portland planners hope to more effectively leverage transit, however, with the MAX extension currently under way on the city's west side. There, an ambitious, state-of-the-art planning campaign aims to create new transit-oriented communities that will obviate the need to build a planned west-side freeway. This western corridor in suburban Washington County has experienced phenomenal growth in recent years. During the 1980s, it accounted for two-thirds of population growth and 96 percent of employment growth in the Portland metropolitan area. Planning for this corridor has been a joint public-private endeavor. The region's governing body, Metro, in coordination with local and county governments, has led public sector planning. In parallel, the 1000 Friends of Oregon, an independent pro-environment group, carried out its own comprehensive planning, under the aegis of the LUTRAQ (land use, transportation, and air quality connection) program. The LUTRAQ study recently concluded that transit-oriented communities could accommodate 65 percent of new homes and 78 percent of new jobs in suburban Washington County.

Among the innovative planning measures currently under way along the west-side corridor has been the use of interim zoning to prevent land uses that might be incompatible with TOD during the planning stages. Besides prohibiting automobile-oriented uses within one-half mi (0.8 km) of planned stations, interim zoning sets minimum densities, limits parking supplies, and requires buildings to be physically oriented to light-rail station entrances. Additionally, public-private master development of transit-oriented communities, using some 1,500 acres (6.07 kms) of vacant land, is now breaking ground. One site, Beaverton Creek, located in the upscale suburb of Beaverton in the state's high-tech Silicon Forest, is slated to be the first project built under Portland's transit-oriented design guidelines. It is being planned by a team of landowners, including Specht Development, First Western Investments, U.S. Bank, Texktronix, and Tri-Met. The west-side line was routed to take advantage of Beaverton Creek's prime development parcel. Some 1,600 multifamily units at blended densities of 22 to 35 units per acre and several hundred single-family homes are proposed for the Beaverton Creek site. A generous system of pathways will also tie it to the Nike world headquarters, immediately to the north.

Vancouver, British Columbia

Since adopting the *Liveable Region Plan* in 1975, Vancouver has sought to create a system of town centers throughout the metropolitan area that would be efficiently linked by the SkyTrain advanced light-rail system and feeder transit services. The long-range plan calls for a hierarchy of urban centers, with the primary centers interconnected by rail and smaller centers relying on radial crosstown express services and feeder vans Figure 16. An example of transit-oriented development is the Burnaby Metrotown, an urban center that boasts a SkyTrain station in its core. Burnaby is a mature inner suburb of some 160,000 inhabitants located 6 mi (9.66 km) south of downtown Vancouver. In its transit-served core are moderate density commercial, office, and other mixed land uses. The core is surrounded by parks and a supporting ring of multifamily mid-rise apartments and townhouses. Single-family housing lies beyond the higher-density housing. This wedding-cake pattern of densities has put those most likely to ride transit— shoppers, office workers, and apartment dwellers—closest to the SkyTrain hub. Ninety percent of all commercial parking spaces in Burnaby are provided in structures or below ground. This has freed up land for parks, passageways, and bike paths that connect surrounding residential areas to the SkyTrain station.

REGIONAL GROWTH MANAGEMENT

Several of the case study areas also stand out for attempting to manage regional growth to create a more compact, transit-supportive urban form. Portland has long had one of the most ambitious regional planning and growth management efforts in North America. The Portland region has enacted an urban growth boundary (UGB). This boundary sets the outer limits for urban development over a 20-year period. Metro, the region's governing body, defined the UGB in 1979 and has made only minor revisions to it since then. The UGB's strength in containing sprawl will likely be tested

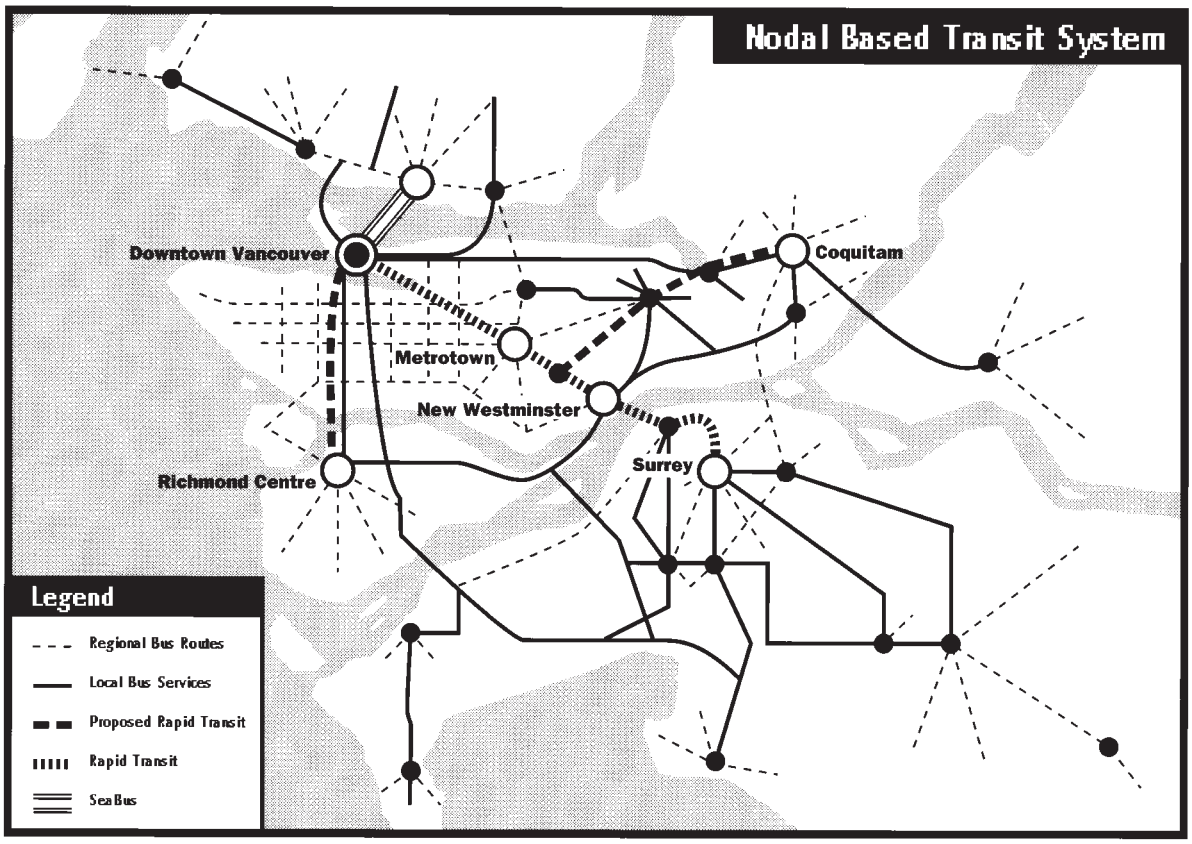


Figure 16. The long-range plan for the Vancouver, British Columbia, region links a hierarchy of urban centers using rail and bus services.

in coming years; it was originally drawn to contain a generous supply of land, and only recently have some cities begun to run out of developable land. To guide future growth, Metro has recently worked with local governments and citizens to reach a consensus on the region's future preferred settlement pattern in a process know as Region 2040. The adopted growth strategy calls for concentrating future growth in regional centers that are served by multimodal arteries and transit services (Figure 17). With an urban growth strategy now in place, the region has begun to move toward designing specific neighborhood plans, many of which are focused on rail transit stations.

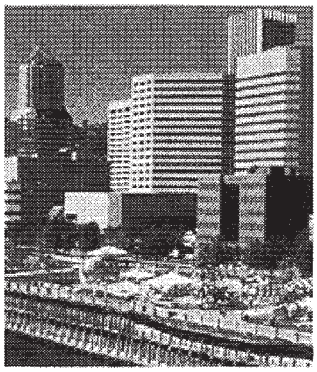
Much of the impetus for regional growth management in the Portland region has come from the state of Oregon. In 1991, statewide legislation was passed that mandates implementation of transportation and land-use measures that will reduce per capita vehicle miles traveled in the Portland region by 10 percent in 20 years and by 20 percent in 30 years. This transportation planning rule has set into motion various initiatives to limit parking near rail stops, improve pedestrian and bicycle connections, and build more transit-oriented communities.

In the Greater Vancouver area, regional transportation-land-use planning and growth management can be traced back to the 1930s. The vision of compact and sustainable regional growth was crystallized in the region's historic *Liveable Region's Plan* that embraced the idea of connecting regional town centers by fast and efficient public transportation. As noted, these town centers have become the foci of higher-density development and the building blocks for a regional system of high-capacity transit linkages.

Last, the San Diego region has enacted a regional growth management strategy through the San Diego Association of Governments. The centerpiece of the regional growth management strategy is the development of reasonably self-contained, less automobile-dependent communities, like Mission Valley, that are conducive to transit riding.

MARKETING SUBURBAN TRANSIT SERVICES

Given the general unfamiliarity of many suburban residents and employees with nontraditional transit services, marketing takes on a particularly vital role in an suburban transit service program. As elsewhere, marketing has two key features: (a) identifying and targeting services to existing, potential, and emerging ridership markets; and (b) promoting and acquainting the public with service options.



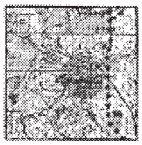
Central city

Downtown Portland serves as the hub of business and cultural activity in the metropolitan region. It has the most intensive form of development for both housing and employment, with high-rise development common in the central business district. The role of downtown Portland as a center for finance and commerce, government, retail, tourism, and arts and entertainment will continue in the future.

Neighboring cities

Communities such as Sandy, Canby, Newberg and North Plains will be affected by Metro's decisions about managing the region's growth. While Metro cannot plan for these communities, a significant number of people live there, some of whom work in the metropolitan area. Cooperation among Metro and these communities is critical to address common transportation and land use issues.

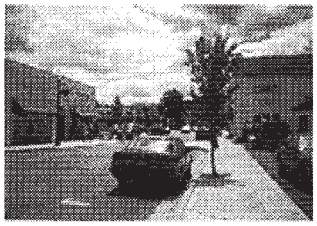
Regional centers



Regional centers are characterized by compact employment and housing development served by high-quality transit. Two- to four-story buildings are typical.

In the growth concept, nine regional centers serve six market areas – Gateway serves central Multnomah County; downtown Hillsboro serves the far western area; downtown Beaverton and Washington Square serve inner Washington County; the downtowns of Oregon City and Milwaukie along with Clackamas Town Center serve Clackamas County and parts of Portland; downtown Gresham serves the eastside; and downtown Vancouver, Wash., serves Clark County.

Regional centers are centers of commerce and local government services. They will become the focus of transit and highway improvements.



Corridors and main streets

Similar to town centers, main streets have a traditional commercial identity but are on a smaller scale with a strong sense of neighborhood community. Examples include Southeast Hawthorne in Portland, the Lake Grove area in Lake Oswego and the Kenton area in North Portland. Corridors are major streets that are used intensively and serve as key transportation routes for people and goods. Examples of corridors include the Tualatin Valley Highway and 185th Avenue in Washington County, Powell Boulevard in Portland and Gresham, and McLoughlin Boulevard in Clackamas County. One- to three-story buildings are typical in corridors and main streets, and both are served extensively by transit.

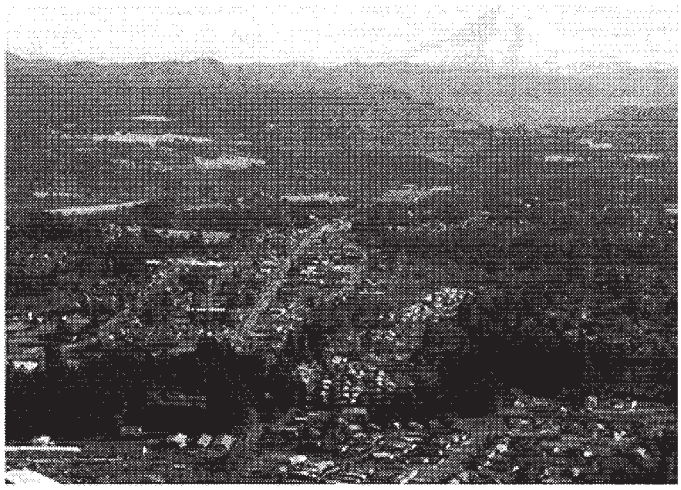


Figure 17. Development guideline examples taken from the Portland, Oregon, area's Region 2040 plan.

Figure 18. A CCCTA one-stop transit shopping center.

Figure 19. The Riverside, California, intermodal center showing the RTA information center.

Identification and evaluation of suburban transit markets are normally carried out through formal surveys, focus groups, and meetings with regional stakeholders and informants. Less formal approaches are also sometimes used. For example, transit managers often meet with drivers to discuss ways of tailoring services to customer needs.

Once services are introduced, typical marketing approaches include direct mailings, distribution of fliers, advertising campaigns, and radio jingles. Some service providers have gone the extra distance to get the public to notice and try their new services. When the WhirlyBird Mall express shuttle service was introduced, LANTA had a costumed mascot at the mall and gave away promotional coloring books with coupons good for free rides and gifts from mall merchants. LANTA adds the special touch of sending patrons a birthday card and free ride coupon when they turn 65. In Contra Costa County, new shuttles services were aggressively marketed through newspaper stories, television coverage, circulating brochures, and hanging banners along shuttle routes. CCCTA also considers its "one-stop transit shopping center" to be an important feature of its marketing campaign (Figure 18). Open from 6 AM to 7 PM on weekdays, the Center provides full customer information and services, including personal and automated trip planning, multiride punch cards and regional transit connection discount cards, and telephone information.

Where services are directed at specific residential neighborhoods, marketing has tended to be more targeted (Figure 19). The Fort Worth T mailed information packages describing the Rider Request component of route-deviation services, along with a refrigerator magnet listing the reservation telephone number.

To make their services stand out, several suburban transit agencies have also introduced unique color schemes. LANTA uses a special color and logo to distinguish shuttles from core bus services. CCCTA similarly uses a distinctive logo and color scheme for its shoppers' shuttle in downtown Walnut Creek.

CHAPTER 3

ACTIONS TO MODIFY AND IMPROVE THE OVERALL SUBURBAN TRANSIT FRAMEWORK

This chapter describes strategies used by suburban operators to enhance the performance of their overall network—transit centers and timed transfers, express bus routes, and limited-stop services. The sections describing each of the strategies, for this chapter as well as for each succeeding chapter, are divided as follows:

- Description,
- Applicability,
- Performance range, and
- Conditions of effectiveness.

ESTABLISHING A TRANSIT CENTERS CONCEPT AND TIMED-TRANSFER PROGRAM

Description

One of the most common types of changes introduced on a regional basis for improving suburban transit services is the introduction of timed-transfer systems organized around suburban transit centers. In metropolitan areas with rail services, these centers are very often intermodal terminals located at rail stations, supplemented by other centers located at malls, in suburban downtowns, or at other key activity centers. In non-rail cities, the transfer terminals are also often associated with the malls and suburban downtowns, and commonly offer transfers to urban bus routes to provide for regional trip making. The experience of Tidewater Transit, however, demonstrates that transfer centers can also exist independently of activity nodes.

Timed-transfer systems organized around transit centers are designed to facilitate transfers and reduce the length of waits. Timed transfers are particularly important in suburban settings because low-density operating environments often result in relatively long headways. Transit centers, ranging from the simple shelters of the Tidewater Transit District to enclosed, temperature-controlled structures such as in Dallas, serve as the intermodal hubs where suburban transfers are made (Figures 20 and 21).

Applicability

One national survey of 88 U.S. transit properties found that 68 percent of the surveyed agencies had some form of timed-transfer and transit center services; among properties with more than 350 vehicles, almost 90 percent used timed transfers.

Among the 11 case sites the researchers examined, two general approaches to designing timed-transfer networks were found, pulsed, and coordinated.

- Pulsed systems involve designing suburban transit routes so that buses arrive and depart transit centers at approximately the same time. Often a "window" is set where buses are to arrive within 3 to 5 min of each other. This means buses fan out from a designated transit center into different neighborhoods at roughly the same time and feed back into the same center at approximately the same time. A prime example of a pulsed system is Tidewater Regional Transit (TRT). Among the 11 case sites, TRT's timed-transfer system is the most impressive. Using Edmonton's seminal timed-transfer system as a model, TRT introduced 13 direct transfer centers in 1989. These are locations where buses serving two or more routes arrive within 3 min of each other. (Buses operate on 30-min intervals, normally scheduled to arrive at centers 15 min before and after the hour.) A 3-min wait time is scheduled at each location (with up to a 2-min extension if a driver sends a radio message that he or she is running late).
- Coordinated timed-transfer systems tend to operate more loosely. Here, bus schedules are not strictly set with vehicles expected to arrive within a few minutes of each other. Rather, in view of the sometimes circuitous roadways found in low-density settings, efforts are made to bring buses together at a transit center within a more liberal time allotment, usually between 10 and 15 min. In the case of Portland Tri-Met's timed-transfer system, feeder buses tying into transit centers face tighter on-time requirements than other buses, and they have a window during which they can wait for a delayed trunk-line route (Figure 22). However, waits of 10 to 15 min to transfer between buses among Tri-Met's 15 transit centers are not uncommon.

Every one of the operators surveyed had at least some element of timed-transfer/transit centers within their overall framework, whether the concept was a simple as coordinated transfers between feeder routes and trunk routes at malls in

Figure 20. A very basic transit center design from the Tidewater Transit District in Norfolk, Virginia.

LANTA or as complex as the network of suburban transfer centers in large metropolitan areas such as Dallas, Tidewater, Houston, Portland, and Vancouver (BC). In the latter cases, major transfer terminals were developed to serve as hubs around the region for the confluence of local suburban bus services, local circulators and shuttles, central business district (CBD)-oriented radial bus and rail services.

Tidewater's direct transfer centers operate in a manner akin to the downtown "pulse points" found in many smaller cities. The difference is that there are multiple pulse points and they are located throughout the region. An important feature of TRT's direct transfer centers is that they are fairly modest, which has lowered capital costs and saved on ongoing maintenance. Because all connections are timed, passengers usually move directly from bus to bus. This means they need not wait at the center or if they do have to wait, it is for only a few minutes. In inclement weather, passengers are permitted to stay aboard buses until their connecting buses arrive. Because all transfer activity occurs when several buses are at the center, security is less of a problem, even during evening hours.

DART has oriented its service around 14 transit centers, most of which include a park-and-ride component (Figure 23). The transit center serves as the transfer point between feeder/distributor routes, express routes, and crosstown routes. Most facilities include an enclosed climate-controlled waiting room with off-street loading for up to 12 buses. Several transit stations will become rail stations when the new light-rail system expands into the suburbs.

Figure 21. A temperature-controlled suburban transit center in Dallas, Texas.

LANTA adopted a 10-year strategic plan in 1993 to meet its changing needs and included a strong push toward new services in the suburban areas outside the urban core. Shuttles have been developed that are linked to suburban malls, where regular CBD-oriented bus services are available. Use of regional malls enhances the viability of the circulators for local travel and offers a linkage for suburb to CBD trips that otherwise would be too costly to provide with a single direct route (Figure 24). It also allows LANTA to keep its capital costs low and fosters participation from the mall developers.

CCCTA operates all of its fixed route buses into BART stations with a tie to BART timetables but not a true timed-transfer pattern. Bus-to-bus transfers are increasing, however, and CCCTA is beginning to concentrate on non-rail station transit centers in other areas of the county. The centers themselves are carefully designed to accommodate bus operations as well as to maximize customer comfort and convenience during the transfer process. The concept is further supported by transit-friendly regulations aimed at concentrating activities around these transit hubs and promoting the transit village concept. In general, BART has designed intermodal facilities to allow for efficient bus maneuvers into stations, to ensure safety, and to make transferring convenient. Within its stations, bus staging areas are designed to provide sufficient turning radii and layover facilities for buses, space for shuttles, and to prevent vehicle conflicts. The sawtooth boarding bay arrangement at most stations allows buses to pull in and out easily and has made buses more easily identifiable, thus expediting passenger transfers.

The transit environment in suburban areas is defined by diverse origin-destination patterns and moderate to low densities. Under these conditions, it is recognized that ubiquitous networks are impossible to provide and even moderate networks are costly to maintain unless the services can be organized and focused so that the diverse trip patterns can be concentrated and transit services appropriately organized. As the case studies demonstrate, the transfer centers concept is recognized as the most appropriate approach to addressing these issues. It is applicable across the board as a means of focusing services, linking local and regional systems in the most cost-effective manner, and linking the family of services needed to tailor transit to the suburban market. It enables operators to serve multiple origin-destination patterns more effectively and, through the use of timed transfers, to do so with a minimum of disruption to the customer.

Performance Range

Implementation of the first direct transfer centers in Tidewater in 1989 coincided with the first gain in system ridership after 4 years of steady decline. However, the specific influ-

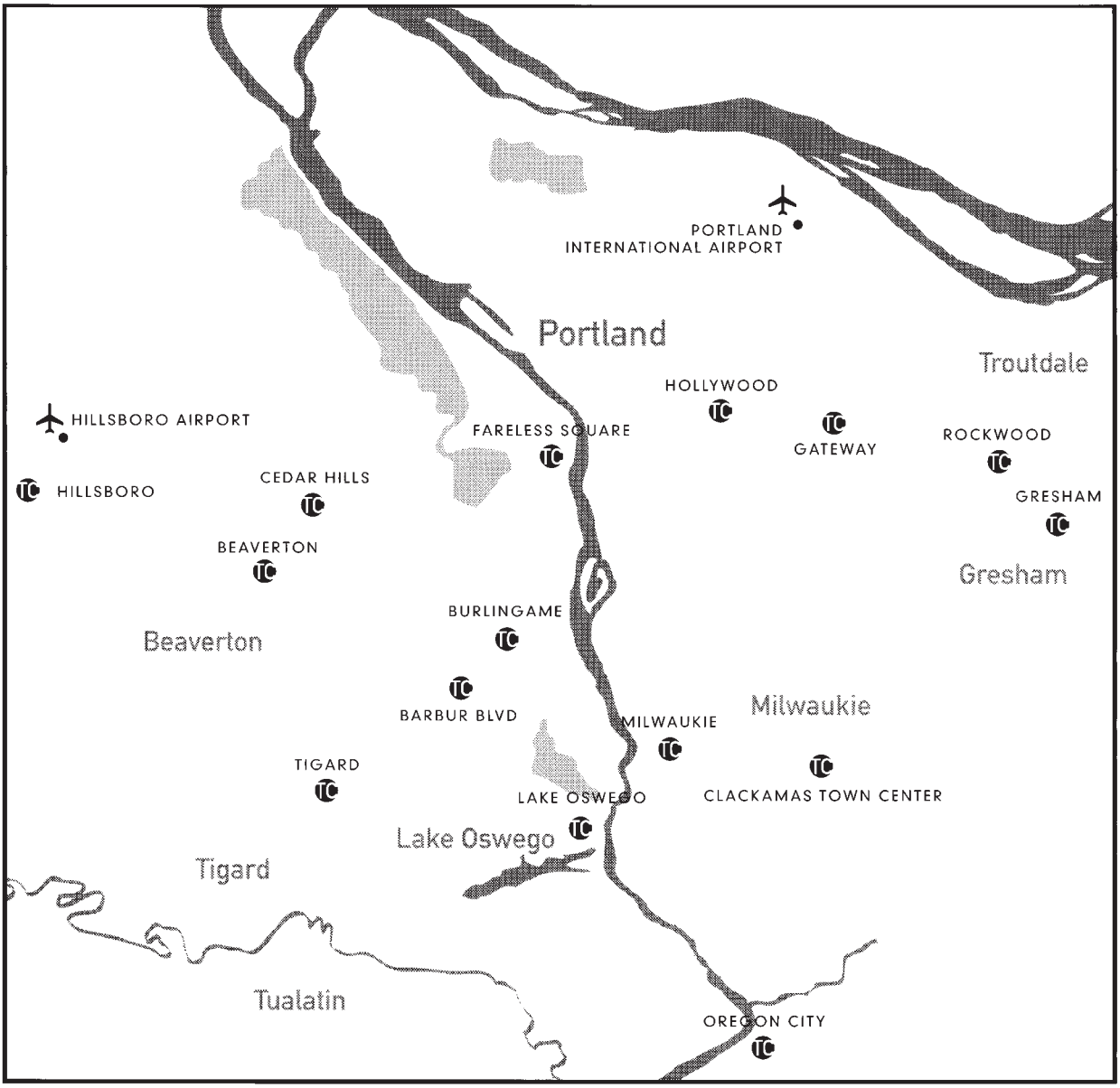


Figure 22. The network of transit centers for the Tri-Met transit system in Portland, Oregon.

ence of the direct transfer centers on these gains cannot be determined because other events occurred at the same time—elimination of direct service to some locations, provision of new services to other areas, and so forth. Moreover, the ridership gains immediately following the initiation of timed-transfer services were short lived. Ridership continued to fall throughout the Tidewater area during the first half of the 1990s in large part because of a downturn in the economy induced by defense industry cuts and deployment of naval personnel to the Middle East and other military locations. From a user's perspective, TRT's direct transfer system appears to have been well received. A 1992 on-board ridership survey revealed that three-quarters of TRT's customers preferred timed transfers to previous services.

More compelling evidence about the potential ridership benefits of timed transfers comes from AC Transit, serving the Oakland (East Bay) region of the San Francisco Bay Area. In the late-1980s, AC Transit began phasing in timed transfers in response to the suburbanization of employment. A multidestination transit centers program was formally initiated in early 1989. Table 4 shows that ridership increased during a 2-year period (1989–1991) when timed transfers and pulse scheduling were introduced within two subdistricts of AC Transit's service area. By contrast, patronage on the rest of AC Transit's service area, where traditional radial services remained, continued to fall over the same period. Service levels (vehicle miles of service per 1,000 households) were similar across the subdistricts over the 1989–1991 period.

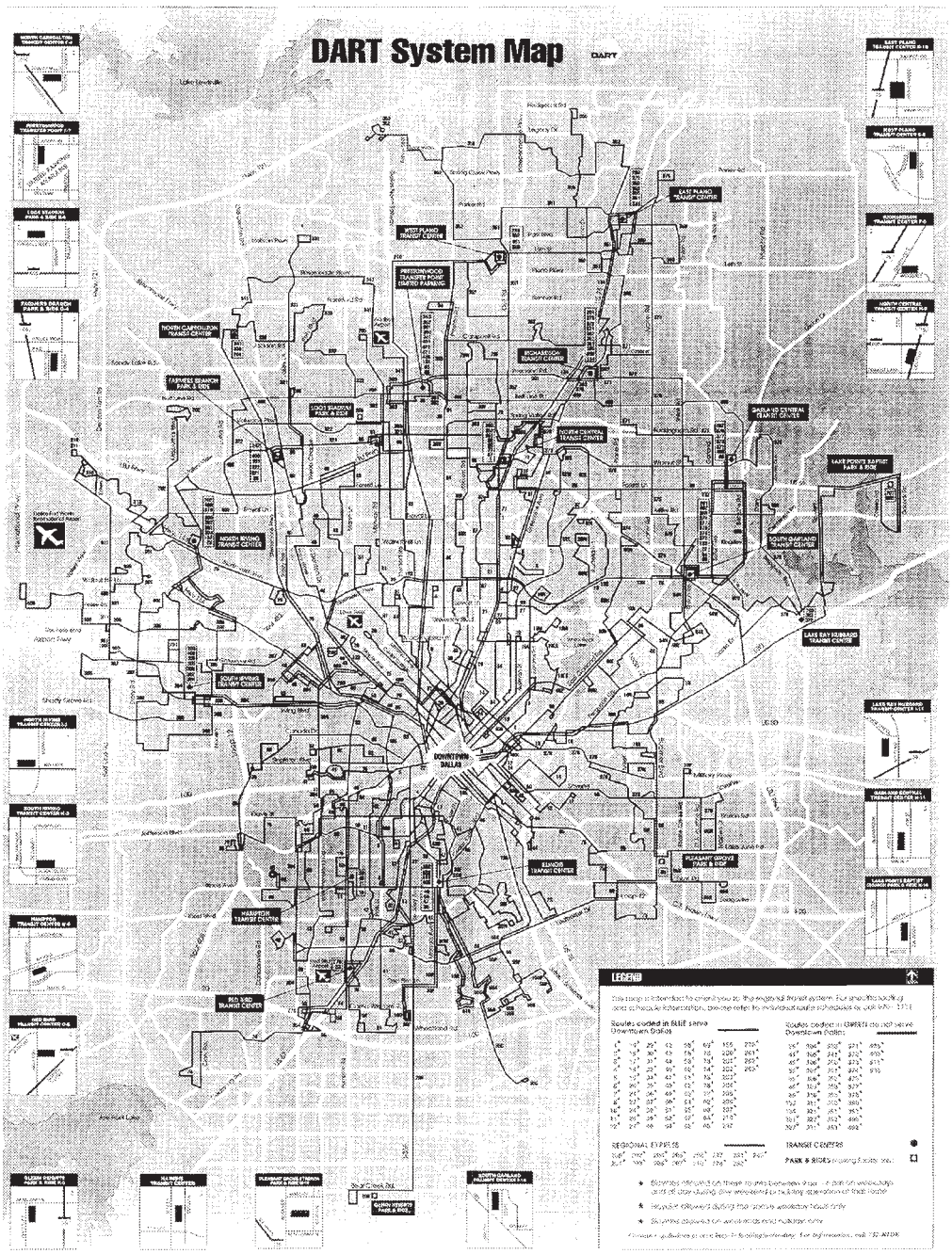


Figure 23. Layout of the DART timed-transfer bus systems.

Historic data from other areas also seem to indicate that the switch to timed transfers can have a positive impact on ridership. Comparisons of ridership 1 year after introduction of timed transfers showed systemwide increases of 3.2 percent in Dayton, Ohio (between 1990 and 1991), and 40 percent in Painsville, Ohio (between 1989 and 1990), even though ridership was falling for most other Ohio transit properties for the same periods.

In general, even in the absence of any quantitative data on performance, operators and customers generally agree that the timed-transfer concept provides mobility benefits to the customer and cost savings to the operator, albeit with a modest loss in directness for some origin-destination pairs.

Conditions of Effectiveness

The conditions of effectiveness are generally straightforward for implementing a transfer centers approach. They include the following:

Figure 24. A LANTA suburban transfer center located at the regional mall offers convenient transfers between local circulators and shuttles and the regional line-haul network.

- An overall strategy described in a long-range plan for the area can provide significant support in the development of a transfer center concept. Having a coordinated land-use/transportation strategy in place has provided the impetus for major initiatives in Vancouver (BC) and Dallas and supports the actions taken in Tidewater and Contra Costa County by fostering development strategies that will strengthen the concept. Plans with long-term commitments to transit-friendly designs, land-use controls to concentrate development around transit centers, and the like will continue to strengthen the impetus for transit center development.
- Establishing support among local planners and policy makers, developers, and mall owners helps to develop, design, and promote transit-friendly centers. Being allowed to develop centers at malls or other major activity centers (besides rail stations) enhances use of buses for both local and regional travel.
- Clearly, the presence of rail to serve as a hub for the transfer center concept helps immensely, providing a major impetus to local bus ridership. Strong connections to express buses and other CBD-bound services can have similar effects, especially if wait times are minimized.
- Not all arrivals at a transit center come by local bus for their transfer to rail or express bus. Parking lots at transit centers will encourage transit use for the line-haul trip even if it competes, locally with the feeder bus network. Although it is recognized that no level of bus service will attract everyone, park-and-ride lots will provide additional benefits to the community at large if a significant number of riders are persuaded to make their line-haul trip via transit and not on congested roadways (Figure 25).
- Because the concept tends to lengthen many trips by forcing routes into a transfer center, care needs to be taken to understand origin-destination patterns to avoid long bus trips compared with the same trip taken by car. The transit trip cannot be made so indirect that it becomes uncompetitive even for the nontransferring passenger.
- Although the transit center can be quite modest, constant attention is still required to keep it clean and attractive to users. Furthermore, riders need to feel safe and secure, which requires consideration of the center location as well as a plan for ongoing supervision of the site.
- Transfer fees, if any, need to be kept low to encourage these trips. Furthermore, low-cost or no-cost transfers should be allowed between various operators, with the ideal being a seamless fare approach that allows free movement among all operators using the transfer center.

ENHANCING LINE-HAUL SERVICES

The backbone of any bus system, urban or suburban, is its network of trunk-line routes. Suburban operators have found that, when properly planned and implemented, enhancing

TABLE 4 Ridership Trends Associated with Phase-In by AC Transit of Multidestination, Timed-transfer System, 1989–1991

Subdistrict	Average Weekly Ridership December 1989	December 1991	% Change
West Contra Costa County[a]	12,488	28,329	+32
Oakland-Berkeley-Alameda[b]	146,386	156,987	+7
Remainder of AC Transit Service Area	58,671	49,357	-16
SYSTEM TOTAL	226,545	234,673	+4

[a] Multi-destination and timed transfer system introduced in September 1990
[b] Multi-destination and timed transfer system introduced in April 1991

Source: R. Cervero, "Making Transit Work in the Suburbs," Transportation Research Record 1451, pp. 3-11

Figure 25. Many of the Dallas transfer centers are located at park-and-ride facilities.

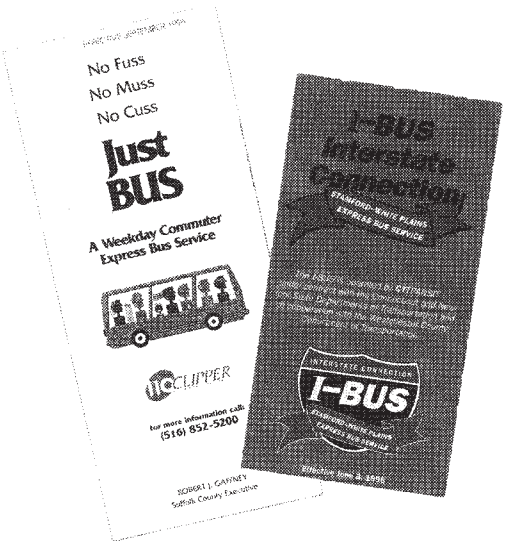


Figure 26. Cover art for route maps and schedules for two suburban express bus services.

these local routes with limited-stop or express bus routes offering a higher quality of service can improve service for its core riders and can attract choice riders to the system. This section describes experiences with these two concepts for suburb-to-suburb travel.

Express Routes

For long distance trip making from suburb-to-suburb, particularly for commuter trips, many operators have begun express bus services, hoping to provide travel speeds similar to single-occupant vehicles coupled with comfort and reliability aimed at offering a stress-free ride.

Description

Express bus service generally consists of long-haul, moderate- to high-speed routes with few stops, serving regional trips. Stops, if any, are widely spaced, for collection and distribution, and most of the route is operated at high speeds along the arterial or highway network (Figure 26). Ideally, express services are provided with special equipment, which is designed for more comfort than regular coaches in local service.

There are a range of variations in the way express bus services are provided, but the underlying principal is to provide a higher speed, more comfortable ride than local bus service offers, so that public transportation can be competitive with the automobile for longer distance trips, particularly for commuter trips. Speed, reliability, and comfort are key determinants of the success of these services along with pricing and availability.

To obtain reliable travel times and competitive travel speeds, as much of the trip as possible is provided on highways or arterial roadways, preferably with special treatments such as bus or high-occupancy vehicle (HOV) lanes. Most frequently, these lanes are oriented to CBD-bound express buses, but the use of HOV lanes for suburb-to-suburb travel has been increasing and was cited in at least one of the case studies. To minimize in-vehicle travel times, express buses will originate at park-and-ride lots in some cases, with collection being done either by local buses or by automobile. Finally, operators increasingly have developed express bus services with special equipment, featuring cushioned seats, individual interior lighting, and other features to compete with the comforts of the automobile.

Applicability

There are two general applications of express bus services found among suburban operations.

Corridor Enhancement. Express bus services are used to offer a higher level of service in heavily traveled corridors, often to supplement local bus services running along the same corridor. These expresses often use the same roadways as the local buses, achieving higher operating speeds by reducing the number of stops along the route. To achieve higher speeds, selected sections of the routes can be operated along limited access highways instead of along the arterial road network.

Passengers boarding and alighting at the ends of existing local routes are provided with higher quality service, and at the same time loads on heavily traveled local buses can be reduced to acceptable levels. New riders are attracted by the faster travel speeds and, in many cases, more comfortable equipment used on the express buses.

Corridors in which suburb-to-suburb express services operate need to be densely developed with both significant numbers of residents and activity centers. Furthermore, they

need to be anchored by well-defined, active terminal points upon which the service is oriented. In the case of the Inland Empire Express, operated by the Riverside Transit Agency, the two terminal locations are the Edge Cities of San Bernardino and Riverside, which are not only final destinations for many trips but also major transfer points to local Omnitrans and Riverside Transit buses.

Long Island Bus (LI Bus), which operates in suburban Nassau County and adjoins New York City on the east, has a number of high-density bus corridors that connect major suburban activity centers to the New York City subway network in Eastern Queens County. Once primarily oriented for Nassau residents going into New York, these corridors now have significant travel in both directions as employment opportunities have expanded to the suburbs. In recent planning studies, these corridors have been identified for the development of express bus and limited bus services, operated in much the same manner as described for the Inland Empire Express. The express services would operate between the terminals in Queens and those in Nassau County without interim stops; the limiteds would provide stops along the route at key activity nodes. LI Bus hopes to separate loads in this manner to operate more efficiently, thus improving overall operations, and to enhance its services to attract additional choice riders to transit.

In both cases, another factor in the application of express services is to offer a premium service, relative to a local bus, but at a fare lower than that of parallel rail services—Metrolink in Riverside County and Long Island Rail Road in Nassau County. The express buses and rail services, though both in the same corridor, have been found to attract different markets, with the bus riders generally having a lower income profile and shorter average trip lengths.

The frequency of the service and total trip length appear to be highly dependent on local conditions and markets. Riverside Transit operates Route 100 on 75-min headways, and the total route travel time is 35 min. As the next section on performance shows, despite the long headways, the route has good ridership. The LI Bus service, as described in the agency's recent planning study, could have as many as four to six express trips per hour interspersed with a local service operating as frequently as every 5 min.

Peak Employment Services. Express buses are used by a number of operators to offer entirely new commuter-oriented services to compete with the single-occupant vehicle in heavily congested corridors. Typically there are three to five trips in the peak direction during peak periods. To provide flexibility, operators often ensure that service extends to the shoulders of the peak and that midday travel needs are met with either one or two bus trips or an employee-sponsored guaranteed ride home/emergency service program. Early morning and late evening runs generally have very low productivities compared with the peak runs but have been shown to be important "safety nets" for drawing riders to these services.

Typical travel times are 30 to 60 min, but the range among the case studies was from 20 to nearly 90 min. The application is best suited to trips of at least 30 min on the express bus itself and only where the in-bus travel time can be competitive with the drive time by automobile. HOV lanes and priority treatments at tolls or exit ramps significantly increase the competitive edge of the bus over the single-occupant vehicle.

Among the peak-hour express services described in the case studies, three operate from park-and-ride lots and serve major suburban work sites. Collection, which is time consuming and costly to operate, is dependent on automobiles in each case. None of the park-and-ride lots is served by collector buses. The express buses do provide distribution and collection at the work trip end, but, for total travel times to be competitive with the automobile, most of the time must be spent in express operation on the highway. The Route 110 Clipper in Suffolk County operates in an HOV lane of the Long Island Expressway (Figure 27).

Houston METRO provides express crosstown services between several park-and-ride lots and outlying employment centers, the most significant of which is Route 292, which runs from the Westwood park-and-ride lot, located in a principally residential area to the Texas Medical Center (TMC), a massive suburban employment enclave with 3,000 workers. TMC was considered an excellent candidate for express crosstown services for several reasons: it is one of the few suburban locales with significant parking charges—$70 per month for a garage space, $55 per month for a surface lot, and $40 per month at service lots; it features on-street amenities like sidewalks, shelters, and skyway pedestrian connections between buildings; and most employers help underwrite the costs of employees' transit expenses.

One of the services, the I-Bus from Stamford, Connecticut, to White Plains, New York, operates between the centers of two edge cities as well as along the I-287 employment corridor (Figure 28). Access to the service can be made via other buses and rail services at intermodal centers in both cities or from several residential areas through which the bus passes before using I-95. This service, initiated in 1996, provides a transit link in a heavily traveled east-west highway corridor unserved by rail.

Range of Performance

Corridor Express Service. The sole corridor express service identified in the case studies was the Riverside Transit Agency Inland Express, which has a productivity of 38 passengers per trip on weekdays and 20 passengers per trip on Saturdays, which translates to 21.7 passengers per hour on weekdays and 14.4 on Saturdays. During peak hours, there is often standing-room-only. The cost recovery rate was 20 percent. In comparison, Riverside Transit's local fixed routes had a 1994–95 productivity of 26 passengers per hour, with a range from 3.7 to 37.9 passengers per hour. For developing

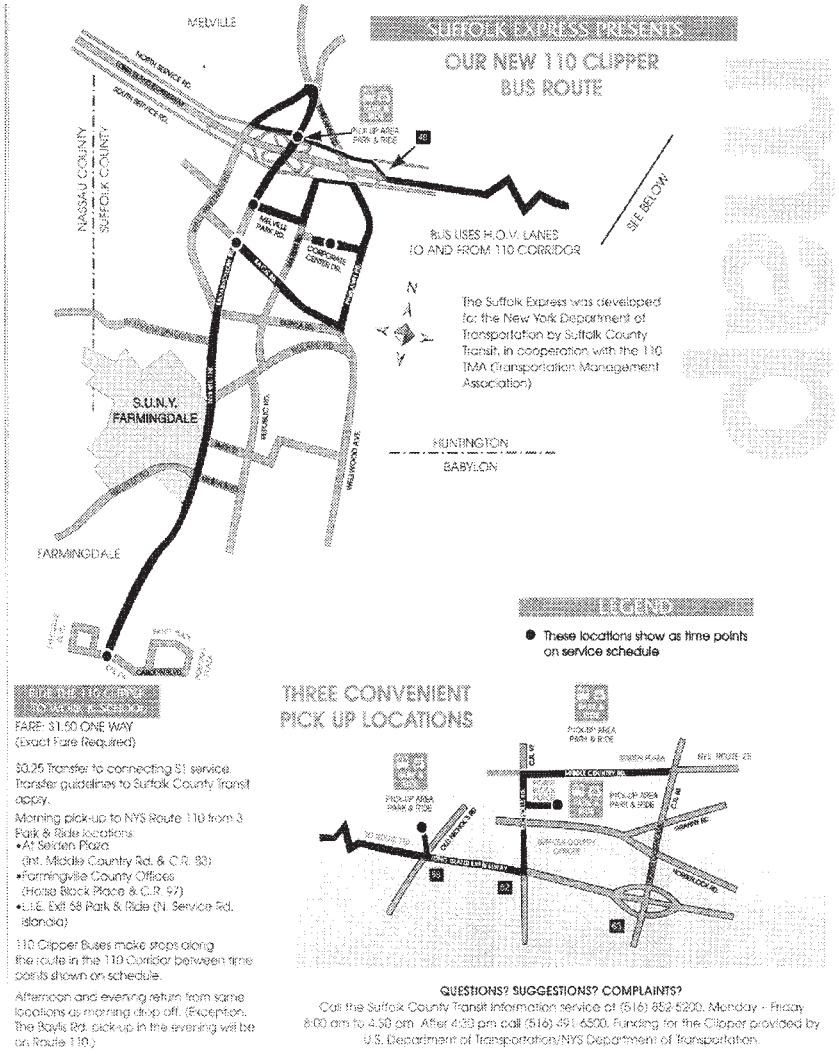


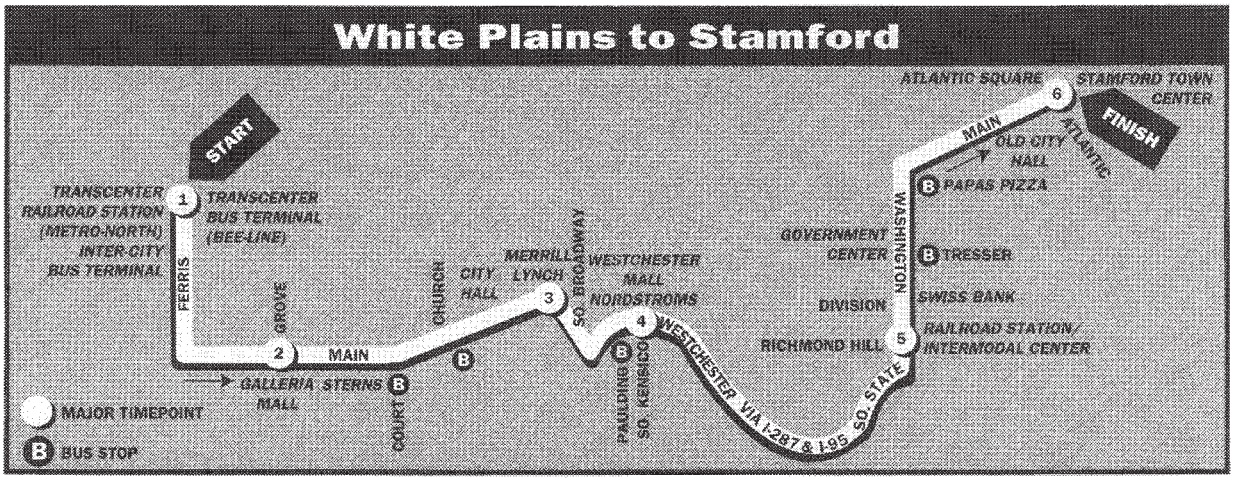
Figure 27. Route map and schedule of the Route 110 Clipper, Suffolk County, New York.

urban area routes, as designated by Riverside Transit, the average productivity in that period was 16.0 passengers per hour. The service also is considered a success in meeting regional mobility needs, as it strengthens the commitments to interregional cooperation, offers alternatives to transit-dependent populations unable to afford rail, and complements other fixed-route services.

Peak Commuter Express Service. The range of performance is large for the peak commuter express services surveyed for the project.

Introduced in fall 1994, Houston METRO Route 292 operates at 15-min peak-hour headways, similar to downtown express services. A daily ridership target of 648 was set for Route 292; however, after 1 year of service it was averaging only a little over 200 passengers daily. Follow-up surveys by METRO revealed part of the reason for this disappointing performance: many TMC employees were unaware of the service and the availability of employer-paid transit allowances. Several employees indicated they were not willing to "experiment" with transit because if they go back to driving, they would be placed at the bottom of the priority list for available parking spaces (i.e., they'll be assigned to the most remote parking space). METRO plans to continue supporting Route 292 and hopes to increase ridership through targeted marketing and working with TMC employers to change parking policies. METRO also anticipates trying new crosstown express routes in the future, most likely with contracted minibuses.

The Suffolk County, New York, Route 110 Clipper and Connecticut Transit/Westchester County (NY) I-Bus are relatively new services in their first year of operation. Each is generating approximately 10 to 11 persons per trip, with the Route 110 Clipper providing approximately 130 trips per day and the I-Bus approximately 180 trips per day. Both operators



	Connections		I-BUS Trips			Connections			I-BUS Trips		Connections		I-BUS
			1	2	3				4	5			6
	Metro-North from NYC	Metro-North from Brwstr	Trans-Center	Galleria Mall	Main & So. Brdwy	Bee-Line Shuttle from Westchester Ave. A	B	C	So. Kensico	Rail. Stat. Intermodal	CCC Dwnt. Shuttle	Metro-North NH Line	Atlantic Square
AM Peak	—	5:58	6:03	6:05	6:07	—	—	—	6:08	6:27	6:37	6:46	6:32
	—	—	6:33	6:35	6:37	—	—	—	6:38	6:57	7:00	—	7:02
	6:50	6:36	7:00	7:02	7:04	—	—	—	7:06	7:25	7:41	—	7:30
	7:14	7:00	7:20	7:22	7:24	—	—	—	7:26	7:46	7:53	7:53	7:50
	—	7:39	7:43	7:45	7:47	—	—	—	7:49	8:10	8:12	8:26	8:15
	7:44	7:49	8:05	8:07	8:09	—	—	—	8:11	8:30	8:36	8:56	8:35
	8:17	8:07	8:30	8:32	8:34	—	—	—	8:36	8:55	9:00	—	9:00
	8:47	8:30	8:50	8:52	8:54	—	—	—	8:56	9:15	9:25	—	9:20
	—	8:56	9:10	9:12	9:14	—	—	—	9:16	9:35	—	9:51	9:40
	9:18	9:29	9:30	9:32	9:34	—	—	—	9:36	9:55	—	—	10:00
	9:44	9:57	10:00	10:02	10:04	—	—	—	10:06	10:25	—	10:51	10:30
	10:14	—	10:30	10:32	10:34	—	—	—	10:36	10:55	—	—	11:00
PM Peak	2:14	1:57	2:30	2:32	2:35	—	—	—	2:37	2:55	—	—	3:00
	3:14	2:57	3:19	3:21	3:24	3:20	3:20	3:20	3:26	3:45	3:56	3:51	3:50
	—	—	3:43	3:45	3:48	3:44	3:44	3:44	3:50	4:10	4:22	4:25	4:15
	3:54	—	3:58	4:00	4:03	3:59	3:59	—	4:05	4:25	4:34	—	4:30
	—	3:57	4:13	4:15	4:18	4:13	4:13	4:13	4:20	4:40	4:46	4:52	4:45
	4:18	—	4:40	4:42	4:45	4:46	4:46	4:46	4:48	5:07	5:11	5:10	5:12
	4:46	4:59	5:05	5:07	5:10	5:10	5:00	—	5:12	5:32	5:43	5:40	5:37
	5:08	—	5:20	5:22	5:25	5:16	5:16	5:16	5:27	5:47	5:54	6:09	5:52
	5:25	5:29	5:40	5:42	5:45	5:42	5:42	5:42	5:47	6:07	6:13	6:14	6:12
	5:41	5:55	5:58	6:00	6:03	6:00	6:00	—	6:05	6:25	6:28	6:31	6:30
	6:26	—	6:32	6:34	6:36	6:32	6:32	6:19	6:38	6:57	7:03	7:20	7:02
	6:58	6:59	7:15	7:17	7:19	6:46	6:46	6:46	7:21	7:40	—	7:52	7:45

Figure 28. Route map and schedule of the I-Bus between White Plains, New York, and Stamford, Connecticut.

believe the services have started well and have potential for growth and will continue the projects for at least 2 years with CMAQ funding. The farebox recovery for the I-Bus was 16.6 percent. The Route 110 Clipper is operated by a private operator under contract to Suffolk County.

The last of the services included in this section is the Lakewood Park and Ride, operated by a private contractor for NJ Transit. The service, between two park-and-ride lots in southern Ocean County and the Lakewood Industrial Park, a medium-density employment location at the north end of the county, was discontinued after 2 years of operation because of poor performance. Before being discontinued, ridership levels were about three persons per trip, and the farebox recovery rate was 7.9 percent. The NJ Transit standard for their suburban service experiments is 25 percent after the second year. Elements contributing to poor performance were a lack of support from employers in the industrial park, no significant time savings for the buses on the Garden State Parkway operating in mixed traffic, and a dispersed residential marketshed from which to draw riders.

Conditions of Effectiveness

Clearly the range of performance indicates that a number of conditions that contribute to or detract from the opportunity to succeed with suburban express bus services.

Key contributing factors appear to be the following:

1. **Real employer support:** Although many projects are begun with the knowledge and interest of the private sector, in some cases supported by assurances of support, those projects with better records of accomplishment are those for which the private sector has contributed tangibly, with financial support either through direct subsidy or employee-subsidized passes and nonfinancial support with guaranteed ride home, flex-time, marketing and promotion, and so forth. The need for employer support is amplified for the peak-hour projects, which depend on commuters and specific employers, and less important for the all-day corridor routes, which serve a larger variety and generally more densely populated market. Planning projects with the private sector also contributes noticeably to success.
2. **Participatory planning and local support:** Projects that are planned with intended riders and/or sponsors have a greater record of success than those initiated and planned internally at a transit agency. Focus groups and surveys of riders; service planning with employers and projected riders; and participation among regional agencies, TMAs, or other groups are all actions taken to develop and promote new services.
3. **Congestion and parking fees that make automobile travel less attractive:** There is a direct correlation between ridership and the level of congestion and parking fees in the corridor for which the express service is planned. Route 292 in Houston capitalizes on the high cost of parking around the TMC; the Route 110 Clipper uses an HOV lane to bypass heavy congestion on the Long Island Expressway.
4. **High density destinations:** To obtain a reasonable level of ridership, given that even in the best corridors the transit share will be a fraction of the total travel market, there must be a sizable travel market from which to draw. Therefore, the destination for the express bus service must be reasonably populated and fairly compact—the number provides a base from which to draw, and the density allows the operator to provide reasonable distribution times that do not detract from the overall time savings achieved on the express portion of the trip.
5. **Reasonably populated residential marketsheds:** Similarly, the collection end of the service must have a reasonable population from which to draw riders. The origins can be served either by the bus itself operating in a collection mode, which works best in densely developed neighborhoods, or via park-and-ride lots in less dense areas.
6. **Bus priority treatments:** Bus priority treatments such as HOV lanes (Figure 29) or queue bypasses at entrances or toll booths allow express buses to save time over single-occupant vehicles, increasing the attraction of the bus service.
7. **Supportive regional planning:** Success often depends on the support of regional plans for transportation and economic development, policies that recognize transit as a tool for long-term regional viability, and establishment of reasonable program goals and objectives. Suburban transit service, taken as a whole, does not achieve the levels of productivity and cost-effectiveness associated with urban services; however, these services may contribute to regional goals for congestion reduction, air quality, and economic development. Although unreasonable costs are unwarranted, lower thresholds have been established in many areas for suburban services in recognition of their contributions to these other aspects associated with the "quality of life" in metropolitan areas.
8. **Transit-dependent populations:** The more successful express services are designed as much for the traditional transit-dependent markets as for the choice rider. Depending solely on choice users, in the absence of strict regulation or high parking fees and congestion, does not produce the volume of riders needed to support express bus service.

Figure 29. HOV lanes increase the attraction of express bus services in Long Island and San Diego.

9. **Special equipment:** Comfortable over-the-road coaches with special equipment—individual lighting, cushioned seats—are recognized as very important contributors to successful peak commuter express services, especially those that rely on the choice market for support.

Limited Routes

Description

Midway between local bus routes and express routes is the category of limited routes. Limiteds operate in much the same manner as the arterial expresses described above. They are used to offer a higher level of service in heavily traveled corridors, supplementing local bus services running along the same corridor. Limiteds use the same roadways as the local buses and achieve higher operating speeds by reducing the number of stops along the route. The M5 service in Manhattan, operated by the New York City Transit Authority, is an urban example of the savings that can be achieved between a local and limited service operating in the same arterial corridor. Along 5th Avenue from 57th Street to 14th Street in Midtown Manhattan, the local bus generally stops at every third block, or approximately 15 times; in the same section, the limited stops only 6 times. The travel time savings in this 2-mi (3.2-km) section, associated with fewer stops—including the time spent getting to and from the curb, signal delays, and loading and unloading—can be as much as 10 min. Passengers boarding and alighting at key stop locations are provided with higher quality service, and at the same time loads on heavily traveled local buses can be reduced to acceptable levels. New riders are attracted by the faster travel speeds.

Applicability

Corridors where limited services are applied need to be densely developed with both significant numbers of residents and multiple activity centers along the route. Local service needs to be fairly dense and well utilized to justify the additional level of service offered. Limited services require concentrated activities at key locations along the local route. If there are no concentrated stop locations along the local route, or if most of the trips being made are relatively short, then the limited service is not applicable to the route.

Only two suburban limited services, both from the Dallas area, were identified in the case studies. These routes provide limited-stop services to suburban employment centers. Route 134 connects transit centers in Plano, Richardson, Prestonwood, and North Irving, with local buses at each transit center serving as collectors/distributors. Route 133 connects the South Garland transit center to the medical area of Dallas. Route 134 was designed to provide reverse commute services from Irving toward Richardson and Plano. The routes were not established to supplement existing local services but rather to serve emerging patterns identified by planners.

As noted in the section on express buses, LI Bus, in its most recent service development planning study, identified corridors for limited-stop services connecting major suburban activity centers to the New York City subway network in Eastern Queens County. These corridors have significant travel in both directions; limited routes would supplement the local services, providing stops along the route at key activity nodes.

Performance Range

The performance range is derived from only two cases. In data from 1996, Route 134 provided 96 passenger trips per day, a rate of 5.3 passengers per trip. Route 133 performed better, with 115 passenger trips per day at a rate of 9.6 passengers per trip. Both services operate well below the system average of 20.73 passengers per trip for all suburban crosstown services, including locals and limiteds. However, ridership on both routes has nearly doubled over the past year, from 53 daily riders for Route 134 and 64 riders for Route 133. Both are still below expectations for this type of service, which were expected to approximate the system average for crosstown services of about 20 passengers per trip.

Conditions of Effectiveness

Limited services are designed to provide faster travel times for commuters than local bus services, thus making the transit option more attractive compared with the automobile during peak periods. Two planning factors appear important to the successful implementation of limited services:

- Presence of successful local service: Although only limited data are available from the case studies, it is apparent that limited services are more readily successful when they are used to upgrade existing services instead of to establish new services. DART is establishing a new service, and although it has the potential for long-term success, its slow growth pattern requires the patience to let the market build. Where a market is already established, limited services have the potential for built-in success with exiting riders, while choice riders are marketed and attracted to the new service.
- Concentrated stop activity and long trips: Limiteds stop only where there is significant activity. To have enough activity to justify the service, the corridor being served must have identifiable activity centers that will draw sufficient ridership; furthermore, passengers going to and from these centers need to come from far enough away so that the use of limited service is practical.

Implementing limited service is largely a technical exercise related to travel patterns, trip densities, and other oper-

ating factors. It is easiest to do in established local corridors, where load factors and travel times can readily establish the justification for the service. Planning is less clear when new services are being established and needs to be done slowly, with sufficient data, and in concert with the public/target market. In new markets, good data on origin-destination patterns, travel speeds, and complementing and competing services are essential when laying out new services, followed by marketing and development of public awareness. Planners must understand how the service will operate and what kinds of competitive advantages are offered over existing transit services and the single-occupant vehicle in order to accurately estimate the demand for the service. Focus groups and other outreach efforts taken in the planning phase of a project can help direct the planning effort toward services that reflect market desires.

GO TO CHAPTER 4