213

National Cooperative Highway Research Program

NCHRP Synthesis 213

Effective Use of Park-and-Ride Facilities

A Synthesis of Highway Practice

Transportation Research Board
National Research Council

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

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Synthesis of Highway Practice 213

Effective Use of Park-and-Ride Facilities

KATHERINE F. TURNBULL, Ph.D.
Texas Transportation Institute
Texas A&M University

Topic Panel

VANESSA ADAMS-DONALD, *Illinois Department of Transportation*
WAYNE BERMAN, *Federal Highway Administration*
RICHARD G. CHRISTIE, *Texas Department of Transportation*
RICHARD E. HOLLIS, *Connecticut Department of Transportation*
LARRY KING, *Federal Highway Administration*
JOHN M. SEDLAK, *Houston Metropolitan Transit Authority*
JAMES H. SLAKEY, *Washington State Department of Transportation*
JEROME C. SMITH, *Michigan Department of Transportation*

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PREFACE

A vast storehouse of information exists on nearly every subject of concern to highway administrators and engineers. Much of this information has resulted from both research and the successful application of solutions to the problems faced by practitioners in their daily work. Because previously there has been no systematic means for compiling such useful information and making it available to the entire community, the American Association of State Highway and Transportation Officials has, through the mechanism of the National Cooperative Highway Research Program, authorized the Transportation Research Board to undertake a continuing project to search out and to prepare documented reports on current practices in the subject areas of concern.

This synthesis series reports on various practices, making specific recommendations where appropriate but without the detailed directions usually found in handbooks or design manuals. Nonetheless, these documents can serve similar purposes, for each is a compendium of the best knowledge available on those measures found to be the most successful in resolving specific problems. The extent to which these reports are useful will be tempered by the user's knowledge and experience in the particular problem area.

FOREWORD

By Staff
Transportation Research Board

This synthesis will be of interest to traffic planners and engineers, as well as to transit planners and operations personnel, design and construction contractors, and municipal, transit, and highway agencies. Security and management officials who are responsible for safe and efficient operation of park-and-ride facilities will also find this synthesis useful. This synthesis provides an assessment of the current status of park-and-ride facilities, which are intended to provide easy access to change from low occupancy vehicles to higher occupancy transit or highway use by carpools and vanpools.

Administrators, engineers, and researchers are continually faced with highway problems on which much information exists, either in the form of reports or in terms of undocumented experience and practice. Unfortunately, this information often is scattered and unevaluated and, as a consequence, in seeking solutions, full information on what has been learned about a problem frequently is not assembled. Costly research findings may go unused, valuable experience may be overlooked, and full consideration may not be given to available practices for solving or alleviating the problem. In an effort to correct this situation, a continuing NCHRP project, carried out by the Transportation Research Board as the research agency, has the objective of reporting on common highway problems and synthesizing available information. The synthesis reports from this endeavor constitute an NCHRP publication series in which various forms of relevant information are assembled into single, concise documents pertaining to specific highway problems or sets of closely related problems.

The various aspects of park-and-ride facilities, including conceptual issues, location factors, demand estimating procedures, design considerations, administration and operation of facilities, including funding, maintenance, and other supporting elements are addressed in this synthesis. This report of the Transportation Research Board also provides information on the current usage of park-and-ride facilities throughout the nation, operating and maintenance practices at selected sites, descriptions of safety and security measures used at various facilities, and the relationship of ridesharing and travel demand management (TDM) programs to the success of park-and-ride facilities.

To develop this synthesis in a comprehensive manner and to ensure inclusion of significant knowledge, the Board analyzed available information assembled from numerous sources, including a large number of state highway and transportation departments. A topic panel of experts in the subject area was established to guide the research in organizing and evaluating the collected data, and to review the final synthesis report.

This synthesis is an immediately useful document that records practices that were acceptable within the limitations of the knowledge available at the time of its preparation. As the processes of advancement continue, new knowledge can be expected to be added to that now at hand.

CONTENTS

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EFFECTIVE USE OF PARK-AND-RIDE FACILITIES

SUMMARY

Park-and-ride facilities represent one approach being used in rural areas, small communities, and major metropolitan areas throughout the country to address concerns related to mobility and accessibility, traffic congestion, air quality, and quality of life. Park-and-ride programs are thus integral components of multimodal transportation management systems in many areas. This synthesis provides a synopsis of the current practices associated with planning, designing, implementing, and operating all types of park-and-ride facilities. This synthesis also provides practical and useful information for transportation practitioners and policy makers interested in the efficient development and operation of park-and-ride facilities.

The intent of park-and-ride facilities is to provide a common location for individuals to transfer from a low- to a high-occupancy travel mode. Park-and-ride lots are often oriented toward providing parking spaces for automobiles connected with bus or rail stations and frequent transit services. Individuals may also access the facilities by walking, bicycling, or being dropped off. In areas where transit services are not available, park-and-pool lots may be developed to encourage the formation of carpools and vanpools. Thus, all types of park-and-ride facilities are intended to maximize the efficiency of the transportation system and to provide enhanced commute options for travelers.

Park-and-ride facilities are generally categorized by the location, the level of transit service provided, and the exclusive nature of the operation. Three general locations—remote, local, and peripheral—are often used to describe park-and-ride lots. Remote lots are located relatively far from major activity centers, and are usually oriented toward providing a change of mode for residents of suburban areas or satellite communities. Local service park-and-ride lots are located at the end of or along a local bus route, are situated closer to the central business district (CBD) or major activity center than remote lots, and usually have lower levels of transit services. Peripheral lots are located at the edge of a CBD or major activity center and function to expand the amount of available parking by intercepting automobiles before they enter congested areas.

Park-and-ride lots are also divided into exclusive and shared-use facilities. Exclusive lots are planned, designed, constructed, and operated specifically to serve as park-and-ride facilities, whereas shared-use lots serve multiple functions. For example, shared-use facilities may use a portion of an existing shopping center, school, or church parking lot. There are advantages and disadvantages associated with each approach that need to be considered in the planning process.

The process of locating a park-and-ride facility is complex due to the variability in

individual travel behavior and numerous factors related to the cost and availability of gasoline, the general economy of an area, the levels of congestion, changing job locations and travel patterns, and the level and orientation of transit services and HOV lanes. Based on experience from several documented projects, a number of factors that appear to contribute to the development and operation of park-and-ride facilities have been identified. Additionally, formal techniques and procedures are available to assist in identifying anticipated demand for the facility, determining the appropriate size of the lot, and selecting the optimal location.

Once the location process is complete, the next step involves the actual design of the facility. A number of factors to be addressed during the design stage include local zoning and land use regulations, interface with the roadway system, internal lot layout, sign needs, and environmental issues. Primary considerations in the design process focus on providing the following: safe and efficient traffic flow within the site and on access roads, adequate parking spaces, pedestrian walking and waiting areas, shelters or stations, facilities for special user groups, and adequate security. A number of reports are available that examine design considerations for park-and-ride facilities, as well as providing examples and guidelines. Several states also have prepared guidelines.

Because the ongoing administration and operation of facilities and transit services are key to the success of park-and-ride facilities, several elements need to be considered. These include the potential for increased liability, as additional responsibilities are placed on transit agencies, state DOTs, local communities, and other groups; the availability of various lease agreements; the different techniques and approaches to funding, contracting, operating, and maintaining facilities; and security and safety at facilities.

A number of supporting services and facilities can be used to reinforce the overall efficiency and effectiveness of park-and-ride facilities. These include priority treatments for transit services and HOV facilities, ridesharing programs, travel demand management (TDM) strategies, land use and growth management techniques, and the use of intelligent transportation systems (ITS) and other advanced technologies.

Additional research could enhance the effectiveness and efficiency of park-and-ride facilities. Areas identified for further research include a more detailed assessment of the air quality and environmental impacts of park-and-ride facilities; development of simplified demand estimation procedures; exploration of innovative approaches to development, operation, and maintenance; and use of ITS and advanced technologies.

CHAPTER ONE

INTRODUCTION

Park-and-ride facilities represent an important component of many transit systems in the United States. A variety of facilities—including park-and-ride, park-and-pool, and kiss-and-ride lots—are found with all types of transit services. The size and orientation of these facilities vary, ranging from large lots adjacent to major rail lines and high-occupancy vehicle (HOV) lanes, to smaller shared-use lots located along local bus routes. Although differing in size, scale, and nature, park-and-ride facilities all serve a similar function of providing the opportunity for travelers to change between low- and high-occupancy commute modes.

Interest in park-and-ride facilities has continued to grow in small communities and major metropolitan areas throughout the country as the facilities represent one approach to addressing increasing concerns related to traffic congestion, mobility, air quality, and environmental issues. As a result, park-and-ride programs are becoming integral components of multimodal transportation management systems in many areas. This interest is placing additional demands on public transit agencies, state departments of transportation (DOTs), local municipalities, metropolitan planning organizations (MPOs), and other groups to ensure that park-and-ride facilities and transit services are planned, designed, constructed, and operated in a safe, efficient, and convenient manner. Responsible agencies must therefore have information on the current state of the practice related to all aspects of park-and-ride facility planning, demand estimation techniques, design, and operation to respond to these demands.

PURPOSE OF SYNTHESIS

This synthesis was developed to address these needs and to provide a state-of-the-art synopsis of the current practices associated with all types of park-and-ride facilities in the United States. Included is an overview of the current use of park-and-ride facilities and existing practices for estimating demand for park-and-ride services; locating, sizing, and designing facilities; and funding, constructing, operating, and maintaining park-and-ride lots. Approaches being used to address potential safety and security concerns are also examined, as well as supporting policies and programs that may enhance the effectiveness of park-and-ride facilities. Further, innovative approaches to developing and operating park-and-ride programs and enhancing multimodal integration to improve the overall management of the transportation system are identified.

METHODOLOGY

The information contained in this synthesis was obtained from a variety of sources. First, a comprehensive literature review was completed on park-and-ride facilities. Journal articles, Transportation Research Board (TRB) papers, reports, and other documents on park-and-ride facilities were examined. Information on the historical development of park-and-ride lots was reviewed, along with the different approaches and techniques that have been used to plan, design, and operate park-and-ride projects. The results of the literature review were used to document both the background and current status of many elements relating to the effective use of park-and-ride facilities. In addition, the published literature was used to identify examples of park-and-ride projects, planning techniques, and innovative approaches for more detailed examination.

To obtain an assessment of current practices related to the use of park-and-ride facilities, a telephone survey was conducted of representatives from 55 selected transit agencies of different sizes and state DOTs throughout the country. A listing of the 43 transit agencies included in the telephone survey is contained in Table 1, and Table 2 provides information on the 12 DOTs contacted.

Representatives were asked a series of questions relating to the practices and experiences with park-and-ride facilities at their agencies. A copy of the survey form is provided in Appendix A. Information obtained through the survey included the characteristics, funding, and use of existing park-and-ride facilities, as well as plans for future projects. In addition, respondents were asked about current practices relating to demand estimation techniques, use of design guidelines or standards, and any operational issues that have been encountered. Specific questions addressed how agencies were dealing with safety and security concerns. Finally, the representatives were asked about supporting services, innovative techniques, and other ideas for enhancing the use of park-and-ride facilities.

The agency representatives were also asked to provide examples of reports and other documents addressing park-and-ride facilities. A mix of information, including maps, brochures, project descriptions, examples of different types of lot sharing agreements, reports, design plans, guidelines, and other documents, was provided. Much of this material has been incorporated into the examples included in this synthesis.

ORGANIZATION OF SYNTHESIS

The remainder of this synthesis is divided into six chapters. An introduction to the park-and-ride lot concept, which is presented in Chapter 2, includes a general review of the concept, a summary of the historical development of park-and-ride facilities, a description of the different types of projects, a review of the current use of park-and-ride facilities, and an overview of the benefits generally associated with park-and-ride lots. Chapter 3 discusses different methods and techniques used for demand estimation of park-and-ride facilities and criteria for locating and sizing lots. A summary of current design factors used in developing the different elements associated with park-and-ride projects is provided in Chapter 4, followed by a discussion, in Chapter 5, of the factors related to the administration and operation of park-and-ride facilities. A summary of the supporting policies, programs, and services often associated with park-and-ride lots is presented in Chapter 6. This synthesis concludes with a review of the major elements, the identification of areas for additional research, and a discussion of the future of park-and-ride facilities. A copy of the telephone survey, examples of park-and-ride lot design criteria used by transit agencies, and a model park-and-ride site priority rating form are provided in the Appendices.

TABLE 1
TRANSIT AGENCIES CONTACTED IN THE TELEPHONE SURVEY

Agency	Acronym	Region and General Service Area
Altoona Metro Transit		Altoona, PA
Ann Arbor Transportation Authority	AATA	Ann Arbor, MI
Beaver County Transit Authority		Rochester, PA
Capital Metropolitan Transit Authority	Metro	Austin, TX
Central Oklahoma Transportation and Parking Authority	COTPA	Oklahoma City, OK
Chicago Transit Authority	CTA	Chicago, IL
Corpus Christi Regional Transit Authority	RTA	Corpus Christi, TX
City Transit Management Company, Inc.	Citibus	Lubbock, TX
Dallas Area Rapid Transit	DART	Dallas, TX
Denver Regional Transit District	RTD	Denver, CO
Des Moines Regional Transit Authority	RTA	Des Moines, IA
Duluth Transit Authority	DTA	Duluth, MN
Greenville Transit Authority		Greenville, SC
Greater Cleveland Regional Transit Authority	RTA	Cleveland, OH
Johnson City Transit System		Johnson City, MN
Indianapolis Public Transportation Corporation		Indianapolis, IN
Kansas City Area Transportation Authority	ATA	Kansas City, KN
Los Angeles Metropolitan Transportation Authority	MTA	Los Angeles, CA
Madison Metro Transit System	METRO	Madison, WI
Metropolitan Atlanta Rapid Transit Authority	MARTA	Atlanta, GA
Metropolitan Transit Authority of Harris County	METRO	Houston, TX
Metropolitan Transit Authority-New York	MTA	New York, NY
Metropolitan Transit Commission	MTC	Minneapolis-St. Paul, MN
Metro-Dade Transit Agency	MDTA	Miami, FL
Miami Valley Regional Transit Authority	RTA	Dayton, OH
Milwaukee County Transit System	CTS	Milwaukee, WI
New Jersey Transit Corporation	NJTC	New Jersey
Niagara Frontier Transit Authority		Buffalo, NY
Orange County Transit District	ODTD	Orange County, CA
Phoenix Regional Public Transit Authority		Phoenix, AZ
Port Authority of Allegheny County	PAT	Pittsburgh, PA
Sacramento Regional Transit District	RTD	Sacramento, CA
St. Cloud Metropolitan Transit Commission	MTC	St. Cloud, MN
Salem Area Mass Transit District		Salem, OR
Snohomish County Public Transportation Benefit Area	Community Transit	Snohomish County, WA
Southeastern Pennsylvania Transportation Authority	SEPTA	Philadelphia, PA
Tidewater Transportation District Commission	TRT	Norfolk, VA
Toledo Area Regional Transit Authority	RTA	Toledo, OH
Tri-County Metropolitan Transportation District of Oregon	Tri-Met	Portland, OR
Utah Transit Authority	UTA	Salt Lake City, UT
VIA Metropolitan Transit Authority	VIA	San Antonio, TX
Waco Transit System		Waco, TX
Washington Metropolitan Area Transit Authority	WMATA	Washington, D.C.

TABLE 2
STATE DOTS CONTACTED IN THE TELEPHONE SURVEY

Agency	Acronym	1990 Population[1] (1,000)
California Department of Transportation	Caltrans	29,760
Connecticut Department of Transportation	ConnDOT	3,287
Georgia Department of Transportation	GDOT	6,478
Illinois Department of Transportation	IDOT	11,431
Minnesota Department of Transportation	MnDOT	4,375
New Jersey Department of Transportation	NJDOT	7,730
New York Department of Transportation	NYDOT	17,990
Pennsylvania Department of Transportation	PennDOT	11,882
Texas Department of Transportation	TxDOT	16,987
Virginia Department of Transportation	VDOT	6,187
Washington Department of Transportation	WSDOT	4,867
Wisconsin Department of Transportation	WisDOT	4,892

[1]*Statistical Abstract of the United States, 1993*, U.S. Department of Commerce, Washington, D.C., 1993.

CHAPTER TWO

THE PARK-AND-RIDE CONCEPT

OVERVIEW OF THE PARK-AND-RIDE CONCEPT

The intent of park-and-ride facilities is to provide a common location for individuals to transfer from a low- to a high-occupancy travel mode. In most cases, this means transferring from an automobile to a bus or a rail system. Therefore, most park-and-ride lots are oriented toward providing ample parking spaces for automobiles connected with bus or rail stations and frequent transit services. In areas where bus and rail service is not available, park-and-pool lots may be provided to encourage the formation of carpools and vanpools. Further, many park-and-ride lots associated with bus and rail systems allow use of the parking areas for carpool and vanpool formations. Access to the lots may also be accomplished by walking or bicycling, and many park-and-ride facilities provide accommodations, such as bicycle storage lockers. In addition, some travelers may be dropped off and picked up, rather than leaving their vehicle in the lot all day. Short-term waiting areas, called kiss-and-ride facilities, are often provided at lots to accommodate these travelers.

Regardless of the exact type of facility, the park-and-ride concept is intended to maximize the efficiency of the transportation system and to provide commute options to travelers. Park-and-ride facilities offer travelers the opportunity to change between low- and high-occupancy vehicles, providing an effective combination of automobile and transit modes with each mode used in the geographic area and in the method best suited to their specific characteristics. Driving, walking, or bicycling serves as the collection and distribution function at the residential end of the trip. The transit mode—carpool, vanpool, bus, or rail—serves as the line-haul function for the majority of the trip.

HISTORICAL DEVELOPMENT OF PARK-AND-RIDE FACILITIES

Park-and-ride facilities are not a new concept in the United States. Rather, various forms of park-and-ride lots have been in existence for more than 70 years. Use of such facilities therefore predates public ownership of transit systems and current concerns over traffic congestion and environmental issues. Many of the early park-and-ride facilities appear to have been developed for reasons very similar to those influencing the implementation of lots today, including improving transit operating efficiencies, attracting new riders, providing commute alternatives in congested travel corridors, reducing energy consumption and air pollution, and addressing the transportation needs of special events.

The first reported use of informal park-and-ride facilities occurred in Detroit in the 1930s. At that time, the city operated eight park-and-ride lots at gas stations along transit routes (*1*). In 1939, the Long Island Railroad developed a large park-and-ride lot on the grounds of the Worlds Fair in New York City, which represented the first facility oriented toward a special event. This facility continues to serve commuters today (*2*).

During the 1940s, the use of park-and-ride lots spread slowly throughout the country. These facilities were often referred to as fringe lots because of their usual location on the edge of major downtown areas. For example, a bus fringe park-and-ride lot demonstration project was undertaken by the Baltimore Transit Company in 1946. Similar facilities oriented toward both bus and rail services were developed in other cities, including Boston, Philadelphia, Cleveland, St. Louis, Hartford, Atlanta, and Richmond (*3*).

The development of park-and-ride lots continued in the 1950s. A 1,000 space lot was implemented in Forest Park, a St. Louis suburb, in 1953, providing bus connections to the downtown area. In 1955, the Port Authority of New York and New Jersey developed an 1,800 space lot at the west end of the Lincoln Tunnel, which links New Jersey to Manhattan, marking the first major involvement of local government in park-and-ride facilities (*1*). The opening of the first park-and-ride lot in the Washington, D.C. region also occurred in 1955. This facility included 800 spaces at the Carter Barron Amphitheater along 16th Street, N.W., which were dedicated to park-and-ride use, and frequent bus service was provided from the lot into the downtown area. The success of this facility lead to the development of other lots in the Washington, D.C. area (*4*).

By the 1960s, the park-and-ride concept seemed to be well accepted by both public and private transit operators throughout the country. At least 36 cities reported some type of park-and-ride facilities in operation by the late 1960s (*5*). These facilities continued to cover a wide spectrum of approaches. For example, the first use of a park-and-ride lot in Texas appears to be the 1963 opening of a parking lot and subway system connected to Leonard's Department Store in downtown Fort Worth. Patrons parked in a lot located approximately 1.6 km (1 mi) from the store and took the subway to reach their destination (*5*). This system is still in operation today.

A number of other elements began to emerge during the 1960s that influenced the future development of park-and-ride facilities, the first of which related to the growing trend toward public ownership of previously privately owned and operated transit systems. This trend was influenced by such factors as the growing use of private automobiles, the development of the Interstate highway system, the increasing suburbanization of both residential and job locations, the historically low transit fares, and the deteriorating rolling stock and capital facilities. All of these factors lead to the decline and, in many cases, bankruptcy of private transit companies.

To maintain services, many local governments purchased the assets of private transit providers and began operating the systems. In other cases, regional or metropolitan transit authorities were created through state enabling legislation, and these organizations became responsible for the provision of public transit services. As local and regional governments became more involved in funding and operating transit services, interest also increased in the types of services offered and the need to attract new riders to the systems.

These efforts were supported by the Urban Mass Transportation Act of 1964, which provided the first federal support for the construction, reconstruction, and acquisition of mass transportation facilities and equipment.

Federal involvement was initiated with the Federal-Aid Highway Act of 1968, which contained funding for demonstration projects focusing on park-and-ride lots and related facilities. The program, which was administered by the Federal Highway Administration (FHWA), centered on urban areas with populations of 500,000 or more. Funding was made available for 50 percent of the cost of right-of-way acquisition and construction of park-and-ride facilities located along the federal-aid highway system. In addition, the program required that transit service be provided to the facilities. The first lot to be funded through this demonstration program was located in Woodbridge, New Jersey, with transit service provided by the Penn Central Railroad (*6*).

The Federal-Aid Highway Act of 1970 contained permanent provisions for federal funding of park-and-ride facilities. Further, this Act provided greater flexibility in the use of funds from different programs and authorized the use of federal funds for lots along both federal-aid and secondary highways. As a result, park-and-ride facilities began to be considered in a variety of applications throughout the United States.

The use of park-and-ride lots became even more widespread as a result of the energy crisis in 1973. The Emergency Highway Energy Conservation Act of 1974 authorized both FHWA and the Urban Mass Transportation Administration (UMTA) (which became the Federal Transit Administration (FTA) in 1991) to assist local areas in developing energy conservation projects. Federal funding was made available through the Act to support the development and implementation of these programs. Projects that focused on diverting commuters from driving alone to using transit or some other type of high-occupancy commute mode represented a major focus of the program. Further, funding through UMTA was made available to assist with facilities and equipment for use in providing the needed public transit services and for coordinating transit and highway activities.

These provisions were further strengthened by additional legislation and policy guidance in the late 1970s and 1980s, and by growing concerns related to traffic congestion and air pollution in many areas. The first joint urban transportation planning regulations issued by FHWA and UMTA, which became effective in 1975, contained a number of provisions that related to park-and-ride facilities. The most important of these was the requirement that metropolitan planning organizations (MPOs) develop transportation plans that included both a long-range element and a short-range transportation systems management (TSM) element.

The focus of the TSM element was on low-cost or no-cost improvements that would enhance the operation of the transportation system. Park-and-ride lots and supporting transit or rideshare programs became important components of many TSM programs. In the 1980s and 1990s, park-and-ride facilities became integral elements of most travel demand management (TDM) programs. In contrast with TSM, TDM focuses on the demand, rather than the supply, side of the transportation system. The TDM technique covers a variety of actions that better manage the demand on transportation facilities by acting to shift commuters into transit and multi-occupant vehicles or into less congested travel periods, or removing trips from the roadway altogether. Park-and-ride facilities are considered integral parts of TDM programs in many areas.

The development of park-and-ride lots has also been encouraged by environmental legislation. For example, the Clean Air Act Amendments of 1977 required that metropolitan areas not meeting national ambient air quality standards develop and submit revisions to state implementation plans. These plans, which were developed jointly by MPOs and the states, had to include transportation control plans (TCPs), which outlined the strategies for reducing transportation related air pollutants. The Clean Air Act Amendments of 1990 and related provisions of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) provide further requirements for reducing vehicle miles of travel and increasing vehicle occupancy levels in air quality nonattainment areas. For example, employers with 100 or more employees in areas in the extreme and severe nonattainment categories must develop, implement, and monitor plans and programs to increase vehicle occupancy levels and to reduce the number of commuters driving alone to work sites between 6:00 and 10:00 a.m.

Additional provisions of ISTEA and subsequent rules place restrictions on the types of facilities that can be considered and constructed in nonattainment areas. For example, under the Transportation Conformity Rules issued by the Environmental Protection Agency (EPA), new park-and-ride lots may not be allowed in some nonattainment areas. The Act, however, provides new programs and greater flexibility in the use of funds within many programs. For example, park-and-ride facilities may be eligible for funding through the new Congestion Mitigation and Air Quality Improvement (CMAQ) Program.

State governments have also been involved in funding, developing, and operating park-and-ride facilities. The first official state involvement appears to have occurred in Connecticut in 1967. In response to growing concerns over the use of space at highway interchanges as informal parking areas, the state legislature authorized the Connecticut Highway Department to plan, implement, and maintain park-and-ride lots. The intent of this legislation was to encourage the use of mass transportation and to eliminate informal parking at unauthorized locations (*7*).

Other states enacted similar legislation or developed comparable programs in the 1970s. Minnesota, California, and Washington all provide examples of this. As will be discussed more extensively later in this synthesis, the current involvement of state DOTs in planning, designing, funding, constructing, and operating park-and-ride facilities varies. Also, as described in more detail in later sections, the relationships and coordination between state DOTs and local transit agencies differ. Examples exist of jointly developed facilities, as well as those with one agency taking the lead role.

TYPES OF PARK-AND-RIDE FACILITIES

Park-and-ride facilities are generally categorized by the location, level of transit service provided, and exclusive nature of the operation. Three general locations—remote, local, and peripheral—are commonly used to describe park-and-ride lots. These three types of facilities are located at different distances from the major activity center, serve different segments of the travel journey, and are characterized by different levels of transit services. Figure 1 provides an illustration of the three general locations for park-and-ride facilities. In addition to these types of facilities, park-and-ride projects are also categorized as either exclusive or shared-use lots. The characteristics associated with all five of these types of facilities are described next along with examples of projects

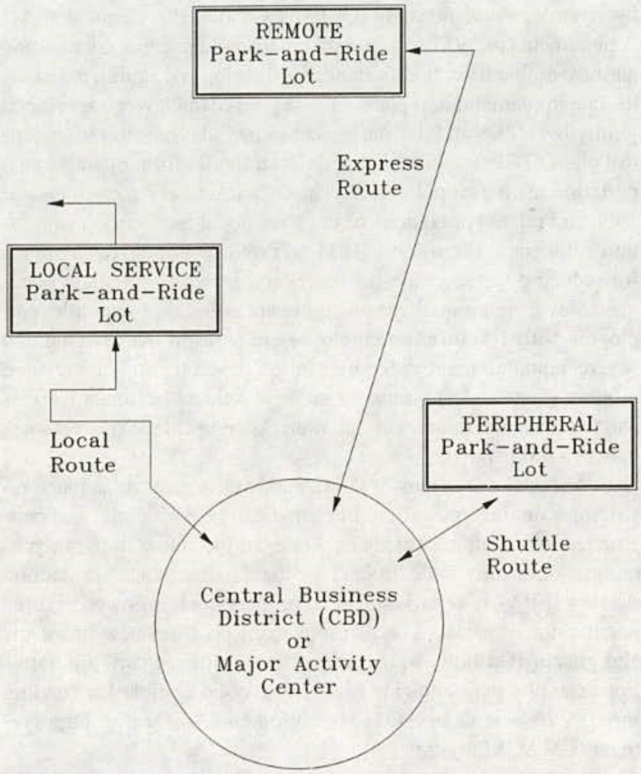


FIGURE 1 Remote, local, and peripheral park-and-ride lot locations.

currently in operation throughout the United States. This discussion provides an idea of the general nature of the various types of park-and-ride facilities, although obvious differences exist based on local characteristics and circumstances.

Remote Park-and-Ride Facilities

Remote park-and-ride lots are located relatively far from the major activity center or the final destination of users. Most remote park-and-ride facilities are oriented toward providing a change of mode for residents of suburban areas or satellite communities, with transit services oriented toward the central business district (CBD) or other major employment center. The exact distance of remote facilities from the activity center varies depending on the size of the metropolitan area or community. Remote lots in large metropolitan areas may be located at relatively long distances from the final destination. For example, many of the park-and-ride lots in Houston, Los Angeles, New York/New Jersey, and the Washington, D.C. area are located between 16 and 64 km (10 and 40 mi) from the CBD. In smaller communities, remote lots, although located on the periphery, are usually closer to the final destination.

Remote lots function to intercept automobiles close to the residential or home end of the trip. To accomplish this, they are often situated adjacent to or relatively close to freeways or major roadways in heavily traveled corridors. Commuters usually arrive by single-occupant vehicle (SOV), although local bus routes, walking, bicycling, or carpooling may also be used.

The size and level of transit service at remote lots will depend on the corridor demand. Many remote park-and-ride facilities,

FIGURE 2 Park-and-ride lot with commuter rail system. (Courtesy of Connecticut Department of Transportation (ConnDOT))

especially those located in major metropolitan areas, contain a large number of parking spaces and have high levels of transit service. These types of lots are usually associated with commuter rail, heavy rail, light rail transit (LRT), HOV lanes, and express bus systems. Figures 2 through 6 provide examples of these types of facilities, which are all surface lots. Figure 7 illustrates the use of a parking garage in Chicago for a park-and-ride facility.

Table 3 provides examples of large remote park-and-ride lots currently in operation throughout the country, a number of which contain more than 1,000 parking spaces. The information in the table provides an indication of both the size and type of transit mode associated with remote lots. All of these facilities are located in congested travel corridors in major metropolitan areas. Further, as discussed in more detail later in this chapter, many of these facilities represent just one element of a larger system. For example, 16 major park-and-ride lots are currently in operation adjacent to the five Houston HOV lanes, providing a total of approximately 15,000 parking spaces.

Most large remote park-and-ride lots are provided with frequent high capacity transit services, oriented primarily toward the morning and afternoon peak periods; off-peak service may be limited or non-existent. Therefore, the transit services from many large remote park-and-ride lots tends to be express or limited stop, providing relatively high speed travel and frequent peak-hour headways.

A different type of remote park-and-ride lot is a smaller facility located in an area without regular route transit service. Usually referred to as park-and-pool lots, these facilities are oriented toward the formation of carpools and vanpools. Park-and-pool lots are often located in rural areas and may have few, if any, amenities. Some metropolitan areas and states have developed networks of park-and-pool lots. For example, the DOTs in Connecticut, Minnesota, Texas, and California have developed park-and-ride and park-and-pool lots statewide. Figure 8 provides an illustration of a rural park-and-ride lot in upstate New York.

Local Service Park-and-Ride Facilities

Local service park-and-ride lots are located at the end of or along a local bus route. These lots are situated closer to the CBD or activity center than remote lots and serve the residential

FIGURE 3 Park-and-ride lot with heavy rail. (Courtesy of Washington Metropolitan Area Transit Authority)

FIGURE 4 Park-and-ride lot with LRT. (Courtesy of Sacramento Regional Transit District)

FIGURE 5 Park-and-ride lot with HOV lane, Houston, Texas. (Courtesy of Texas Transportation Institute (TTI))

FIGURE 6 Rural park-and-ride lot with express bus service. (Courtesy of ConnDOT)

neighborhoods at the end of a route, as well as those along the route. Local service lots are usually smaller than exclusive facilities. The local service facilities identified through the telephone surveys averaged between 10 and 50 parking spaces, although a few larger lots were noted.

Local service lots may be either exclusive or shared-use facilities (see Figures 9 and 10). The survey results indicate that sharing existing shopping center, church, and school parking lots is common, especially in smaller urbanized areas. For example, the Miami Valley Regional Transit Authority in Dayton, Ohio currently operates 23 shared-use lots with shopping centers and other businesses. These facilities range in size from 6 to 75 parking spaces and support the three larger formal park-and-ride lots in the area. As discussed in more detail later, however, numerous problems may be associated with shared-use facilities, including liability, seasonal demands on the parking facilities at shopping centers, and conflicts between pedestrians and buses.

Most local park-and-ride lots are oriented toward bus services. Further, most tend to be served by local routes, although some may have limited-stop or express service during peak hours, and service is often slower than that provided from remote lots. Buses may also operate on less frequent headways, averaging between 15 and 30 minutes during the peak hours, but all-day service is often provided.

FIGURE 7 Park-and-ride garage with heavy rail system. (Courtesy of Chicago Transit Authority)

Peripheral Park-and-Ride Facilities

Peripheral park-and-ride lots are located on the edge of a major activity center, usually a CBD. These lots function to expand the amount of available parking and to intercept automobiles before they enter congested areas. With peripheral lots, the major portion of the commute trip is made by automobile, with the last short segment made by transit. Special shuttle services or existing local routes may serve peripheral park-and-ride lots and may be used in combination with a reduced fare or a free-fare zone. The lots may also be used to encourage ridesharing by providing reduced or free parking rates for carpools and vanpools.

The peripheral parking lot associated with Leonard's Department Store in downtown Fort Worth described in Chapter 1 provides one example of this type of facility. Other examples of peripheral parking lots can be found in Minneapolis and St. Paul, Minnesota. Part of the 17.6 km (11 mi) I-394 HOV lane system in Minneapolis includes three large parking garages on the edge of the downtown area. The Third Avenue Distributor (TAD) garages, which include almost 6,000 parking spaces as well as bus waiting areas, provide reduced parking rates for carpools and vanpools using the I-394 HOV lane. The garages are connected to the pedestrian skyway system and are served by buses in the downtown

TABLE 3
EXAMPLES OF LARGE REMOTE PARK-AND-RIDE LOTS AND ASSOCIATED TRANSIT SERVICES

Location and Lot	Number of Parking Spaces	Type of Transit Service
Houston—Kuykendahl (I-45N)	2,246	HOV Lane
Los Angeles—El Monte (I-10)	2,100	HOV Lane
Connecticut—Fairfield	1,039	Commuter Rail
Miami—Dadeland South	1,504	Heavy Rail
Miami—Golden Glades	1,350	Bus
Philadelphia—Butler Park and Main	585	Commuter Rail
Sacramento—Roseville Road	1,087	LRT

FIGURE 8 Rural park-and-ride lot in upstate New York. (Courtesy of Parsons Brinckerhoff)

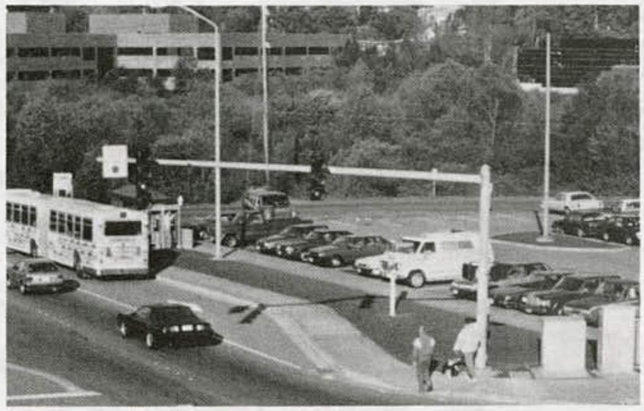


FIGURE 9 Local exclusive park-and-ride lot, Bellevue, Washington. (Courtesy of Parsons Brinckerhoff)

FIGURE 10 General shared-use park-and-ride lot. (Courtesy of ConnDOT)

reduced fare zone. In downtown St. Paul, frequent regular route bus service is provided from a number of peripheral parking lots. Some of these facilities have been developed and used in conjunction with the relocation of major employers, including the development of the new St. Paul Company headquarters building.

Exclusive Use Park-and-Ride Facilities

Exclusive use facilities are those planned, designed, constructed, and operated specifically to serve as park-and-ride lots. Remote park-and-ride lots are usually exclusive facilities. As described previously, these lots tend to be of medium to large size and are often associated with rail systems, HOV lanes, or express bus services. Further, exclusive park-and-ride lots commonly provide other passenger amenities—such as stations or shelters—and are served by frequent peak-period transit service.

Because they are designed to serve park-and-ride functions, exclusive use lots offer advantages related to adequate automobile parking and bus space to meet anticipated demands, efficient layouts to maximize operations, and the ability to minimize potential automobile and pedestrian conflicts. These lots do, however, require significant capital cost and development time. Exclusive park-and-ride lots are usually developed by transit agencies and state DOTs, although local jurisdictions and private groups may also be involved.

Shared-Use Park-and-Ride Facilities

Shared-use lots serve multiple functions, rather than being devoted only to park-and-ride services, by using all or a portion of an existing lot for transit related parking. Shopping center, church, school, and other activity center parking lots are common shared-use facilities. Shared-use lots are usually located along existing bus routes and are smaller than exclusive lots, often ranging from 15 to 100 spaces. As discussed more extensively later, formal agreements covering issues such as rent, maintenance, and ongoing repairs may exist between a transit authority and the lot owner.

Advantages of shared-use lots include short implementation periods, as well as low capital and maintenance costs. Because of this, shared-use facilities often provide the opportunity to test the demand for a service without requiring a major investment. Further, shared-use facilities that provide shopping or other activities in close proximity may encourage ridership.

Disadvantages of shared-use lots include space and design limitations, for example the existing layout of the parking lot may not fit the intended transit function. Further, space may not be available for expansion if demand warrants, and pedestrian-automobile conflicts may exist. Problems may also be encountered if the transit and facility parking needs conflict. For example, some transit systems report problems with shared-use facilities located in shopping center parking lots during the Christmas season when extra demands are placed on these facilities. Formal agreements may be used between a transit agency or state DOT and the lot owner to address these concerns.

CURRENT USE OF PARK-AND-RIDE FACILITIES

The review of current literature and the results of the telephone survey indicate that all types of park-and-ride facilities are used extensively throughout the United States. Further, it appears that many areas use multiple approaches, targeting specific types of facilities and services to different market segments. Examples of different approaches in use at the state, metropolitan, and community levels are summarized next.

- *Ann Arbor, Michigan*—The Ann Arbor Transportation Authority (AATA) currently operates six park-and-ride facilities—one exclusive and five shared-use lots. A total of 1,200 parking spaces are provided, and express and local bus services are operated from the facilities.
- *Atlanta, Georgia*—The Metropolitan Atlanta Rapid Transit Authority (MARTA) currently operates 33 exclusive park-and-ride lots, which provide a total of 23,000 parking spaces. Twenty-four lots are located at MARTA rail stations and are oriented toward the heavy rail system, while nine lots are served by the bus system. In addition, a few shared-use lots are in operation along local bus routes.
- *Austin, Texas*—Capital Metro currently operates three exclusive park-and-ride lots in the Austin area, which provide a total of 650 parking spaces, as well as eight shared-use lots. One fringe parking lot, located on the edge of the downtown area, is connected to the downtown "Dillo" circulator service, and another facility is coordinated with CARTS, the rural operator in the area, allowing riders to transfer between the two systems. All of these facilities are oriented toward the bus system. A new park-and-ride facility, which will contain 250 parking spaces, is scheduled to open by 1996. A number of park-and-pool lots, constructed and maintained by the Texas Department of Transportation (TxDOT), are also provided in outlying portions of the metropolitan area.
- *Buffalo, New York*—The Niagara Frontier Transportation Authority in Buffalo operates park-and-ride lots oriented toward both bus and LRT services. Two exclusive facilities, encompassing a total of 1,400 spaces, are in operation with the LRT system. The bus system includes one exclusive and five shared-use lots, with parking spaces for 200 vehicles.
- *Connecticut*—The Connecticut Department of Transportation (ConnDOT), in cooperation with FHWA, local jurisdictions, transit operators, rideshare agencies, and other groups, has developed a statewide system of park-and-ride lots oriented toward encouraging commuters to change from driving alone to carpooling, vanpooling, or taking the bus or train. Approximately 226 lots are currently in operation. Of these, 95 provide rail or express bus service, while the remainder are oriented toward local bus service, carpools, or vanpools. The facilities range in size from small lots of 10 to 20 parking spaces, to large lots averaging 800 to 1,000 spaces. Further, the facilities include both exclusive and shared-use lots, as well as remote and local service facilities. A number of different arrangements and funding agreements have been used to develop and operate these facilities.
- *Dallas, Texas*—The Dallas Area Rapid Transit (DART) currently operates 16 formal and 4 shared-use park-and-ride lots within its service area, providing a total of 9,574 parking spaces. Additional park-and-pool lots have been developed in the metropolitan area by TxDOT. Currently, all of these facilities are oriented toward the bus system. An additional three lots with 2,000 spaces are being planned as part of the bus system and nine park-and-ride lots are being developed with the new LRT system.
- *Dayton, Ohio*—The Miami Valley Regional Transit Authority in Dayton has developed a network of exclusive and shared-use park-and-ride lots. Currently, three exclusive and 23 shared-use facilities are in operation, providing approximately 960 parking spaces. Most of these lots, which range in size from 10 to 75 spaces, have been developed through joint agreements with local shopping centers. Express and local bus services are operated from the lots.
- *Denver, Colorado*—The Regional Transportation District (RTD) in Denver currently operates 49 park-and-ride lots, with a total of approximately 9,500 parking spaces. Most of these are exclusive lots, with a few shared-use facilities. All are currently served by buses, but future plans also include park-and-ride lots associated with the new LRT system.
- *Des Moines, Iowa*—The Des Moines Metropolitan Transit Authority currently operates one exclusive 150-car park-and-ride facility with its bus system. Additional shared-use lots are in operation, located primarily at local shopping centers.
- *Duluth, Minnesota*—The Duluth Transit Authority (DTA) currently has one exclusive park-and-ride lot with 22 parking spaces. Both peak-hour express service and all-day regular route service are provided from the facility, which is located at the end of a regular route. In addition, other parking lots throughout the system are used informally.
- *Houston, Texas*—Currently, 39 park-and-ride and park-and-pool lots are operating in the Houston metropolitan area. These include 21 existing park-and-ride lots, 7 transit centers with park-and-ride facilities, and 11 park-and-pool lots, all of which provide approximately 27,000 parking spaces. Planning for five additional park-and-ride and five park-and-pool facilities is underway. The park-and-pool lots have been developed by TxDOT, while the park-and-ride facilities have been developed either jointly by TxDOT and the Metropolitan Transit Authority of Harris County (METRO) or by METRO alone. METRO is responsible for operating transit services out of the park-and-ride lots and for maintaining the facilities. All of the park-and-ride lots are exclusive facilities focused on bus service, and most are large lots located adjacent to the five operating HOV lanes. Fourteen of the lots, the largest of which is the Kuykendahl park-and-ride lot along the I-45 North Freeway, contain spaces for between 950 and 2,246 automobiles each. Direct access to the HOV lanes is provided from most of these facilities. Frequent bus service is provided from most lots, averaging around 5 min or less headways during the peak hours. At the largest lots, peak-hour headways average 3 min or less and limited midday service is provided using mini-buses. A guaranteed ride home program also offers greater flexibility to park-and-ride lot users.
- *Madison, Wisconsin*—The Madison Metro Transit System operates two shared-use and one exclusive park-and-ride lot. The facilities have been in use for more than 15 years, with additional lots in use in the early 1980s during the energy crisis.
- *Miami, Florida*—The Metro-Dade Transit Agency operates a total of 25 exclusive park-and-ride lots with both the METRORAIL and METROBUS systems in the Miami area. These facilities provide 11,453 parking spaces. Seventeen of the lots are oriented toward the METRORAIL system, accounting for a total of 9,391 parking spaces. Four of these lots have more than 1,000 spaces. South Miami is the largest facility with parking for some 1,683 vehicles. There is a $1.00 a day charge to park at the METRORAIL facilities. Many of these are outdoor at-grade lots, but a few of the larger facilities are multi-story parking garages. The METROBUS system includes eight park-and-ride lots, with a total of 1,767 parking spaces. The largest of these lots has 1,350 spaces, with the remaining seven ranging in size from 25 to 115 spaces. There is no charge to park at these facilities. In addition, five shared-use lots are in operation with the bus system at regional shopping centers.

• *New Jersey*—A variety of park-and-ride facilities are provided in New Jersey through the cooperative efforts of the New Jersey Transit Corporation, the New Jersey Highway Authority, local jurisdictions, and other groups. The facilities are oriented toward rail, bus, and ridesharing. Approximately 166 park-and-ride lots provide some 50,000 parking spaces along the New Jersey Transit Corporation commuter rails and Port Authority Transit Corporation (PATSCO) rail transit systems. A total of 157 commuter lots provide 33,579 parking spaces statewide for bus, vanpool, and carpool commuters. Additional park-and-sail facilities provide over 1,000 parking spaces for ferryboat passengers in the Trans-Hudson commuter area.

• *Philadelphia, Pennsylvania*—The Southeastern Pennsylvania Transportation Authority (SEPTA) operates a total of 133 park-and-ride lots in the greater Philadelphia metropolitan area, which provide approximately 14,000 parking spaces. These facilities are oriented toward both bus and rail—119 lots are focused on the rail system, while 14, including six shared-use lots, are oriented toward the local bus system. Available parking spaces at the bus facilities average below 100 spaces per lot. Although there are some small lots adjacent to the rail lines, on average the rail facilities tend to be larger, with 60 lots providing between 100 and 600 spaces each. There is no charge for use of the bus park-and-ride lots. Some of the rail lots are free, while parking charges at others range from $0.50 to $1.00 per day. Monthly parking permits may be purchased for some lots at a cost of $10.00. Additional park-and-ride facilities are in the planning stage, and facilities with 5,700 new parking spaces are scheduled to open by 1995.

• *Phoenix, Arizona*—Valley Metro, which serves the Phoenix area, currently uses 64 park-and-ride facilities accounting for some 2,462 parking spaces. Most of these are shared-use lots located at shopping centers. Four lots are located at transit centers and two other exclusive lots are in use. All facilities are oriented toward the bus system or ridesharing, and some lots provide bicycle racks or bicycle lockers. Further, some of the lots are oriented to the I-10 HOV lanes.

• *Rochester, Pennsylvania*—The Beaver County Transit Authority in Rochester operates two formal park-and-ride lots, one with 24 parking spaces, and the other with 48. The two lots are well used and planning is underway for a third, which will have parking for 50 automobiles.

• *Sacramento, California*—A total of 15 park-and-ride facilities are operating in the Sacramento area. These lots, which are oriented toward the LRT system, bus services, and ridesharing activities, provide a total of 3,908 parking spaces. The Sacramento Regional Transit District (RTD) has nine park-and-ride lots, accounting for 3,713 spaces, at stations along the LRT system. The largest is the Roseville Road park-and-ride lot, which contains 1,087 parking spaces. Further, the RTD operates two shared-use lots, with 39 spaces, along bus routes. The California Department of Transportation (Caltrans) operates and maintains four lots in the area, with parking spaces for 156 vehicles.

• *Salem, Oregon*—The Salem Area Mass Transit District operates five park-and-ride lots—one exclusive facility with 20 parking spaces, and four shared-use lots, which average between 10 and 15 parking spaces each. Local bus service is provided from the facilities.

• *Seattle, Washington*—Park-and-ride facilities represent an important element of the overall transportation system in the Seattle metropolitan area and the state of Washington as a whole. Currently, some 96 exclusive park-and-ride lots, providing almost 19,000 parking spaces, are operating in King and Snohomish counties. Further, approximately 42 leased park-and-ride lots, with some 2,079 spaces, are also in operation. Many of these facilities are oriented toward the HOV lane system in the area and support both bus and carpool use. The park-and-ride system has been developed through the cooperative efforts of the Washington State Department of Transportation (WSDOT), Seattle METRO, Community Transit, and local jurisdictions. To the south of Seattle, 19 lots, providing 1,998 parking spaces, are located in the City of Tacoma and Pierce county. WSDOT, Pierce Transit, and local jurisdictions are responsible for these facilities, which are oriented toward the bus system and carpooling. Some 238 park-and-ride facilities are in use throughout the state of Washington, accounting for a total of 28,793 parking spaces. WSDOT is responsible for 121 of these lots, while transit systems operate 26; other groups have developed 91 facilities.

• *Snohomish County Public Transportation Benefit Area*—Community Transit in Snohomish County, north of Seattle, uses six major, five minor, and 10 shared-use park-and-ride lots, all of which provide a total of 3,200 parking spaces. Express bus service oriented to downtown Seattle and the University of Washington are operated out of these facilities.

• *Toledo, Ohio*—The Toledo Area Regional Transit Authority (TARTA) operates 14 park-and-ride lots, which are shared-use facilities located at shopping centers and malls along regular bus routes. Each lot contains between 20 and 50 parking spaces. Additional facilities are being planned.

• *Washington, D.C. Metropolitan Area*—A total of 152 designated park-and-ride lots are operating in the Washington, D.C. metropolitan area. These facilities, which are oriented toward the Metrorail system, commuter rail, HOV lanes, bus services, and ridesharing, account for a total of 53,200 parking spaces. Thirty-one lots, providing 26,280 spaces, are associated with the Metrorail system, while 21 lots with 3,640 spaces are oriented toward commuter rail services. A total of 98 facilities, with approximately 23,280 spaces, are focused on bus services and ridesharing. Most of the Metrorail facilities are outdoor at-grade lots, but multistory parking structures exist at four stations. Parking fees at the Metrorail lots are between $1.50 and $3.00 a day.

GENERAL BENEFITS OF PARK-AND-RIDE FACILITIES

A number of benefits associated with the different types of park-and-ride facilities have been identified (*1,6,8-10*). These benefits may be realized by users, non-users, transit operators, and the general community. Benefits accruing from well-planned, well-designed, and well-operated park-and-ride facilities include cost and travel time savings for transit users, more effective congestion management, lower demand for parking spaces, reduced energy consumption and automobile-generated air pollution, enhanced mobility, and improved efficiency of the transit system. Each of these potential benefits is briefly summarized next.

Transit User Cost and Travel Time Savings

By using park-and-ride facilities and associated transit services, individual commuters may realize cost and travel time savings, as well as other benefits. The costs associated with owning and operating an automobile may be reduced in a number of ways. First, the purchase of more than one automobile may be avoided. Second, even if a household is not able to reduce the overall number of vehicles owned, cost savings can be realized through reduced fuel expenditures, lower insurance premiums, and reduced maintenance costs and vehicle depreciation. Further, in heavily congested travel corridors where transit is provided with an exclusive right-of-way, commuters using park-and-ride services may realize travel time savings, more reliable travel times, and a more relaxed commute trip.

Congestion Management

By reducing the number of SOVs using a roadway, park-and-ride facilities can assist in managing traffic congestion in major travel corridors and in maximizing the efficiency of the overall transportation system. The exact impact of park-and-ride services on congestion is dependent on a number of factors including current traffic levels and latent demand. In rapidly growing areas, park-and-ride lots, as well as other transit services and roadway improvements, may not result in actual traffic volume or congestion level reductions, but such facilities can provide valuable assistance in managing demand and maximizing the efficiency of the travel corridor. Park-and-ride facilities may also reduce accident rates and enhance safety by taking SOVs out of the traffic stream.

Reducing Parking Space Demand

Park-and-ride facilities may reduce or help manage the demand for parking spaces at major activity centers by intercepting automobiles before they reach their destination. This can reduce the need to build additional parking facilities, as well as assist in maximizing the use of existing parking spaces. The net result will be savings in construction costs and land associated with building more parking facilities.

Reducing Energy Consumption and Automobile-Generated Air Pollution

Through the use of park-and-ride facilities, energy consumption per passenger mile and automobile-generated air pollution can be reduced by diverting drivers from SOVs to rail or bus services, carpooling, or vanpooling, resulting in an increase in energy efficiency. Further, fewer cold starts and hot soaks will be concentrated in CBDs and other activity centers. Cold starts occur when a vehicle has not been operated and the engine is cold. Emission rates are higher for the first few minutes until the engine and the emission control equipment begin operating more efficiently. Hot soaks refer to the evaporative emissions that occur after the engine has been turned off but is still hot. Work trips are generally assumed to involve cold starts and hot soaks. Although some air quality impacts of park-and-ride facilities (e.g., cold starts and hot soaks) are currently being debated, in general, park-and-ride services have favorable air quality results in congested corridors and downtown areas.

Enhanced Mobility

Although most lots are designed for automobile owners, transit services can also be accessed by walking, biking, or being dropped off. As a result, park-and-ride facilities can enhance the accessibility of jobs at major activity centers and improve the mobility of residents in the area.

Transit System Benefits

Park-and-ride lots allow transit agencies to provide cost-effective line-haul services and to avoid operating services in low density areas. Further, well-planned, well-operated park-and-ride services should result in increased ridership and revenues for the transit system. Park-and-ride facilities may also provide opportunities for joint-development projects, such as leasing space for concessions, day care facilities, or other service, and joint-use of facilities by other service providers. Houston METRO, for example, constructed additional space at the Addicks Park-and-Ride facility for use by an intercity bus company. In addition to the commuter parking area, bus platform, and passenger waiting areas, a building was constructed for the intercity buses and ticketing agents. The company leases the facility from METRO, and also sells METRO passes and tickets at the site. Joint developments offer the opportunity to bring in additional revenues to the transit agency and to increase ridership. Park-and-ride facilities have also been used in many areas to provide extra transit services, such as in Houston and Atlanta, where facilities are used extensively with football, baseball, and other special events.

CHAPTER THREE

LOCATING PARK-AND-RIDE FACILITIES

Locating park-and-ride facilities is not an exact science. The variability of individual travel behavior and numerous factors related to the cost and availability of gasoline, the general economy of an area, the level of traffic congestion on adjacent roadway facilities, changing job locations and travel patterns, and the level and orientation of transit services and HOV lanes all may influence the use of park-and-ride facilities. However, a general set of factors that appear to contribute to the successful implementation and operation of park-and-ride facilities can be identified based on the experience with different projects. In addition, formal procedures and techniques are available for estimating the potential demand for park-and-ride services and for sizing different types of park-and-ride lots. The six general steps in planning and designing a park-and-ride facility are illustrated in Figure 11. The first five steps are discussed in this chapter and the sixth is described in Chapter 4.

GENERAL CONSIDERATIONS IN LOCATING PARK-AND-RIDE FACILITIES

Based on the experience documented in several studies of park-and-ride facilities, the following general factors have been identified as important considerations in the planning process (*5,8-13*).

- *Locate park-and-ride facilities in congested travel corridors*—The use of park-and-ride services is often highest in major travel corridors that experience severe levels of traffic congestion.
- *Locate park-and-ride facilities in advance of areas experiencing major traffic congestion*—Providing commuters with the opportunity to transfer to an HOV mode before they reach a congested area increases the attractiveness of a facility.
- *Locate park-and-ride lots in areas with high levels of travel demand to the major activity center or centers served by the facility*—Locating lots in areas with high travel demand to the destinations served by the park-and-ride services will enhance the chance of success.
- *Include preferential transit services, either rail or HOV lanes, to enhance park-and-ride facility ridership levels*—Providing users with the travel time savings and travel time reliability offered by rail and HOV lanes makes the use of park-and-ride services more attractive to potential customers.
- *Locate park-and-ride facilities so that commuters do not have to backtrack to reach the lot*—Providing the majority of commuters with a direct route to the lot, rather than taking them in the direction opposite their ultimate destination, will enhance the potential success of the facility.
- *Orient park-and-ride facilities to ensure good accessibility and visibility*—Lots need to be highly visible to potential users to increase their awareness of the facility. Further, good accessibility, which relates to the ease with which potential users can get to the general area and enter and exit the facility, is also important. Safety and security concerns for passengers and vehicles will also need to be addressed.
- *Locate park-and-ride facilities at appropriate distances*—Separating park-and-ride lots by appropriate distances will help ensure that services and facilities are not duplicated. The distance between lots will depend partially on the level of transit service provided and the characteristics of an area. Lots with frequent transit services may draw from a larger market area than facilities with only limited services.
- *Encourage cooperation among agencies in developing and operating park-and-ride facilities*—Close cooperation is usually needed among transit agencies, the state DOT, local communities, and other groups to help ensure the effective and efficient development and operation of park-and-ride facilities.

DEMAND ESTIMATION PROCEDURES

The results from the telephone survey and the literature review indicate that many park-and-ride facilities, particularly shared-use lots, are developed and implemented with only limited estimates of potential demand levels. The use of more formal demand estimation procedures appears to be more common with the development of large exclusive lots, especially those associated with major rail or HOV lane projects. In both cases, however, the lack of rigorous demand estimates appears to be the result of limited resources and

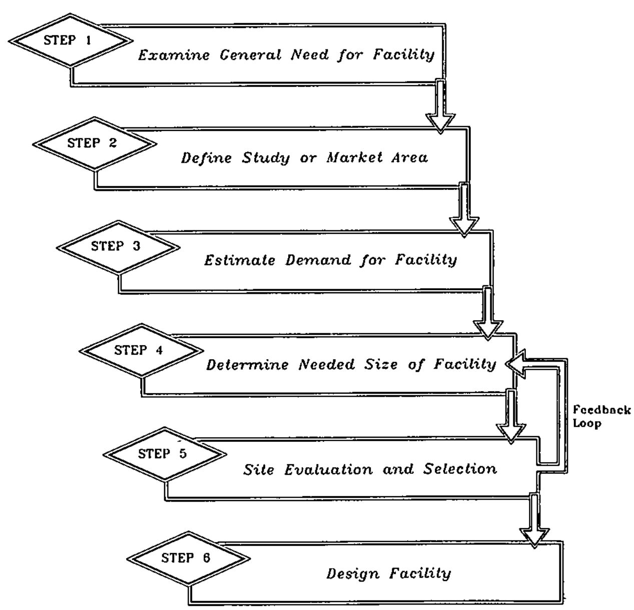


FIGURE 11 General steps in planning a park-and-ride facility.

time, and, in some instances, the need to respond to specific opportunities or requests.

However, a number of different techniques for estimating the demand at park-and-ride facilities have been identified and used throughout the country. This section reviews the different techniques and briefly explains how each can be applied. It may often be appropriate to use more than one demand estimation technique, with the results from each technique establishing a range of approaches to be considered in the planning process.

It is also appropriate that the technique used, and the time and resources required to conduct the analysis, be matched to the scale, scope, and complexity of the project. Thus, consideration of a shared-use lot along an existing local route should not require the same level of analysis as the consideration of a major new park-and-ride lot along an HOV lane or rail system. The techniques described in this section vary in the level of detail and sophistication, providing a range of approaches for use in a variety of situations.

A note of caution should be raised with the use of any of these techniques, however, as all have advantages and disadvantages. Estimating the demand for park-and-ride facilities has been suggested to be more of an art than a science. Much depends on the type and level of service being offered, the potential time and cost savings over alternative modes, and other aspects unique to the local situation. For example, facilities associated with rail systems or HOV lanes exhibit different demand characteristics than those associated with local or express bus services with no preferential treatment. Thus, the characteristics of the local area should be considered with whatever demand estimation procedure is used.

Definition of Study or Market Area

The first step in examining the demand for a possible park-and-ride facility is to examine the market area. This area, which may also be referred to as the study, service, catchment, or commutershed area, represents the geographic region from which users are apt to originate. The size of this area will depend on the type of facility being considered, as well as the nature, orientation, level, and frequency of the transit services provided.

Experience indicates that the most common market areas for park-and-ride services reflect either parabolic, semicircular, or circular shapes (*8,11-16*). Figures 12 through 14 illustrate these different configurations. The demand estimation techniques described next will provide a better indication of the nature of the market area for park-and-ride facilities based on the unique characteristics of each area.

Demand Observation

This technique, which is based on actual field observations and surveys, represents the simplest approach for estimating the potential demand for park-and-ride facilities. In most cases, data from a number of different sources are used to identify the potential demand. Information for use in this approach may be obtained through field observation, current ridership levels, aerial photographs, census data, land use maps, traffic counts, special surveys, and other sources. Each of these elements is briefly described next.

Field Observation

Field reconnaissance of the major travel corridors and neighborhoods in the area can be used to obtain information on current traffic conditions and major congestion points, informal park-and-ride arrangements, unsafe or illegal parking activities, major access points, and potential sites. Ultimately, field observations will be used with all the techniques to assist in identifying the best location for a site. Including it as a step early in the demand process is strongly encouraged, however, as firsthand knowledge of the area is critical in examining the results of other demand procedures.

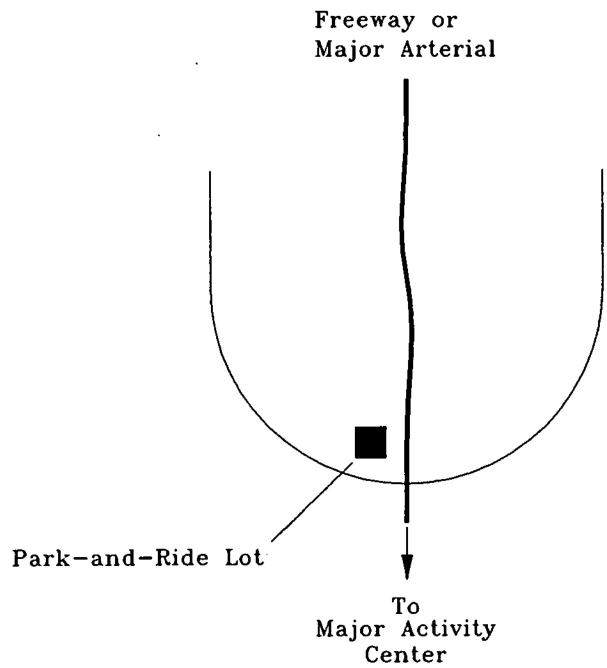


FIGURE 12 Parabolic market area.

Current Transit Routes and Ridership Levels

Examining the current route structure and ridership levels in an area can provide a good indication of the potential for park-and-ride facilities. Corridors or areas with frequent service and high ridership levels may be candidates for park-and-ride lots, as well as improved transit services and other priority treatments.

Aerial Photographs

Aerial photographs can be used to provide an idea of the size and nature of residential neighborhoods and commercial areas, and thus will help in defining the potential market area. These photographs also show the local and regional roadway system, providing an indication of access and accessibility from different areas. Finally, aerial photographs can be used to identify vacant land and existing parking lots that may be candidates for the location of park-and-ride facilities.

Census Data

Census data can be used to indicate the number of individuals residing in the market area, as well as to provide information on income levels, automobile ownership, and travel characteristics. This information is of use in determining the potential for park-and-ride services.

Land Use Maps

Along with aerial photographs, land use maps can be used to provide an indication of both existing and future land use patterns and densities. This can help identify current demands, as well as potential future demands. Reviewing land use maps, comprehensive plans, and zoning maps provides a further indication of anticipated growth areas and community goals.

Traffic Counts

Examining traffic counts and other traffic data can be useful in identifying congested corridors and specific bottleneck problems. This can assist in pinpointing logical locations for park-and-ride facilities and other transit priority treatments.

Special Surveys

A variety of special surveys may be used to help estimate the demand for potential park-and-ride facilities. For example, surveys may be conducted of existing transit riders, commuters in the corridor, employees and shoppers at a major activity center, and residents in the neighborhood. On-board, mail, telephone, and direct interview techniques may all be used to conduct these surveys, which may be done for the specific purpose of obtaining information on the potential for a park-and-ride facility or which may be part of a larger study.

The increasing use of geographic information systems (GIS) by many communities, metropolitan planning organizations (MPOs),

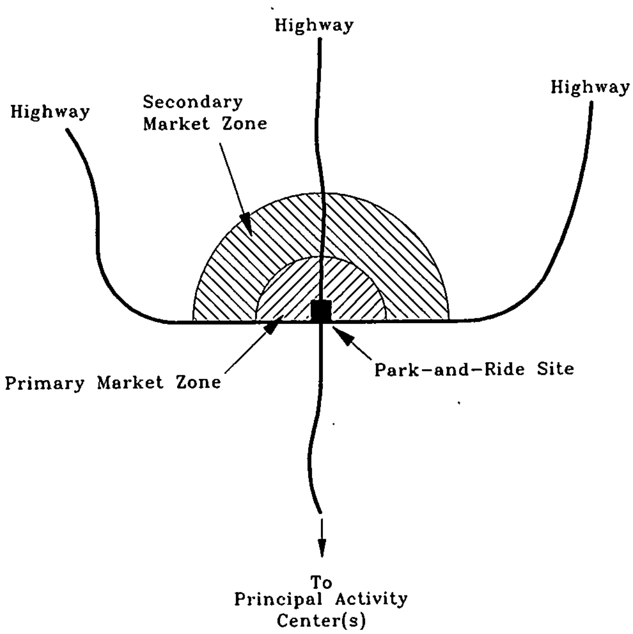


FIGURE 13 Semicircular market area.

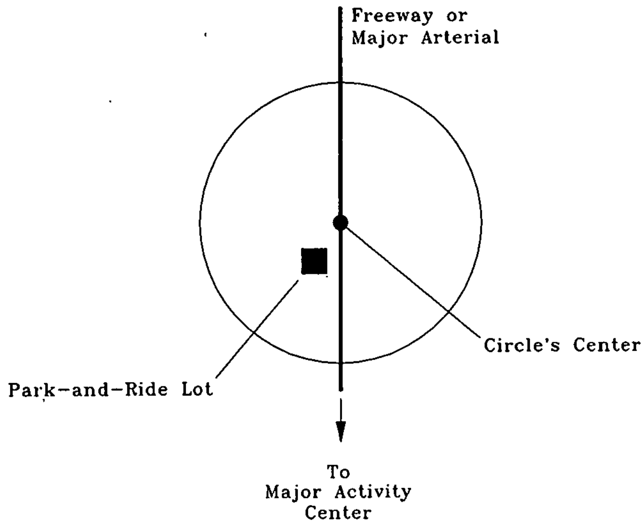


FIGURE 14 Circular market area.

and some transit agencies will make obtaining and analyzing much of the information used in the demand observation approach easier. However, there will be a continued need to actually observe the area under consideration.

The results of the telephone survey indicate that the demand observation approach is the technique most commonly used today, especially among small- to medium-sized transit systems. Commonly reported factors considered in the demand observation process included existing ridership levels, traffic congestion indicators, and census data. The use of field observations, both to identify potential demand and to locate possible sites, was also commonly reported. Further, it appears that this technique is often used as a first step or in conjunction with one of the more rigorous methods described next.

Market Area Population

This technique uses the population in the proposed park-and-ride lot service area to obtain an estimate of the facility's potential use. Under this approach, the percentage of users from existing park-and-ride facilities would be estimated and this percentage would then be applied to estimate the demand for a new facility in the same corridor or in another area. For example, research work conducted by the Texas Transportation Institute (TTI) of park-and-ride facilities in six Texas cities identified ridership ranging from 0.05 to 2.0 percent of the market area population (*11*). The differences in the range appear to be related to other factors such as the level of congestion, intensity of development in the activity center, and parking costs at the destination.

Similar to the demand observation technique, the market area population demand estimation technique provides a relatively simple approach. As such, it may be used most appropriately in developing an initial estimate or in combination with another technique. It is also appropriate for use in estimating the demand for shared-use and small exclusive lots. The market area population methodology assumes that demand is equal for all activity centers being served. Examining the demand to different activity centers is a more detailed step.

Modal Split

The modal split methodology takes the market area analyses one step further by examining the portion of the market area population that works in the activity center or centers to be served by the facility. Thus, it attempts to account for the fact that different parts of the potential service area have different attraction rates to the various activity centers. This procedure requires that the percentage of the market area population working in each activity center be identified and analyzed to estimate the potential demand for the park-and-ride facility.

Obtaining this information may be difficult, which makes this methodology more cumbersome and time consuming. However, the results should provide a more accurate estimate of the potential demand for a given facility.

Institute of Transportation Engineers Model

The Institute of Transportation Engineers (ITE) model (*17*) is based on the assumption that park-and-ride demand is a direct function of peak-period traffic on adjacent travel facilities. A further assumption is made that commuters will not divert from their normal travel routes to reach a park-and-ride lot so that potential users will only be commuters who were already passing the park-and-ride location in their normal travel routes. The formula used for the ITE model is:

$$\text{Demand} = a(\text{Peak}) + b(\text{Prime})$$

where:

- Peak = total peak-period traffic on adjacent facilities (including the prime facility);
- Prime = peak-period traffic on the prime facility; and
- a, b = diversion factors for total traffic and prime facility traffic, respectively.

Diversion factors of 1 percent for total area traffic and an additional 3 percent for traffic on the prime facility have been recommended for use with this model. In general, the ITE technique is easy to use, requiring only peak-period traffic volumes on the major travel facilities. The approach has limitations however, in that no attempt is made to distinguish between commuting and non-commuting trips or among trips to different destinations.

Other Demand Estimation Techniques

Other techniques and models are also available for estimating the demand for park-and-ride facilities, including regression analysis techniques, as well as models developed by the Georgia DOT and others. Microcomputer modeling packages are also used in some areas to analyze the potential demand for park-and-ride facilities. The content and use of these approaches are discussed more extensively in other sources (*8,11,12*). In addition, regional park-and-ride plans have been developed in some areas based on the use of sketch planning techniques.

SIZING PARK-AND-RIDE FACILITIES

Once the potential demand for a park-and-ride facility has been identified, the next step is to estimate the size of the lot to be developed. Key considerations in determining the appropriate size of a park-and-ride facility include daily fluctuations in demand, pedestrian walking distances, type and level of transit services, access, supporting facilities, and land availability. Each of these factors is summarized next.

Daily Demand Fluctuations

The results of the demand estimation process will provide a projected average daily demand for the proposed park-and-ride facility. Because of the nature of conventional park-and-ride services, little daily fluctuation in this demand should be expected, except on days with severe weather. Individuals using park-and-ride facilities do so routinely for trips to and from work. However, designing the facility to accommodate slightly more vehicles than the demand estimates indicate may be appropriate. A 10 percent increase has been suggested as a realistic approach to ensure that adequate parking spaces are available (*8,12*). Additional space may be desired, however, to ensure flexibility for future lot expansion.

Maximum Walking Distance

In sizing park-and-ride lots, consideration must be given to the distance people will have to walk to and from their vehicles. Thus, the size of a lot may be constrained to some extent by walking distances. The acceptable walking distance for commuters—from their parked vehicle to the transit loading area—has been identified as between 120 and 300 m (400 and 1,000 ft) (*8,12*). However, keeping the distance within 120 to 195 m (400 to 650 ft) appears to be the best. Experience indicates that walking distances of greater than 195 m (650 ft) may be viewed as too long by users, resulting in illegal parking closer to the transit area or non-use of the facility (*8,12*). Walking distances of more than 300 m (1,000 ft) are necessary, however, in some facilities serving major congested travel corridors. For example, some fully used lots located along the Metrorail system in Washington, D.C. have walking distances of greater than 300 m (1,000 ft). Factors influencing walking distances may include sheltered walkways, moving sidewalks, and the frequency of transit services. Considering these factors and walking distances is important in both sizing and designing a park-and-ride facility.

Transit Services

The type, capacity, and frequency of the transit service will also influence the size of a park-and-ride lot. The type of transit mode will impact the size and layout of the platform and waiting area, as well as the parking area. Rail and bus systems will have different requirements for rights-of-way, platforms, stations, shelters, and waiting areas. Rail transit systems, which have the capacity to carry 10,000 persons per hour or more, can obviously accommodate larger park-and-ride lots than facilities oriented toward bus or ridesharing modes. Parking garages, rather than surface lots, have been used in some areas to accommodate high levels of demand with rail systems in major travel corridors. Parking garages can increase the capacity of a facility and reduce walking distances. Parking structures represent a higher cost alternative, however, and require additional safety and security measures.

The frequency of bus services and the types of vehicles used will influence the size of bus oriented park-and-ride lots. Bus headways of 5 to 10 min appear to be common from larger lots associated with HOV lanes or other dedicated facilities, but headways as low as 3 min are currently in use in Houston. Using 3-min headways, 20 buses an hour could serve a facility. Assuming that 40-ft buses are used, approximately 900 to 1,000 passengers could be accommodated during the peak hour. Shared-use lots, which are located along existing regular routes, are more likely to be sized based on available parking and negotiated agreements with the owners.

Ridesharing Use

Walking distances in lots oriented only toward ridesharing activities—carpooling and vanpooling—are less of a concern than with bus or rail facilities. This is because carpoolers and vanpoolers will usually meet at a prearranged location, rather than walking to a central platform or waiting area. The sizing of park-and-pool lots will depend on the demand projections, available space, and design constraints. Consideration should be given to the potential for future transit services if this appears warranted. Many bus systems allow carpools and vanpools to use park-and-ride facilities as staging areas, as long as the facilities are not at capacity. Consideration should be given to carpool and vanpool formations in the lot sizing process to accommodate this use.

Access

The capacity of roadways and intersections adjacent to the park-and-ride site will also influence the size of the facility. Good access is needed to ensure that the facility does not overload the existing roadway system, causing delays to both users and non-users. To address potential concerns, a site-specific traffic impact analysis should be conducted as part of the lot selection and lot sizing process. This analysis should include a review of existing capacity and levels of service, as well as an estimate of the impact of the park-and-ride lot. This analysis will identify whether there is a need to improve the roadway system to accommodate the projected demand.

Land Availability

A key consideration in the sizing of a park-and-ride facility will be the amount of available land, the purchase or lease costs, and development costs.

PARK-AND-RIDE SITE SELECTION

Once the decision has been made that an adequate demand exists for a park-and-ride facility and the size of the facility has been estimated, the next step is to identify, evaluate, and select a site. A number of important factors in the site selection process have been identified. These factors, which are briefly described next, should be considered in the examination of alternative locations for potential park-and-ride facilities.

Transit System, State, MPO, or Community Goals and Policies Related to Facility Development

The site selection process usually begins with a review of the appropriate agency or community goals and policies relating to the development of fixed transit facilities. These policies, which may be adopted by the transit system, state DOT, MPO, or community, will help determine the importance placed on different types of facilities and development arrangements. These policies can be used to help guide the site selection process.

Availability

The availability of potential sites is obviously a critical factor. Thus, one of the first steps will be to identify the availability of possible sites. This may include checking ownership records and zoning requirements for vacant and developed sites. In the case of parking lots being considered for shared-use facilities, this will mean determining the long-term viability of a joint-parking arrangement. The information sources identified previously with the demand observation technique can also be used to help identify available sites.

Site Accessibility

Examining potential sites for their accessibility to both commuters and transit vehicles is important. Selecting sites that have convenient access from major roadways will help reduce development costs and increase ease of use. Multiple access points—or at least access from two streets—are often preferred.

Site Visibility

Checking the visibility of potential sites from major roadways is important to ensure that passing motorists will be aware of the facilities. Visibility can also act as a deterrent to possible vandalism and enhance the safety and security of a lot.

Adequate Space

It is important that potential park-and-ride sites are able to accommodate the projected demand. Sites that are not large enough to provide the necessary parking spaces and transit areas are often avoided, as problems may result with parking in neighborhood areas or other unauthorized locations. Consideration may be given to both the immediate and long-term demand, with space reserved for future expansion.

Transit Service Operations

Examining potential sites for their proximity to existing transit routes and services is a critical step. Selecting sites that maximize operating efficiencies is often considered by transit systems. This will help ensure operating savings and encourage ridership.

Development Costs

The cost of developing a park-and-ride facility is often a prime factor in the site selection process. Factors influencing the cost of a site may include the purchase or lease price, grading and leveling, environmental factors, and construction of the different supporting elements. Sites that are level, have good access, and are free of environmental problems obviously offer numerous cost savings over sites with many or all of these problems.

Transit and HOV Priority Treatments

Sites that provide access to transit and HOV priority treatments will offer potential users with additional incentives. Park-and-ride lots located adjacent to rail or HOV lanes—which provide dedicated transit rights-of-way—usually provide users with travel time savings and more reliable travel times. It may also be appropriate to consider other transit priority measures, such as signal priority treatments, arterial street HOV lanes, and direct access ramps, to further encourage use of the facility.

Proximity of User Amenities

Consideration may also be given to the availability of user amenities in the general area. These may include services such as gas stations, grocery stores, dry cleaners, and day care facilities. Locating park-and-ride lots in areas with other businesses may encourage use by providing riders with easy access to desired services. The activity and visibility generated by these businesses may also help deter vandalism. On the other hand, sites in developed areas are prone to be more expensive than those in undeveloped areas.

Joint Development Opportunities

The potential for joint development projects or activities may be examined in the site selection process. Logical projects may include convenience stores, day care centers, or other services, as well as shared use by other providers. Exploring joint development opportunities can result in additional revenues to the transit agencies through leases or other arrangements and increased ridership.

Environmental Considerations

Park-and-ride lots may have environmental impacts on the areas adjacent to the facilities. Giving early consideration to potential environmental issues can help ensure that any possible impacts are identified and adequately addressed. Noise and air quality issues are the most likely problems to arise. Noise walls, landscaping, and design treatments can all be used to address these concerns.

A number of transit agencies reported using some type of rating form or checklist as part of the site selection process. The techniques currently being used range from formal criteria with numerical ratings to more informal guidelines. An example of the design criteria used by one system, METRO Transit in Oklahoma City, is provided in Appendix B. The *Guide for the Design of Park-and-Ride Facilities* (*18*), published by the American Association of State Highways and Transportation Officials (AASHTO), also contains an example of a park-and-ride site priority rating form. A copy of this form is provided in Appendix C.

CHAPTER FOUR

DESIGN OF PARK-AND-RIDE FACILITIES

Once the lot sizing and site selection processes have been completed, the next step involves designing the actual facility. Major factors that may influence the design process and that should be considered include local zoning and land use regulations, interface with the roadway system, internal lot layout, provision of informational signs, and environmental issues. Within each of these general categories exists a variety of matters that will also need to be considered.

A number of reports that examine design considerations for park-and-ride facilities and provide examples and guidelines are available. These include the AASHTO *Guide for the Design of Park-and-Ride Facilities* (*18*), *Park-and-Ride Facilities—Guidelines for Planning, Design, and Operation* (*8*) sponsored by FHWA, and *High-Occupancy Vehicle Facilities: A Planning, Design, and Operation Manual* (*19*) prepared by Parsons Brinckerhoff Quade & Douglas, Inc. The AASHTO guidelines were the most frequently cited design reference by the state and transit representatives contacted during the survey.

In addition, design guidelines have been prepared in some states. For example, guidelines for Texas are included in the *Revised Manual for Planning, Designing, and Operating Transitway Facilities in Texas* (*12*), and guidelines for Washington can be found in *Park-and-Ride Design Guidelines* (*20*). Several transit agencies have also developed their own design guidelines. Examples of these include *Metro Transportation Facility Design Guidelines* (*21*) by the Municipality of Metropolitan Seattle, *Transit Facility Design Guidelines* (*22*) by the Regional Transportation District in Denver, *Design Guidelines for Bus and Light Rail Facilities* (*23*) by the Sacramento Regional Transit District, and *Design Criteria for METRO Park-and-Ride and Transit Center Facilities* (*24*) by Houston METRO.

This chapter provides an overview of the key issues and factors that are often considered in designing park-and-ride facilities. The major emphasis is on design considerations associated with exclusive park-and-ride lots, although shared-use facilities are briefly discussed. The chapter is intended to highlight the major elements to be addressed in the design stage, rather than provide a detailed design guide. Individuals interested in a more extensive description of the design process or specific examples should consult the reports noted previously.

The design process usually involves numerous individuals, agencies, and groups. For example, individuals with technical expertise in transit planning; traffic, civil, and environmental engineering; design; architecture; landscape architecture; and enforcement will all be needed. Further, representatives from the transit agency, local community, state DOT, and other agencies will need to be involved to ensure that all policies and requirements are addressed. The design process also includes participation from neighborhood groups, environmental groups, adjacent businesses, and others who may be affected by the facility. Use of a multi-agency planning and design team may be one approach to ensuring that the concerns of all groups are adequately addressed in the design process.

Primary considerations in the design process focus on providing safe and efficient traffic flow within the site and on access roads, and ensuring that adequate parking spaces, pedestrian walking and waiting areas, and shelters or stations are provided. Facilities to accommodate disabled individuals and other special user groups, as well as security and safety issues, will also need to be considered. In addition, park-and-ride facilities should be designed to fit into the surrounding neighborhood. Specific steps to be considered in the design process are described next.

ZONING AND LAND USE REGULATIONS

The design process starts with a review of the local zoning ordinance and land use regulations, along with any other local requirements that may influence the development of the facility. As noted previously, ensuring that a park-and-ride lot is an allowable use or requesting a rezoning or other change should be done as part of the site selection process. Once this has been accomplished, the zoning ordinance and other regulations should be reviewed to ensure that all appropriate requirements are addressed. These may include elements such as setbacks, building designs, buffer areas, landscaping, environmental requirements, and access considerations. Establishing a good working relationship with representatives from the planning and engineering departments of the jurisdiction in which the facility is located is important in the design process.

Involving neighborhood groups and adjacent businesses is also critical to help ensure that any concerns are addressed early in the process. A public participation process may be required in many areas. Several transit representatives contacted during the survey reported encountering neighborhood opposition with some facilities. Involving these groups early in the process may help overcome potential concerns, which often relate to perceptions that local street traffic, noise levels, and vandalism will increase. Further, any state or federal policies or regulations concerning design issues should be identified and addressed, such as ensuring that the needs of disabled commuters and other user groups are accommodated.

INTERFACE WITH THE ROADWAY SYSTEM

A number of design issues associated with the interface between the park-and-ride facility and the local roadway system will need to be examined. These include automobile access and egress considerations, transit vehicle access and egress, park-and-ride lot access points, access roadways, and traffic signals and traffic control devices. The main elements to be considered in each of these areas are summarized next.

Automobile Ingress and Egress

The design of a facility will need to provide access and egress for automobiles entering and leaving the lot. It is important that the design provides for safe access and easy maneuverability for vehicles, as well as minimizing the impact on adjacent roadways. Factors that may influence access and egress include topography, location and type of adjacent roadway, traffic levels, and traffic control devices.

Transit Vehicle Ingress and Egress

The considerations noted above for automobiles will have to be examined for transit vehicles serving the facility. Rail and some bus systems, such as those associated with HOV lanes, use dedicated rights-of-way. In other cases, special bus only entrances and exits may be used to expedite the movement of transit vehicles.

Park-and-Ride Lot Access Points

Based on the general considerations of automobile and transit access and egress, a more detailed examination should be conducted to determine the best access points for the park-and-ride facility. A traffic impact assessment should be conducted to identify potential problems and appropriate solutions. Park-and-ride lots, especially large exclusive facilities, will have significant impacts on the local roadway system. Addressing possible issues in the design stage will help ensure the safe and efficient operation of the facility.

Access Roadways

The design of the roadways accessing the park-and-ride facility is important. The traffic impact assessment can be used to determine the existing roadway capacity, current traffic volumes, and projected volumes with the park-and-ride lot. Appropriate improvements can then be identified. The analysis may also consider the impact of any potential growth in commercial and business development and activities in the areas that may result from the location of the transit facility, as well as normal growth.

Traffic Signals and Traffic Control Devices

Examining the need for new traffic signals, modifications to existing signals, and other traffic control devices is often included in the traffic impact assessment. Changes in timing at existing traffic signals or new signals may be needed at heavily used access and egress points to ensure the safe and efficient movement of vehicles using the park-and-ride facility as well as those on the local roadway. The *Manual on Uniform Traffic Control Devices* (MUTCD) (*25*) can be used in evaluating and justifying any new signals or changes in the timing or phasing of existing signals. Provision of information or guide signs that are easily visible is important to provide commuters with directions to the facilities.

INTERNAL LOT LAYOUT

Park-and-ride facilities provide a combination of parking and transit related areas. As such, they encompass design elements of both parking lots and bus or rail stations and waiting areas. A number of factors will need to be considered and addressed in the design of these areas. As described next, these include factors related to different functional areas, internal circulation, amenities, pavement and drainage, landscaping, lighting, and safety and security.

Functional Area Designs

The design of park-and-ride facilities will need to accommodate the functional requirements of different user groups and transit services. For example, different types of access modes may be used, resulting in the design of long-term parking areas, drop-off or kiss-and-ride areas, parking areas for disabled individuals, bicycle racks or lockers, and pedestrian walkways. In addition, some facilities may provide access by feeder buses or minivans.

The design requirements, as well as the locations, of these access modes may differ. Ideally, the facility design should provide for a hierarchy of uses. Parking for disabled individuals, bicycle storage, other amenities, and connecting transit services are usually located closest to the transit waiting area. Drop-off and pick-up areas, or kiss-and-ride areas, are also located close to the transit access point. All-day parking areas are usually the farthest removed from the transit loading area. Providing a mix of large and small car parking spaces may be an option, although some areas report problems with this approach as people park in whatever space is available. Transit stations, shelters, and waiting areas represent important considerations in the design phase, along with bus bays or bus pull-in areas. Figures 15 through 17 provide examples of the different functional areas within a park-and-ride facility.

The flow of pedestrians to and from parking areas and between different transit modes is also very important. Transit loading areas are often located to equalize walking distance from the long-term parking areas and to minimize potential conflicts between vehicles and pedestrians. The Americans with Disabilities Act (ADA) of 1990 and the subsequent regulations issued by FTA and the Architectural and Transportation Barriers Compliance Board provide additional guidance for ensuring that a facility is accessible to handicapped individuals. Examples of a number of layouts encompassing these elements are provided in Figures 18 through 20.

FIGURE 15 Park-and-ride lot bus station area, Houston, Texas. (Courtesy of TTI)

FIGURE 16 Park-and-ride lot bus station area, Fullerton, California. (Courtesy of Parsons Brinckerhoff)

FIGURE 17 Park-and-ride lot long-term parking area, Riverside, California. (Courtesy of Parsons Brinckerhoff)

Internal Circulation

The layout circulation system is related to the design of the different functional areas and is a critical element in ensuring that conflicts do not arise between the different user groups. The internal circulation should allow for the safe and efficient movement of automobiles, vanpools, buses, motorcycles, bicycles, and pedestrians. The circulation system will further need to consider the requirements of park-and-ride lots, which occur during the morning and afternoon rush hours.

Amenities

Possible passenger amenities represent another design consideration for park-and-ride facilities. These will depend on the type of facility, the anticipated patronage levels, local policies, and available funding. Amenities that are often incorporated into different types of park-and-ride lots include public telephones, trash receptacles, newspaper vending machines, other vending services, transit information displays, and transit shelters. Figures 21 and 22 provide examples of newspaper vending machines and bicycle storage areas at park-and-ride lots. In addition, some larger facilities include transit stations, heated waiting areas, staffed transit information booths, restrooms, and small convenience stores. One park-and-ride lot in Miami, located adjacent to the METRORAIL system, has a day care facility. A number of the representatives contacted during the survey indicated that although amenities are considered important with park-and-ride facilities, funding limitations often restricted what can be provided.

Pavement and Drainage

Consideration will need to be given to the pavement requirements of the different functional areas within a park-and-ride lot during the design phase. AASHTO design standards, as well as

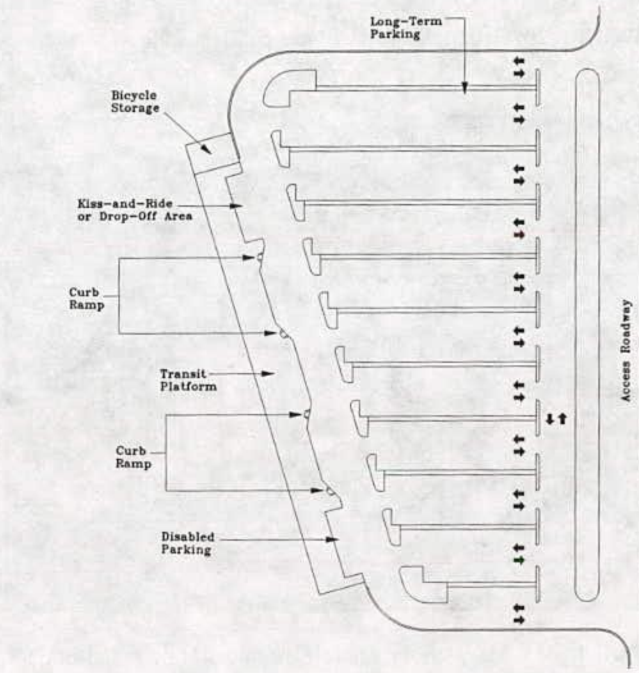


FIGURE 18 Example of large park-and-ride lot layout.

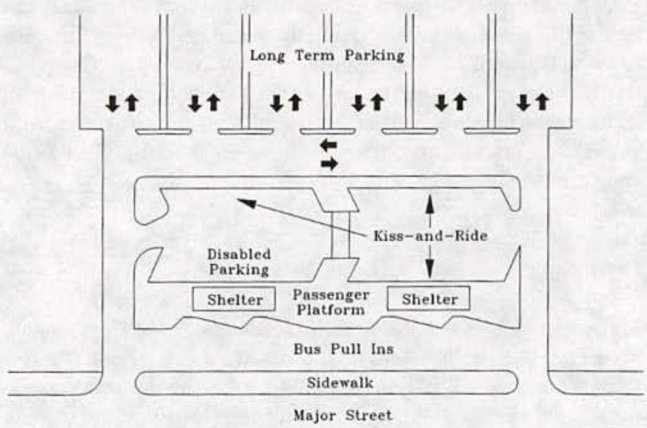


FIGURE 19 Example of mid-size park-and-ride lot layout.

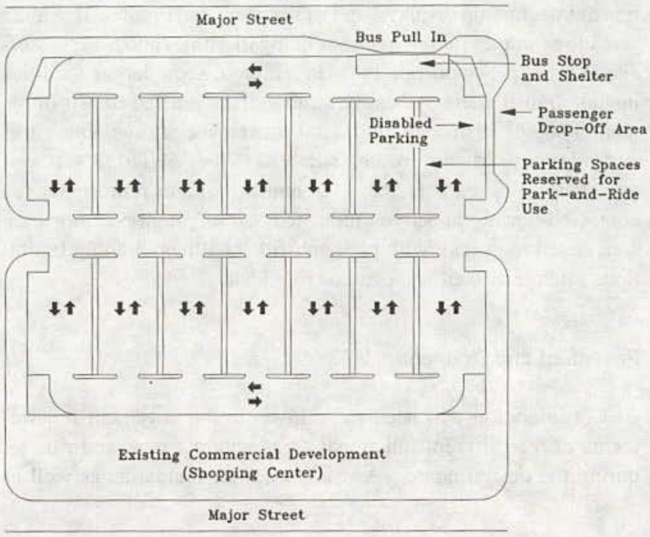


FIGURE 20 Example of shared-use park-and-ride lot layout.

FIGURE 21 Newspaper vending machines at park-and-ride lot, Garland, Texas. (Courtesy of TTI)

local and state pavement specifications and agency guidelines, can be used to determine the appropriate pavement designs for load-carrying demands of the different functional areas. Ensuring park-and-ride lots are designed for proper drainage is also important. In addition, local, state, and federal requirements associated with storm water runoff and other environmental issues need to be considered.

Landscaping

Design of a park-and-ride facility should consider landscaping needs and treatments. A well-landscaped lot can enhance the appearance of a facility, improve public and neighborhood acceptance, and add to the feeling of passenger security. Landscaping should be compatible with the type of facility and the surrounding area, and should not interfere with sight distance, safe operation of

FIGURE 22 Bicycle storage area at park-and-ride lot, Miami, Florida. (Courtesy of Metro-Dade Transit Agency)

the lot, or access for different user groups. Landscaping treatments should also use plants and other elements appropriate to the area, and maintenance needs and costs should be considered to ensure that upkeep will be affordable. Involving neighborhood groups and local governments can further ensure that landscaping addresses the needs of both the facility and the local area. Guidance on landscaping is available in *A Guide for Transportation Landscape and Environmental Design* (*26*), and *Transit Planting: A Manual* (*27*).

Lighting

Providing adequate lighting at park-and-ride facilities is important from a safety and security standpoint. Well-lit areas may help deter vandalism and other potential problems. In designing lighting for a park-and-ride facility, consideration should be given to the type, mounting height, and spacing of luminaries to achieve the desired intensity and maintenance requirements. AASHTO guidelines (*18*) provide recommendations on the type, intensity, and location of lighting for park-and-ride facilities.

Security

Consideration of safety and security features is an important part of the park-and-ride facility design process. Both personal safety and protection of automobiles left in a lot all day are important commuter concerns that can be addressed in the design stage through a number of different approaches. These include lighting, fencing and gates, security monitoring booths, cameras and surveillance equipment, signing, and ensuring adequate visibility from all parts of the facility. Identifying the boundaries of a park-and-ride lot, through the use of fencing, hedges, or other techniques, can help control unauthorized use and reduce the potential for vandalism. For example, Houston METRO uses a program "Crime Prevention Through Environmental Design" developed at the University of Florida to enhance safety and security features at its facilities.

SIGNS

Providing adequate information to users and potential users is critical to the success of park-and-ride facilities. Thus, informational signs—both external and internal—are important elements of any system. Sign needs are best addressed early in the design process and are usually coordinated with other information signs used by the transit agency or state DOT. A number of respondents to the telephone survey indicated that common signs, logos, and information are used throughout the park-and-ride and transit system. Basic elements for consideration in designing external and internal signs are described next.

External Signs

External guide signs, or trail blazer signs, are critical to communicate information on the location and use of a park-and-ride facility to commuters. Ideally, external signs should be placed to intercept potential users on their normal travel paths and to direct them to the facility. Thus, multiple signs are often used to ensure that commuters reach the lot. Park-and-ride signs should be designed in accordance with the MUTCD (*25*), as well as with state and local policies and regulations. Figures 23 through 26 provide examples of possible external guide signs, as well as those currently in use. As indicated by these examples, the message on the signs should be short and concise, conveying key information about the types of services provided.

Internal Signs

Internal guide signs are also critical to help ensure the proper use of park-and-ride facilities. Signs at the entrance to a lot should direct commuters to the proper areas—daily parking, kiss-and-ride areas, and handicapped parking spaces—and provide information on the hours of operation and allowable uses of the facility. Each of these functional areas should also be properly signed. Further, areas for transit vehicles only, pedestrian walkways, and bicycle storage should be well marked. In addition, transit information, including information on routes, schedules, and fares, should be readily available. Information kiosks or map and schedule displays are often used. Internal traffic control and parking can further be enhanced through the use of proper pavement markings or plastic

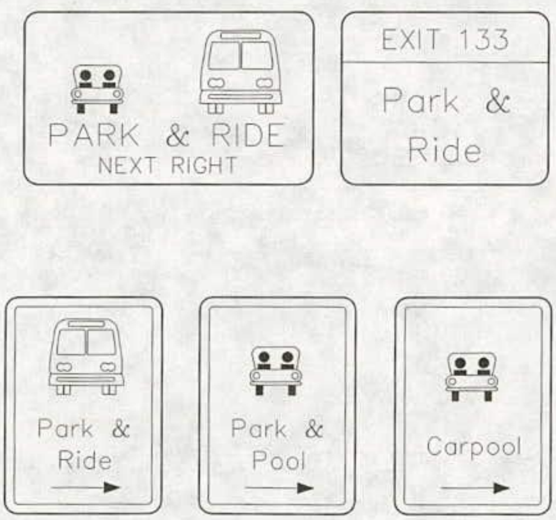


FIGURE 23 Examples of park-and-ride signs.

FIGURE 24 Downtown park-and-ride sign, San Antonio, Texas. (Courtesy of TTI)

FIGURE 25 Virginia DOT commuter lot sign. (Courtesy of Parsons Brinckerhoff)

FIGURE 26 Park-and-ride and park-and-pool signs, Bellevue, Washington. (Courtesy of Parsons Brinckerhoff)

pylons. On paved lots, these may include lines demarcating parking stalls, restricted areas, and stops. Speed bumps or other techniques may also be used to slow vehicles down and to keep unauthorized vehicles out of transit-only areas. The MUTCD (*25*) provides guidelines for pavement markings and many of the internal signing elements.

ENVIRONMENTAL CONSIDERATIONS

The design of a park-and-ride lot should consider and address any environmental issues associated with the site or area, as well as any potential environmental impacts of the development and operation of the facility. Possible environmental concerns may include groundwater runoff and water quality, noise, and visual and traffic impacts. Another concern is air quality, which may be more difficult to address; much ongoing research is needed in this area on the actual impacts and potential strategies. However, techniques that have been identified to address potential air quality concerns in the immediate vicinity of a park-and-ride lot include providing well-ventilated waiting areas, reducing the amount of time commuters have to wait for a vehicle, and minimizing the number of idling vehicles.

CHAPTER FIVE

ADMINISTRATION AND OPERATION

Locating and designing park-and-ride facilities represent only the first steps in developing successful projects. The ongoing administration and operation of both the fixed facilities and the transit services is key to accomplishing the goals of the park-and-ride lot. This chapter summarizes the major elements to be considered in implementing, administering, and operating park-and-ride facilities. A general discussion of the liability issues often associated with park-and-ride lots is presented first, followed by a summary of the leasing arrangements often used with park-and-ride facilities. An overview of the different techniques and approaches used to fund, construct, operate, and maintain park-and-ride services is provided next. The chapter concludes with a discussion of safety and security issues associated with park-and-ride services and the methods being used to address these concerns.

LIABILITY

The development and operation of park-and-ride facilities place additional responsibilities on transit agencies, state DOTs, local communities, and other groups. While the potential for additional tort liability accompanies these responsibilities, a variety of approaches are being used to respond to the potential of increased liability. In some cases, park-and-ride facilities are included as one component in self insurance programs. For example, park-and-ride lots that are considered part of the highway system may be covered by a state's self insurance program. In other cases, special insurance may be purchased by a state, transit agency, or local community to cover a shared-use facility. California provides an example of special liability insurance to cover installation, maintenance, and use of leased lots (*8*). Liability issues are commonly addressed in the lease agreements used with most shared-use facilities. Several survey respondents to the telephone survey indicated that liability issues are a concern. The potential for tort liability is a serious issue that should be considered prior to implementing a project, however, and adequate insurance coverage should be in place before operations are initiated.

LEASE AGREEMENTS

A variety of lease agreements may be used with park-and-ride facilities. As noted previously, park-and-ride lots may be developed in a number of different ways. For example, state-owned highway rights-of-way may be used or a state or transit agency may purchase property for development of a facility. In other cases, land may be leased from the current property owner or a shared-use agreement may be entered into for use of an existing parking lot.

Examples of different types of lease agreements were identified through the literature review and the telephone survey, including those used by the Sacramento Regional Transit District, the Minneapolis-St. Paul Metropolitan Transit Commission, and Caltrans. The Connecticut DOT provided examples of different types of agreements, including those between the state and a local jurisdiction for parking at a rail station, a sublease by a local jurisdiction to a third party for parking at a rail station, leases for facilities built with state funds on town property and private property, and shared-use agreements with a church and a shopping center. Although differences exist among the various lease examples, the following common elements have been identified for consideration in any park-and-ride facility lease or agreement.

- *Identification of parties*—Identification of the parties and their legal standing.
- *Purpose*—Identification of the intended purpose and use for the facility.
- *Premises*—Identification of the area to be used. A separate diagram or map may be included to highlight the specific area.
- *Access*—Identification of access to and from the designated area.
- *Terms and conditions*—Identification of the duration of the agreement, cancellation provisions, and responsibilities of each party for maintenance and other elements.
- *Improvements*—Identification of the improvements or changes that will be made and the responsibility for these. For example, with shared-use lots, a transit agency may agree to improve the pavement in bus waiting areas and access roads.
- *Maintenance*—Identification of specific maintenance functions and responsibilities. For example, with shared-use lots, transit agencies may agree to clean the area or provide free snow plowing in return for use of the lot.
- *Liability insurance*—As noted previously, the responsible groups and insurance coverage should be identified.
- *Use of premise (nondiscrimination)*—This clause may stipulate that the lot must be open to all users, without discrimination by the lot owner.
- *Examination of property*—This section indicates that the property has been examined and has been found to be appropriate for the intended use.
- *Licensing*—This section may be necessary if only a license is granted by the lot owner and would indicate that no legal title or leasehold interest has been created.
- *Government charges*—This section identifies that the agreement does not impose any responsibility on the government agency or unit for property taxes of the private owner.

FUNDING

A variety of funding sources are available for constructing and operating park-and-ride facilities. The literature review and the telephone survey identified that a wide range of local, state, and federal funding sources have been used—and are continuing to be used—with park-and-ride projects. Major funding techniques and programs are summarized below. In most cases, a variety of funding sources appear to be used in designing, developing, implementing, and operating park-and-ride facilities.

Federal Funding

Federal funding for different elements associated with park-and-ride projects is available through both FHWA and FTA. As noted previously, park-and-ride lots associated with the Federal-Aid highway programs administered by FHWA are eligible for funding. In addition, funding from FTA Sections 3, 9, and 18 can be used for park-and-ride related facilities and services. Further, the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) provides greater flexibility in the use of funds from different programs, as well as creating new programs. An example of a new program under ISTEA is the Congestion Mitigation and Air Quality Improvement Program (CMAQ), which is targeted at projects that will help meet air quality goals, primarily in nonattainment areas. The exact level of available funding and the local match requirements vary among the different federal programs. In considering potential projects, states and transit agencies should examine the different federal programs and identify those most appropriate to the scope and nature of the project.

State Funding

A variety of state funding sources have been and are being used to support the capital and operating costs associated with park-and-ride facilities. In most cases, the survey results indicate that state funds are usually used in combination with local funds to provide the required match for federal programs. Sources of state funds used to support park-and-ride facilities include general revenues, sales taxes, the oil overcharge program, gas taxes, lotteries, and public works programs.

Local Funding

Local funds are often used either alone or in combination with state funds to match federal dollars. Sources of local funding identified through the literature review and telephone survey included local sales taxes, farebox revenues, parking fees, general funds, property taxes, revenues from joint development projects, and other transit agency income.

Private Funding

Private funds may also be used to develop and maintain park-and-ride facilities. Shared-use lots at local shopping centers provide one example of private participation. In other cases, a lot may be included as part of a new residential development, or a private company may help fund a facility used by its employees.

CONSTRUCTION

A variety of techniques, approaches, and institutional arrangements have been used to construct park-and-ride facilities. As noted previously, both state DOTs and transit agencies are actively involved in the construction of park-and-ride lots. In many cases, the transit agency is the lead construction group. In other cases, the state or other agency may take the lead. Agencies work both separately and jointly to develop park-and-ride facilities, for example, DOTs in Connecticut, Texas, California, Washington, and Minnesota have all been responsible for the development of park-and-ride and park-and-pool lots both individually and in conjunction with local transit agencies and communities.

Houston METRO provides one of the best examples of multi-agency park-and-ride projects. In some cases, METRO took the lead on developing a park-and-ride facility while, in other cases, TxDOT was the lead agency. These projects also received federal funding, either through FTA or FHWA. Interagency agreements were used to identify the roles and responsibilities of the agencies in different projects.

The techniques used to develop and construct park-and-ride facilities have also varied. In some cases, the state DOT or transit agency has simply followed traditional approaches to land acquisition and facility development. In other cases, innovative and non-traditional approaches have been employed. For example, Houston METRO employed a turnkey process to develop some of its initial park-and-ride lots. This process involved soliciting proposals for improved real estate and entering into earnest money contracts for the selected alternatives. Upon completion of construction, METRO bought the finished lot using local funds, and these facilities were ready for immediate occupancy and operation. The process included issuing a request for proposal (RFP), holding a pre-proposal conference, evaluating proposals, awarding earnest money contracts, inspecting the constructed facility, and closing on the project. A total of 6,350 parking spaces were constructed through use of the turnkey process. METRO estimated that it saved time and money by using this technique (*28*).

OPERATION

Operation of a successful park-and-ride facility involves a number of elements, including those related to both the facility and the transit service provided. Elements to be considered in the ongoing operation of a park-and-ride facility include marketing, any parking fee structures, the frequency and fares for the transit service, maintenance, and security. The first three of these elements are summarized next, with maintenance and security concerns discussed in more detail in the final two sections of this chapter. In addition, other issues related to carpool use of bus and rail oriented park-and-ride facilities and techniques for dealing with over-crowded facilities are briefly discussed in this section. Close cooperation among the local transit agency, community, lot owner, and state DOT is critical to the successful operation of park-and-ride facilities. Formal agreements may be used to outline the roles and responsibilities of these groups or informal understandings may guide the ongoing operation of a facility.

Marketing

Commuters must have information about a facility in order to use it. Marketing involves the use of promotional techniques to inform motorists about the facility and available transit services. A marketing program should be developed and implemented to introduce a new park-and-ride facility. Ongoing efforts are also important for the continued promotion of a facility. Two important aspects for developing a marketing program are identifying the target audience and determining the most effective mechanisms for communicating the desired information. A variety of techniques to identify the target audiences have been used, including focus groups, telephone surveys, mail-out surveys, and employer based surveys.

The results of the market research effort should be a target marketing program focusing on commuters most likely to use the park-and-ride facility. Actual marketing and communication techniques may include direct mail; radio, television, and newspaper advertisements; outdoor billboards; roadside signs; lot location maps, transit maps, and transit schedules; employer focused efforts; and other methods. The marketing effort should match the nature and scope of the project and should address all services—bus, rail, and rideshare—provided at the facility. Obviously, more extensive and expensive marketing campaigns will be used with large exclusive park-and-ride than with small shared-use facilities. Experience also indicates that ongoing marketing efforts are needed to continually reinforce the message and to introduce new commuters to the facility.

Parking Fee Structure

Consideration of an all-day parking fee represents an important policy decision. Parking fees can help generate needed revenue, but they can also discourage use, adding another out-of-pocket cost for users and representing an additional inconvenience. The vast majority of both shared-use and exclusive park-and-ride lots do not charge a parking fee. Current experience indicates that parking fees are charged only in park-and-ride lots associated with rail systems in major metropolitan areas, many of which are at or close to capacity. For example, parking fees range from $0.50 to a high of $3.00 a day for some lots in the Washington, D.C. area.

Transit Frequency and Fares

As with parking charges, the frequency of transit services and fare levels will reflect policy decisions, and should be matched to the anticipated demand. In addition to providing high-frequency services, some transit systems reported providing premium express services to attract choice riders. Over-the-road coaches equipped with additional amenities are sometimes used with these services. The fares charged for all services operated out of park-and-ride lots will reflect the fare policies and fare pricing strategies adopted by the transit agency, such as distance traveled, speed of travel, and any special service features. Thus, it can be anticipated that fares for bus and rail services operated from exclusive remote lots will be higher than fares for local routes serving shared-use facilities

Carpool Use of Bus and Rail Park-and-Ride Facilities

Concerns have sometimes been raised regarding the use of park-and-ride lots as staging areas for carpool and vanpool formations. Although park-and-pool lots are designed exclusively for this use, individuals forming carpools or vanpools at park-and-ride facilities may be taking up limited free parking spaces and at the same time not providing any revenue through fares. This can have a negative impact on the transit system through loss of passenger revenue. The results of the telephone survey indicate, however, that this practice is a problem only at a few lots that are at capacity. In general, most transit agencies indicated that carpools and vanpools are allowed as long as there is space available at a facility. Further, some noted that this use is encouraged.

Lots Over Capacity

Several representatives indicated that some existing park-and-ride lots are at or over capacity, which in some cases results in unauthorized parking on streets adjacent to the facility or in surrounding neighborhoods. In other cases, it results in a loss of riders and revenues because people cannot gain access to the facilities. Approaches and techniques identified to address this problem included purchasing excess rights-of-way initially or later to expand existing lots, developing new lots close by, building parking garages, distributing lot passes through a lottery system, charging for parking, and re-striping existing lots to gain more parking spaces. Further, one innovative technique currently in use in the Washington, D.C. area is to give preferential treatment or lower parking rates to multi-occupant vehicles entering the park-and-ride lots. The San Francisco Bay Area Rapid Transit District (BART) system has provided preferential parking areas for carpools and vanpools at some lots.

MAINTENANCE

Ensuring that a park-and-ride facility is clean, attractive, and well maintained will have a positive impact on users. The type of site, nature and level of transit service, and site location will all influence maintenance requirements. Ensuring that adequate funding is available for maintenance and that the facility is designed to allow for easy maintenance are usually considered early in the planning and design stages. The agency or group responsible for maintenance can also be identified early in the planning process and then be involved throughout all phases. Elements to be considered in developing a comprehensive maintenance program include the following:

- Periodic inspection
- Pavement repair
- Shelter or station repair
- Traffic control devices (signs and pavement markings)
- Lighting
- Mowing
- Sweeping and cleaning
- Trash removal
- Landscaping
- Site furnishings
- Snow and ice maintenance
- Security/gates.

A number of transit agencies indicated they are exploring different approaches to maintaining park-and-ride facilities. For example, in the Milwaukee area, maintenance of different lots is shared between the state, three counties, and three local jurisdictions. The Orange County Transit District reported that an "Adopt a Park-and-Ride Lot" program where individuals or groups agree to clean and maintain a specific park-and-ride lot is being considered. This program is modeled after the successful "Adopt a Highway" programs in many states and "Adopt a Shelter" programs used by some transit agencies.

SECURITY

Concerns over safety and security of both individuals and parked vehicles have been raised with the use of park-and-ride facilities in some areas. Approaches for addressing security issues in the design process were identified previously. However, a number of techniques can be used to address these concerns on operating park-and-ride facilities, including the following:

- *On-site enforcement*—Some park-and-ride lots have an attendant or other personnel on-site during all operating hours. In other cases, locked gates may be used to prevent access to and from the lot during the midday or night. Access can be obtained during these hours by specific request. These approaches can act as deterrents to vandalism or other crimes. Figure 27 illustrates the use of on-site security at a park-and-ride lot in Houston, Texas.
- *Periodic patrols*—In other cases, transit or enforcement personnel may check the facility on a regular basis throughout the day. Figure 28 provides an example of security patrols at a park-and-ride lot in the Washington, D.C. area.
- *Automated monitoring and enforcement*—Television cameras and other monitoring devices may be used to support on-site personnel or may partially reduce the need for on-site attendants. These devices can extend the range of surveillance and allow for all areas of a facility to be monitored on a continuous basis.
- *Coordinating with adjacent activities*—Coordinating enforcement with nearby businesses or activity centers may also be feasible, thereby reducing costs and providing for more uniform coverage of a facility.

FIGURE 27 On-site security, Houston, Texas. (Courtesy of TTI)

FIGURE 28 Security patrol, Washington, D.C. area. (Courtesy of Parsons Brinckerhoff)

Results from the telephone survey indicated that a variety of approaches are being used to enhance safety and security at park-and-ride facilities. Some transit systems, such as Houston METRO and MARTA in Atlanta, reported employing on-site personnel during all operating hours to help monitor use of the facilities. Other agencies, including the Maryland Transit Authority, the Cleveland Regional Transit Authority, and the Pennsylvania DOT, reported using periodic patrols by transit police or local police to monitor the lots. Further, most respondents noted that safety and security concerns are considered in the design phase and lighting, fencing, and other features are often used to help enhance the safety of a facility.

A number of innovative approaches to safety and security were also noted. For example, the fringe downtown parking garages in Minneapolis include an extensive video and sound monitoring and surveillance system. This system, which is operated by security personnel during all hours the facility is open, monitors all parts of the garages, stairs, elevators, and transit waiting areas. In addition, the Orange County Transit District is considering the use of closed circuit televisions at major park-and-ride lots, and Tri-Met in Portland reported developing a "SAFE Program," which includes use of stickers to identify vehicles.

MONITORING PARK-AND-RIDE FACILITIES

Based on responses from the transit and state DOT representatives, the use of ongoing monitoring programs with park-and-ride facilities varies. Regular monitoring and evaluation programs exist at some agencies, while others did not report any formal efforts. For example, the Wisconsin Department of Transportation (WisDOT) monitors the use of park-and-ride facilities in the Milwaukee area on a monthly basis. Other areas, such as Houston, monitor use on a quarterly basis. Representatives from Kansas City, Duluth, and Portland reported periodic surveys.

Monitoring the use of park-and-ride facilities is important for a number of reasons. First, the information gathered through the monitoring process is valuable for ensuring the safe and efficient operation of the facility. Information on current use of the different parking areas, transit ridership levels, and carpool/vanpool formation is critical to determining if the facility is meeting the desired goals and objectives. Monitoring programs should also help identify any potential safety and security problems or other operational issues that may be inhibiting use. Second, the information obtained through a comprehensive monitoring program can enhance the planning process for other park-and-ride facilities.

An ongoing monitoring program should be matched to the needs and resources of the individual area. Data collection and analysis can be a labor-intensive and costly process. The scope and frequency of a monitoring program may partially depend on the number of facilities, type of lots, age of the facilities, and available resources. The following elements should be considered when developing a comprehensive monitoring program.

Utilization Surveys

Periodic surveys should be conducted to determine the number of vehicles and people using the lot to provide an indication of the number or percent of parking spaces being used at any one time. It appears that the most common technique to determine utilization is to count the number of cars parked during the midday (*8,12*). Although this provides an indication of the use of long-term parking spaces, it does not provide information on the use of kiss-and-ride areas or bicycles; the number of people accessing the facility per vehicle or by walking; or the ultimate HOV mode of the individuals. This information can be gathered through the next step.

Access Mode

Information on the access mode of commuters can be obtained by monitoring vehicles as they arrive at the lot in the morning. This will provide an indication of the number of people per vehicle arriving at the facility, as well as the use of kiss-and-ride areas and access by bicycles and walking. This survey can also help identify the use of the lot for carpool and vanpool formation as well as transit use.

Transit Ridership Levels

Transit ridership levels are often monitored at park-and-ride facilities. This may be accomplished through the use of automatic passenger counters on the transit vehicles, periodic counts made by the vehicle operator, or special ridership surveys. This information will allow for the ongoing evaluation of ridership levels for the different park-and-ride facilities, for different types and destinations of service, and for different times of the day, and will help identify the need for increased services or other changes.

Transit User Satisfaction and Characteristics

Periodic surveys of park-and-ride lot users may be conducted to obtain information on their travel characteristics, such as origins and destinations, socio-economic and demographic data, and mode of access. Surveys can also provide information on user satisfaction with the facilities and services. Surveys may be conducted on a regular basis, or special surveys may be undertaken to help plan for changes or improvements.

Ingress and Egress Traffic Operations

Monitoring passenger and transit vehicle ingress and egress to the park-and-ride lot is important to ensure that operation of the local roadway system is not degraded and that the facility is operating efficiently. The periodic monitoring of the ingress and egress operations may include an examination of vehicle volumes, capacity, accident rates, and traffic control impacts.

Air Quality and Environmental Impacts

As noted previously, air quality, noise, and other environmental issues are often raised as concerns in locating park-and-ride facilities. These issues are most frequently voiced by neighborhood and business groups adjacent to or close by the lot. The ongoing monitoring of air quality and noise levels, as well as other environmental factors, is important to identify and address any problems that may develop, as well as documenting that no major problems exist.

Transit Services

The transit services operated out of a park-and-ride lot should be monitored and evaluated as part of the regular process conducted by the transit agency. Factors such as on-time performance, passenger levels, fare revenues, missed trips, and other elements are usually included in ongoing monitoring programs. This information can also be used by transit personnel to conduct periodic analyses of route performance.

CHAPTER SIX

SUPPORTING ELEMENTS

Implementation of a park-and-ride lot does not automatically guarantee that it will be used. A number of supporting facilities, services, programs, and policies have been identified as important to the successful operation of park-and-ride facilities. The use of some supporting elements, such as an ongoing marketing program, were described in the previous chapter. This chapter discusses other supporting services and facilities that may contribute to the overall success of park-and-ride facilities. Topics addressed include HOV lanes and other transit priority treatments, ridesharing programs, travel demand management (TDM) strategies, land use and growth management techniques, and the use of intelligent transportation systems (ITS) and other advanced technologies.

HIGH-OCCUPANCY VEHICLE (HOV) FACILITIES AND OTHER PRIORITY TREATMENTS

As summarized in Chapter 2, park-and-ride lots have been implemented in conjunction with a wide range of transit and ridesharing services. In addition to providing commuters with the opportunity to change modes, park-and-ride facilities associated with fixed guideway transit systems—such as commuter rail, heavy rail, and light rail transit (LRT)—and HOV lanes may provide further incentives to individuals through travel time savings and increased travel time reliability. Further, other priority treatments may be used to increase transit and rideshare travel speeds and shorten travel times, providing additional incentives for commuters to use these modes.

A number of HOV facilities are in operation throughout the country, many of which are connected directly or indirectly to park-and-ride lots. Although differing in design and operation, HOV lanes all have similar purposes. In general, HOV facilities are intended to help maximize the person-carrying capacity of a congested roadway or travel corridor by altering the design and/or operation of the facility to give priority treatment to HOVs.

The primary concept behind these facilities is to provide HOVs with travel time savings and more predictable travel times, both of which serve as incentives for individuals to choose a higher occupancy commute mode. The intent is not to force individuals into making changes against their will, but rather to provide an attractive, cost-effective travel alternative to a significant number of commuters.

As of January 1994, some 55 HOV projects were in operation on freeways or in separate rights-of-way in 23 metropolitan areas in North America. The existing projects encompass approximately 942 centerline km (585 centerline mi) of HOV lanes, which represents a steady increase since the opening of the exclusive bus lane demonstration project on the Shirley Highway (I-395) in the Washington D.C. metropolitan area in 1969. Extensions to existing projects and new facilities are being planned, designed, and implemented in many areas. If the projects currently under construction and those programmed for implementation are completed, approximately 966 km (600 additional mi) of HOV lanes and a total of over 1,771 centerline km (1,100 centerline mi) of HOV lanes will be in operation by the year 2000 (*29*).

Four general categories commonly used to describe HOV facilities on freeways and in separate rights-of-way are (1) exclusive HOV lanes in separate rights-of-way, (2) exclusive HOV lanes in freeway rights-of-way, (3) concurrent flow HOV lanes, and (4) contraflow HOV lanes. Figure 29 provides examples of these four types of HOV facilities. Additional information on the design aspects of HOV lanes is available in the AASHTO *Guide for the Design of High-Occupancy Vehicle Facilities* (*30*), *NCHRP Synthesis of Highway Practice 185: Preferential Lane Treatments for High-Occupancy Vehicles* (*31*), and guidelines developed in Texas and California (*32,33*). The major characteristics of each category are briefly summarized next, along with examples of park-and-ride lots currently in use with the different types of facilities.

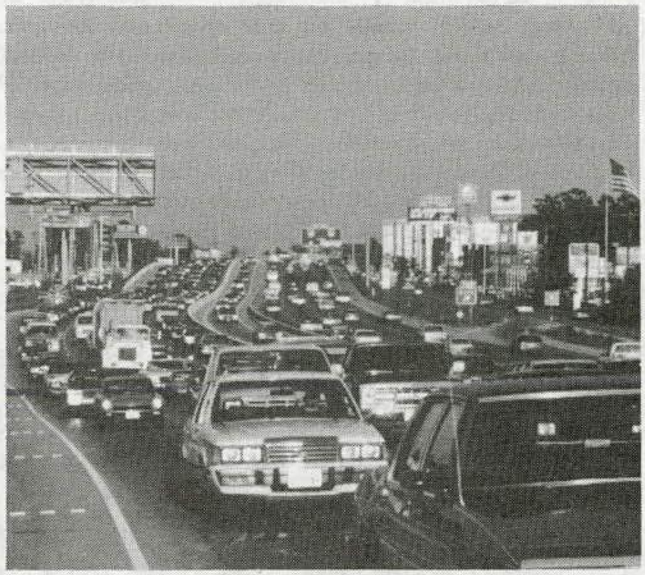
Exclusive HOV Facility, Separate Right-of-Way

This type of HOV facility is a roadway or lanes developed in a separate right-of-way and designated for the exclusive use of HOVs. Most existing facilities of this type are designed for, and used by, buses only. Most are two-lane, two-direction facilities. The South and East Busways in Pittsburgh, the University of Minnesota Busway in the Minneapolis-St. Paul area, and the Transitway in Ottawa, Ontario are all examples of this type of HOV treatment. The Ottawa Transitway and the University of Minnesota Busway both include park-and-ride lots along the facilities. In Ottawa, park-and-ride lots are located at both ends of the Transitway. A large shared-use lot adjacent to the St. Paul campus provides parking for students, faculty, and staff who then use the Busway to reach the Minneapolis campus.

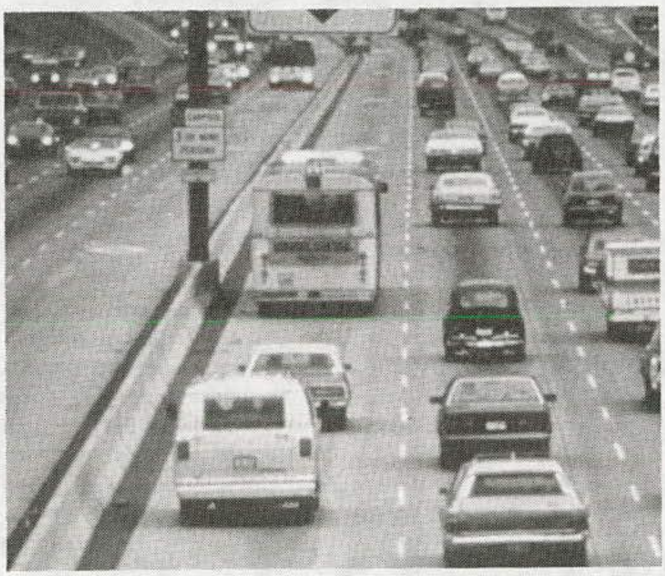
Exclusive HOV Facility, Freeway Right-of-Way

This type of HOV facility is a lane or lanes constructed within the freeway right-of-way that is physically separated from the general purpose freeway lanes by concrete barriers or wide-painted buffers, and is used exclusively by HOVs for all, or a portion, of the day. Exclusive HOV lanes are usually open to all types of HOVs—buses, vanpools, and carpools, and may be reversible or two-way facilities. Most exclusive HOV lanes include extensive park-and-ride lots. For example, the HOV lanes in Houston and on the Shirley Highway in the Northern Virginia/Washington, D.C. area, as well as the San Bernardino Busway in Los Angeles, all have extensive networks of park-and-ride lots, most of which provide direct connections to the HOV lane. Further, high-frequency bus service is provided from many of these lots and parking for carpools and vanpools is allowed.

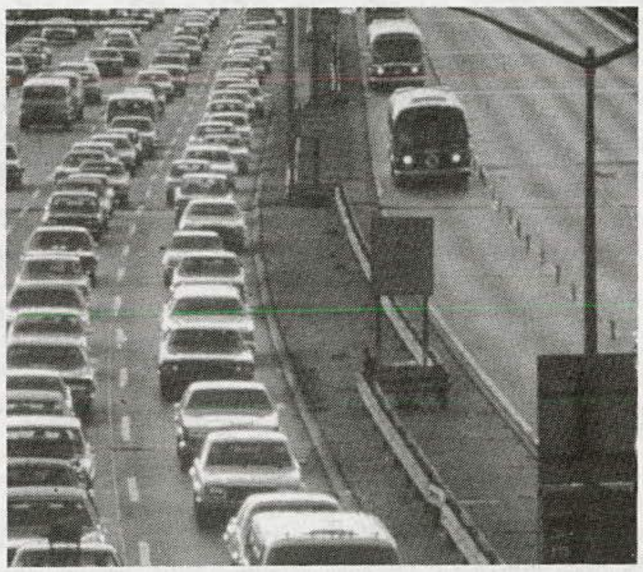
(a) Exclusive HOV lane in separate right-of-way.



(b) Exclusive HOV lane in freeway right-of-way.



(c) Concurrent flow HOV lane.



(d) Contraflow HOV lane.

FIGURE 29 Examples of HOV lanes.

Concurrent Flow HOV Lanes

Concurrent flow HOV lanes are defined as freeway lanes in the same direction of travel, not physically separated from the general-purpose traffic lanes, designated for exclusive use by HOVs for all or a portion of the day. These HOV lanes, commonly delineated by normal paint striping, are usually located on the inside lane or shoulder. Concurrent HOV facilities are usually open to buses, vanpools, and carpools. A number of concurrent flow HOV lanes also include park-and-ride facilities, although these lots tend to be smaller in size than those associated with exclusive HOV lanes, and direct access to the lanes is not usually provided. The HOV lanes in Seattle and Orange County, California, as well as the I-394 HOV lanes in Minneapolis, all provide examples of the use of park-and-ride lots with concurrent flow HOV facilities.

Contraflow HOV Lane

This type of HOV treatment uses a freeway lane in the off-peak direction of travel, typically the innermost lane, as an HOV lane in the peak direction of travel. The lane is separated from the off-peak direction, general-purpose travel lanes by some type of changeable treatment, such as plastic posts or pylons that are inserted into holes drilled in the pavement. Contraflow HOV lanes usually operate only during the peak periods, and some operate only during the morning peak period, reverting back to normal use in the off-peak periods. Three of the four currently operating contraflow HOV lanes are in the New York City area on the Long Island Expressway, Gowanus Expressway, and Route 495 approaching the Lincoln Tunnel. Some of the buses using these lanes originate from park-and-ride lots in outlying areas. The fourth contraflow HOV lane, which is on the East R. L. Thornton Freeway (I-30 East) in Dallas, is not linked directly with major park-and-ride facilities.

In addition to HOV lanes on freeways and in separate rights-of-way, HOV lanes and other priority treatments may be used on arterial streets to increase the speed of buses in congested corridors, and thus enhance their use by commuters. These may include arterial street applications such as downtown bus and pedestrian malls, bus-only lanes, and HOV lanes. HOV queue bypass lanes at signalized intersections and priority treatments for buses at signalized intersections represent further techniques that may be used to increase bus operating speeds and reduce travel times, especially in congested downtown areas or other major activity centers. All of these approaches are appropriate for consideration as part of an overall transit program that includes park-and-ride facilities.

RIDESHARING PROGRAMS

The term "ridesharing" refers to the act of sharing vehicles for the trip to work. The first use of carpool matching assistance occurred during World War II, when ridesharing was promoted in response to gasoline and tire rationing. Since the 1970s, assisting commuters to form carpools and vanpools has been a major focus of most rideshare programs. Today, rideshare programs throughout the United States provide a variety of services within the four broad categories of (1) rideshare matching and vanpool support, (2) marketing, (3) employer assistance/outreach, and (4) other support services. As described next, a number of different approaches and services may be offered within each of these general categories.

Rideshare Matching

During the 1970s, rideshare matching was usually done manually or with the use of early computer systems. Rideshare matching systems have since increased in sophistication and capabilities, however, and most rideshare programs today use one of a number of commercially available software programs, or a specially designed system to provide ridematching services.

The available systems all use some type of geographic base to record and track individual origins and destinations and to identify potential carpool matches. An individual accesses the system by providing the necessary information over the telephone or by mailing in a ridematching application. The computer system matches the individual's origin, destination, and travel time with others in the database and provides a matchlist of possible carpoolers either by telephone or by mail. It is usually left up to the individual to make contact with the perspective carpoolers.

Rideshare programs are currently operating in most major metropolitan areas, and in many medium and small urban areas. A wide range of organizational and institutional arrangements are used. In some cases, ridesharing services are provided by the transit agency, while in other cases they may be provided by a separate regional agency, by the metropolitan planning organization (MPO), or by individual private businesses.

Vanpooling

Vanpooling involves groups of 8 to 15 commuters sharing a van for the commute trip. Usually, the driving is done by one employee, who travels for free, with the other passengers sharing the fixed and operating costs through monthly fees. Four types of vanpooling arrangements are in use throughout the United States: (1) employer-owned vanpools, (2) employer/employee vanpools, (3) owner-operator vanpools, and (4) third-party vanpools. The major difference among these alternatives is the degree of employer involvement.

Under the first option, the vans are owned, operated, and maintained by an individual company or business. Employees may be charged a monthly fee to cover all or a portion of these costs. The second alternative involves employers providing financial support to employees to purchase or lease vans and assisting with the organization of the vanpools. The third alternative involves individual commuters acting as entrepreneurs to purchase a van and develop a pool, without any employer support or involvement. The last alternative involves leasing vans from a commercial company.

During the 1970s and 1980s, the use of vanpool programs was widespread. Although their popularity has declined, vanpools are still used with a number of park-and-ride facilities. The extensive vanpool programs in the Washington, D.C. region provide one example of this.

Employer Assistance/Outreach

Many rideshare programs offer a variety of employer assistance and outreach services, such as specialized ridematching services, third-party vanpool assistance, and the development of multifaceted programs tailored to the needs of individual companies. Many companies have used staggered work schedules, flexible work schedules, and compressed work weeks to help move commute travel outside the peak hours and to provide greater flexibility to employees.

Other Supporting Services

Rideshare programs in some areas may provide additional services or activities. For example, Houston METRO's Rideshare Program is providing assistance to employers with the development of required employer trip reduction programs.

One of the reasons often cited by commuters for not carpooling is lack of flexibility. The growing use of both part-time and instant carpooling by commuters in some metropolitan areas appears to be partially in response to the need to maintain flexibility in the commute trip and the desire to take advantage of the travel time savings offered by HOV and other preferential facilities whenever possible. Both approaches will influence the use of park-and-ride lots, as these facilities are often staging areas for carpool formations. As described next, the flexibility offered by part-time and instant carpooling makes the park-and-ride lot demand estimation process even more difficult.

Part-Time Carpooling

Part-time carpooling is defined as individuals who carpool less than 5 days a week. Usually, part-time carpooling requires that commuters carpool at least two to three times a week. The intent of this approach is to provide flexibility for commuters based on the realization that individuals may need to drive alone some days to accommodate personal business and other activities. As will be discussed under TDM strategies, part-time carpooling is incorporated into many TDM programs.

Instant Carpooling

Instant carpooling has been identified in both the Shirley Highway corridor in the northern Virginia/Washington D.C. area and on the Oakland Bay Bridge in the San Francisco area. In both cases, the same phenomenon is occurring; individuals are forming informal instant carpools on a daily basis, without formal planning or sanctions by any agency or organization, to take advantage of the travel time savings afforded by the HOV facilities in the corridor. In both cases, individuals wanting rides gather at park-and-ride lots and other locations and are picked up by drivers going to the same destination. The vehicle occupancy requirement on the Shirley Highway and the Bay Bridge HOV facilities is three or more individuals (3+), although the Shirley Highway HOV lanes used to have a 4+ occupancy requirement.

Instant carpooling in these corridors has been reported to be used more on the morning inbound trip than on the afternoon outbound trip. Commuters often use conventional transit service for the afternoon return trip (*34,35*). No major problems or incidents have been reported in either area. The impact of instant carpooling arrangements on these two facilities appears to be significant (*34,35*). Some 2,500 instant carpoolers have been estimated in the morning peak-period on the Shirley Highway, while approximately 8,000 commuters have been estimated to use casual carpools on the Bay Bridge in the San Francisco area (*34,35*). As discussed in the last section of this chapter, the use of advanced technologies to encourage instant carpooling is being examined in a number of areas.

TRAVEL DEMAND MANAGEMENT (TDM) PROGRAMS

TDM includes a wide variety of techniques and actions aimed at managing the demand on transportation facilities by encouraging commuters to change from driving alone to using an HOV or shifting into less congested travel periods. Thus, TDM actions focus on a variety of approaches to encourage ridesharing and transit use, alternative work schedules, parking management and parking pricing, and peak-period travel spreading, combined with deterrents to single drivers.

Although many of these approaches are not new, increasing levels of traffic congestion and related air quality and energy concerns have resulted in major emphasis being placed on the use of TDM strategies in many urban areas. This is especially true in locations classified under the 1990 Clean Air Act Amendments as air quality nonattainment regions, which must meet specific requirements by established deadlines or face possible sanctions. Many states and cities have implemented additional regulations to increase vehicle occupancy levels and reduce single occupant vehicle (SOV) use. TDM programs have become integral elements in the approaches being taken in many areas to meet these requirements.

TDM strategies include a wide range of actions focusing on the use of both incentives and disincentives, such as expanded or new transit services, ridesharing programs, guaranteed ride home programs, parking policies and parking pricing, flexible work hours, telecommuting, walking, bicycling, and other techniques. Incentives, such as employer paid bus passes or employee benefits for using HOVs, and disincentives, such as increasing parking rates or penalizing individuals who drive alone, may be used. Recent TDM programs are also characterized by increased private sector involvement, which may occur through the formation of transportation management associations or organizations (TMAs/TMOs), the use of employee TDM coordinators, and joint efforts between public agencies and private businesses. Park-and-ride services are considered integral components of many TDM programs. In addition, the use of park-and-ride facilities can be further supported by the use of other TDM strategies.

As described previously, both transit services and ridesharing programs are TDM strategies that may influence the use of park-and-ride facilities. Examples of other TDM techniques that may encourage greater use of park-and-ride lots include parking policies and parking pricing strategies, employer-based financial incentives and benefits for HOV use, guaranteed ride-home programs, and congestion pricing. A variety of institutional arrangements, including the use of public/private partnerships such as TMAs/TMOs, are being used to implement these programs. These TDM strategies are briefly described next, along with examples of current use with park-and-ride services.

Parking Management and Parking Pricing Strategies

The supply, location, and pricing of parking has been identified as one of the critical factors influencing travel behavior and mode choice. Currently, federal laws allow employers to provide employees with $60 tax free toward parking costs. A number of different approaches and techniques can be used to influence the management and pricing of parking. One approach is simply to provide preferential parking for carpools and vanpools. For example, rideshare vehicles may be given parking spaces close to the front entry or in parking garages. Another approach is to charge higher parking rates for SOVs or to require that they park at more remote locations. Reducing the supply of parking or placing other restrictions or requirements on its use represents a further strategy. Another approach, called "parking cash-out," requires employers who offer subsidized parking to employees to also offer the choice of a cash allowance in lieu of parking. This type of system has been implemented in California and is being considered at the federal level. Parking pricing strategies and supply reduction techniques can be controversial and there are a number of issues to be considered in developing programs using these techniques.

The I-394 HOV lane and downtown parking garages in Minneapolis provide one example of parking management and pricing strategies in use with HOV and park-and-ride facilities. The I-394 project includes 18.8 km (11 mi) of HOV lanes, two major transit stations, seven park-and-ride lots, and three parking garages on the edge of downtown Minneapolis. The garages, which contain bus and passenger waiting areas and 5,930 parking spaces, provide greatly reduced parking rates for carpools and vanpools using the I-394 HOV lanes. Current monthly rates for carpools and vanpools are $10.00, while rates for SOVs are $90.00.

Employer-Based Incentives

Employers may support and encourage transit and ridesharing by their employees in a number of different ways. Direct subsidies, which involve reducing the costs associated with HOV travel modes, may include discounted transit passes, reduced or free parking for HOVs, and cash payments. These subsidies provide a positive economic incentive for employees to change from driving alone to using an HOV mode. Subsidizing transit passes has historically been a frequently used TDM technique. Recently, "transit checks," which provide greater flexibility over a monthly pass, have been introduced in some areas. Transportation allowances, which may involve either ongoing cash payments for HOV use or a one-time payment, have also been implemented by employers recently. Finally, some employers are offering non-cash incentives, such as extra vacation time or other benefits.

Guaranteed Ride-Home Programs

Guaranteed ride-home programs provide commuters who take transit or rideshare with a back-up means of transportation in case of an emergency or a change in work schedule. Thus, these programs are designed to eliminate one of the reasons often noted by commuters for not using alternative commute modes—the fear of not having a ride if they need it. A variety of methods are used to provide this transportation, including taxis, company vehicles, leased vanpools, and private automobiles. Some programs require commuters to register and others place restrictions on the number of trips that can be made. Experience to date indicates that although transit and rideshare users view guaranteed ride-home programs as important, actual use is relatively low. Thus, it appears that the programs are being used only in the case of an emergency or change in schedule and are not being abused.

Congestion Pricing

Congestion pricing involves charging motorists for the use of freeways and roadways during periods of heavy use. The technique is based on the economic concept of charging users, in this case motorists, the "price" that represents the cost they create by using a roadway. For example, the addition of a vehicle to a congested freeway creates further delay to vehicles already using the facility. The intent of this approach is to price the use of a roadway facility so that a sufficient capacity is provided for those willing to pay. Current discussions on the use of congestion pricing have focused on it as one technique to encourage greater use of HOVs. Thus, SOVs might be charged to use a roadway, while HOVs would not. There are a number of issues involved with the use of congestion pricing, and it has not been tried extensively in this country. Ensuring that adequate park-and-ride facilities, transit services, and rideshare programs are available in a corridor where congestion pricing is being considered is critical, however, so that commuters have options and alternatives to the use of SOVs.

LAND USE AND GROWTH MANAGEMENT TECHNIQUES

A variety of policies and programs focusing on land use, growth management, and land development can be employed to encourage greater use of all modes of transit and park-and-ride facilities. These approaches, which are briefly described next, range from community or metropolitan areawide policies to specific techniques to make developments more transit friendly.

Growth Management

Growth management is usually defined as a comprehensive approach to regulating and directing the location, geographic pattern, density, quality, and rate of development in a specific area. Growth management focuses on using public policy to coordinate new development with the capacity of the existing and planned infrastructure and the desired level of service. The transportation system is a major focus of existing growth management programs, although infrastructure concerns relating to water, sewer, police, fire, housing, schools, open space, and economic development are often included. The transportation components of growth management programs are usually based on the trip generation characteristics of various land uses. Controls are then placed on the type, location, density, and timing of development in a particular area to ensure that adequate capacity exists in the transportation infrastructure. Examples of growth management approaches include the Montgomery County, Maryland, Adequate Public Facilities Ordinance; the state of Florida Growth Management Legislation; and the Growth Management Act in the state of Washington.

Trip Reduction Ordinances

These are ordinances or other regulations passed by a local community aimed at reducing or limiting trips from new or existing developments. Similar to growth management programs, trip reduction ordinances are usually targeted at ensuring that the transportation infrastructure in an area is adequate to handle the current and anticipated demand. This type of ordinance may require a development or business to plan and implement programs to reduce single occupant commute trips. A variety of transit and ridesharing strategies, including park-and-ride facilities, may be part of a trip reduction program. Examples of communities using trip reduction ordinances include Alexandria, Virginia; Silver Spring, Maryland; Sacramento, California; and Bellevue, Washington.

Land Use Policies

Another approach in some areas involves establishing and implementing land use policies that promote transit and ridesharing. These policies, which are intended to address existing congestion concerns as well as to prevent future problems, are usually formalized through the comprehensive plan, zoning ordinance, subdivision ordinance, and other local plans and regulations. These ordinances are used to encourage the development of residential and employment areas at densities and with designs that will foster transit use and ridesharing. The use of transit oriented developments (TODs) in the Sacramento area, as well as approaches used with new rail systems in Portland, Atlanta, and the Washington, D.C. area, provide examples of this technique.

Site Design

In many areas, site designs that limit transit access are a barrier to transit use, especially in suburban employment and commercial developments. The use of transit friendly site designs can help overcome this problem. Elements to consider in this approach include providing sidewalks, direct transit access to the front of a building, passenger shelters and other amenities, and mixed land uses. Pro-transit site design considerations can be built into zoning ordinances, subdivision ordinances, and other local regulations.

A variety of new institutional and organizational structures are being used to implement TDM programs and strategies. Many of these entail closer working arrangements between the numerous public sector agencies involved in transportation, transit, and ridesharing, as well as a focus on greater coordination and cooperation among public and private sector groups. Several of the different approaches currently in use are summarized next.

Transportation Management Organizations (TMOs) and Transportation Management Associations (TMAs)

TMOs and TMAs are special organizations established to address transportation and other issues. A unique aspect of these organizations is that they usually represent partnership between businesses and developers and public sector agencies in a specific geographical area, often rapidly growing suburban areas. TMOs and TMAs provide the private sector with a more active role in the transportation planning and decision-making process, and are often responsible for the implementation of specific programs. For example, many TMOs and TMAs have become the focal point for the development, implementation, monitoring, and evaluation of TDM programs. In air quality nonattainment areas, TMOs and TMAs may work with employee transportation coordinators (ETC) and other groups to help implement specific strategies. Thus, TMOs and TMAs assist in establishing more effective working relationships among the public and private sectors and coordinating a wide range of transportation programs.

Joint Power Agreements

Most land use and development decisions are made at the local level. Thus, the action one community takes will influence conditions in other areas. Communities may be hesitant, however, to implement TDM, transit, and land use strategies for fear that businesses will simply locate in the next community, and that they will receive many of the same problems, such as increased traffic congestion; without the benefits of increased taxes from new developments. Thus, competition among communities may limit the use of TDM strategies. In some areas, local communities are implementing joint power agreements or other approaches to coordinate land use and transportation policies and programs. The use of these techniques is aimed at ensuring similar approaches among communities in an area or a corridor. Other groups, such as the state DOT or a TMO/TMA, may also be parties in the agreement. The scope, content, and authority of joint power agreements and other related techniques can be matched to the specific issues in the area and the degree of coordination desired among the different parties.

Management Teams

Traffic and transportation management teams are being used in a variety of settings to address numerous issues. For example, traffic management teams may focus on regional issues while corridor management teams may address concerns within a specific corridor or area. Management teams are usually composed of representatives from the various transportation, transit, and ridesharing agencies, and local governments. The teams meet on a regular basis to discuss, plan, implement, monitor, and evaluate strategies for improving traffic flow, reducing traffic congestion, responding to incidents, addressing concerns during major reconstruction or new construction, and managing traffic during special events.

INTELLIGENT TRANSPORTATION SYSTEMS (ITS) AND OTHER ADVANCED TECHNOLOGIES

A major focus of recent transportation research and development activities has been on a variety of technologies being examined under the general heading of ITS. These systems include the application of a wide range of advanced technologies that share the common goal of improving the efficiency of the overall transportation system. More specifically, ITS technologies are directed at improving mobility and transportation productivity, enhancing safety, maximizing current transportation facilities, and enhancing the environment.

The interest in ITS and the development of projects and operational tests has accelerated rapidly over the past few years. Numerous federal, state, and local agencies; private consultants, private industries and vendors; defense industries; university research institutes; and other groups are all actively involved. The development of many ITS technologies, products, and tests is being jointly funded and conducted by consortiums involving both public and private sector groups. In addition, numerous ITS projects and research activities are being conducted in European countries and Japan.

ITS and other advanced technologies can be used in numerous ways to enhance the implementation, operation, management, and evaluation of park-and-ride facilities, transit operations and management, and TDM actions. First, ITS technologies can provide pre-trip and enroute real-time information to commuters on traffic conditions, transit alternatives, weather, and other elements to help individuals select the most appropriate travel mode and to encourage greater use of park-and-ride facilities and HOVs. Second, the application of advanced technologies can enhance the convenience and ease of use for all types of HOVs. Third, ITS technologies can help manage and enforce TDM strategies related to HOV use, parking, and congestion pricing.

The provision of real-time information on traffic conditions and transit alternatives to individuals in their home and workplace represents an important step to allow commuters to make more informed decisions regarding their travel and mode choices. To influence commuters to change from driving alone to using some form of HOVs, this information needs to be provided in advance of the first mode selection. A few operational tests and demonstration projects are focusing on this. The real-time traffic and transit information may be obtained and coordinated through the use of advanced traffic management systems (ATMS), automatic vehicle identification (AVI), automatic vehicle location (AVL), and other advanced technologies. The information could be provided to individuals through the use of touchtone telephones, cellular or pocket telephones, televisions, microcomputers, and videotex terminals.

The application of ITS technologies can also make using park-and-ride lots and all HOV modes more convenient and attractive to commuters. For example, fare payment methods can be simplified and made more convenient through the use of Smart Cards and other automatic fare payment methods. These techniques focus on the use of prepaid fare media ranging from a relatively simple pass to a more advanced programmable memory chip card. Smart Cards could be used to provide integrated fare payment among different transit modes in an area. In addition, they could be expanded into multi-purpose cards linking transit, parking facilities—including the ability to charge lower rates for carpools and vanpools—and other services such as banking and credit card purchases. Smart Cards could also be used by businesses to help track the use of HOVs by employees as part of an incentive program or to charge more for the use of parking for commuters who drive alone. Other ITS technologies could be used to provide real-time carpool matching capabilities, enhanced guaranteed ride home programs, and other techniques to make the use of all HOVs more convenient.

ITS technologies may also be appropriate to assist with the management, operation, and enforcement of TDM actions related to HOV facilities, parking management, and congestion pricing. A wide range of advanced technologies, including AVI tags, Smart Cards, remote sensing, and other devices may be used to help operate and enforce various TDM strategies. For example, AVI tags are currently in use on a number of toll facilities throughout the country to provide electronic toll collection. Individuals purchase AVI tags encoded with a prepaid toll value. The tags, which are usually located on the front windshield, are read by receivers at special toll plazas, allowing vehicles to pass through the plaza without stopping. This approach is currently being used with buses equipped with electronic tags on the Route 495 HOV lane on the approach to the Lincoln Tunnel in New York City. Many of these vehicles originate from park-and-ride lots in outlying areas. [The potential for other applications using ITS technologies to better manage and enforce TDM actions is discussed more extensively in Chapter 7.]

Several projects currently in different phases of planning and implementation focus on the use of ITS and other advanced technologies to enhance park-and-ride facilities and HOV use. The two that relate directly to encouraging greater use of park-and-ride facilities and transit services are the Houston Smart Commuter operational test (*36*) and the TravLink project in the Minneapolis-St. Paul area (*37*).

The Houston project is examining the potential for gaining more efficient use of major travel corridors through greater use of high-occupancy commute modes, shifts in travel routes, and changes in travel time through the application of innovative approaches using advanced technologies. The operational test is based on the hypothesis that commuters who have quick and easy access to relevant, accurate, and up-to-date information on existing traffic conditions, bus routes, bus schedules, and instant ridematching services in their home and workplace will be more likely to use public transportation and other high-occupancy commute modes. The travel time savings and travel time reliability offered by the Houston HOV lanes provide further incentives for changing travel modes. In addition, individuals may alter their travel time or route based on this information.

The Houston Smart Commuter operational test has been developed and is being implemented through the joint efforts of TxDOT, Houston METRO, FTA, FHWA, and the Texas Transportation Institute (TTI), a part of the Texas A&M University System. The first phase of the operational test is currently moving forward.

The test includes two different, but compatible, components. Both components are intended to make better use of the Houston HOV facilities, which have been developed and funded as multi-agency projects. The first component focuses on encouraging a mode shift from driving alone to using the bus, changing travel times, and shifting travel routes in the traditional suburban-to-downtown travel market in the I-45 North corridor. These changes in travel decisions will result from the provision of current traffic and transit information to individuals in their home and work place through state-of-the-art videotex and telephone technologies.

The second component focuses on the suburb-to-suburb travel market in the I-10 West corridor to the Post Oak/Galleria area. This corridor, which is more difficult to serve with traditional regular-route bus service, provides the opportunity to test the use of a comprehensive employer-based carpool matching service. This system will include the ability to provide real-time carpool matches and is structured to encourage a mode shift from driving alone to carpooling, as well as to encourage an increase from two- to three-person carpools.

The TravLink project represents one element of the larger Minnesota Guidestar program, which is a multifaceted ITS program in Minnesota. The TravLink program is being developed and implemented through the joint efforts of the Minnesota Department of Transportation (MnDOT), the University of Minnesota, the Regional Transit Board (RTB), the Metropolitan Transit Commission (MTC), and FHWA.

A major component of the project focuses on the provision of transit and traffic information to transit users and carpoolers in the I-394 corridor, which is a radial route corridor linking the western suburbs to downtown Minneapolis. The corridor contains a freeway HOV lane, park-and-ride lots, and transit stations. The HOV lanes, which include segments of both concurrent flow and reversible, barrier-separated lanes, are connected to three major parking garages on the edge of downtown Minneapolis. The parking garages contain bus waiting and transfer areas and provide reduced parking rates for carpoolers and vanpoolers using the I-394 HOV lanes.

The TravLink project is designed to increase the use of high-occupancy commute modes in the corridor through the provision of transit and traffic information to individuals at home, at work, and at major transit terminals. In addition, transit users at transit stations along the corridor and at the transit terminals in the parking garages will be provided with real-time information on bus arrival and departure times.

CHAPTER SEVEN

CONCLUSIONS

This synthesis provides an assessment of the current status of park-and-ride facilities in the United States, and has examined the current practices associated with planning, designing, operating, maintaining, and monitoring different types of park-and-ride lots. This synthesis presents an overview of the current use of park-and-ride facilities; existing practices for estimating the demand for park-and-ride services; approaches for locating, sizing, and designing facilities; techniques for funding, constructing, operating, and maintaining park-and-ride lots; practices for addressing potential safety and security concerns; and the use of supporting policies, programs, and services.

AREAS FOR ADDITIONAL RESEARCH

The results of the literature review and the telephone survey identified a number of areas where further research would be of benefit to advance the state of the art related to planning, designing, operating, maintaining, and evaluating park-and-ride facilities. Conducting more detailed analyses on these topics was beyond the scope of this synthesis. However, outlining the general areas for further research by others is appropriate. The major topics suggested for additional research include examining air quality and environmental impacts, developing simplified demand estimation techniques, identifying innovative approaches to operations and maintenance, and analyzing the use of advanced technologies to enhance the operation and use of park-and-ride facilities. The major issues to be included in a more extensive examination of these topics are briefly described next.

Air Quality and Environmental Impacts

The air quality and environmental impacts of park-and-ride facilities continue to be discussed and debated in many areas. The major concerns associated with use of these facilities relate to potential air quality, noise levels, and water quality impacts on the surrounding areas. A comprehensive analysis to fully explore these issues would be helpful. To understand the complexity of the potential environmental impacts, a number of tasks and activities will need to be conducted, including examining the experience at operating park-and-ride facilities, developing and conducting multiple before-and-after evaluations, examining the impacts on the corridor and the central business district (CBD) or major activity center, and actual monitoring and evaluation of air quality, noise levels, water quality, and other possible environmental impacts. The results of these activities could also be used to develop improved analytical tools and techniques for estimating air quality and other environmental impacts of proposed and existing park-and-ride lots, which would help in planning and locating park-and-ride facilities.

Simplified Demand Estimation Procedures

The results of the telephone survey indicate that most agencies are using relatively simple demand estimation techniques and procedures. For example, the demand observation technique was the most commonly reported approach. Additional research on demand estimation models appears to be needed, with work focusing on the development of simplified tools and techniques that transit agencies, state DOTs, local communities, and other groups could use to estimate the potential demand for various types of park-and-ride facilities. This could include both planning techniques for preliminary estimates and more complex models for more detailed estimates.

Innovative Approaches to Development, Operations, and Maintenance

Results of the literature review and the telephone surveys identified the use of several innovative approaches to developing, operating, and maintaining park-and-ride facilities. However, it appears that additional research may be appropriate in this area. This may include not only a more detailed examination of any existing innovative approaches, but also the identification of possible techniques that could be used with future projects. For example, analyzing the potential for enhanced joint development opportunities with park-and-ride facilities, the use of different maintenance practices, and innovative funding mechanisms would all be of benefit.

Use of Intelligent Transportation Systems (ITS) and Advanced Technologies

As noted in Chapter 6, it appears that the use of ITS and other advanced technologies holds promise for improving the efficiency of transit and ridesharing and for encouraging greater use of all HOV modes. However, further research, operational tests, and demonstration projects will be needed to advance the deployment of ITS technologies with park-and-ride facilities and all types of HOV modes. In addition to monitoring and learning from existing projects—such as the Houston Smart Commuter and the Minnesota TravLink operational tests—this research could also examine new and creative applications of ITS technologies with park-and-ride facilities services. These might include operational tests and demonstration projects of providing real-time transit and traffic information to commuters, multi-purpose Smart Cards and other innovative fare payment methods, real-time ridematching services, the use of automatic vehicle location (AVL) systems to enhance transit operations, and the use of advanced technologies to improve the safety, security, and monitoring of park-and-ride facilities. Additional research, operational tests, and demonstration projects will be needed to advance the use of ITS technologies in these areas.

FUTURE OF PARK-AND-RIDE FACILITIES

Park-and-ride facilities represent important elements in large, medium, and small transit systems throughout the country. Thus, park-and-ride lots and associated transit and rideshare services are integral components in the intermodal approaches being taken to address traffic congestion, mobility, and air quality and environmental concerns in many areas. Based on the results of the literature review and telephone survey, as well as the requirements of recent federal and state legislation, it appears that the use of park-and-ride facilities will become even more important in the future.

Almost all of the transit agency and state DOT representatives contacted during the telephone survey indicated that additional park-and-ride facilities are being planned, designed, and constructed with all types of transit modes. This included both expansions to existing lots and new facilities. Examples of new facilities include a 250-space parking lot in Austin, Texas; three bus and nine light rail transit (LRT) park-and-ride lots in Dallas, Texas; and lots accommodating 5,700 new parking spaces in Philadelphia, Pennsylvania. Other areas indicated that additional park-and-ride facilities are in the planning stages.

Many respondents indicated that provisions of the 1990 Clean Air Act Amendments, the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), and other legislation were placing additional demands on increasing the use of all forms of HOVs. Park-and-ride facilities were identified as playing even more critical roles in the future to help meet these requirements. The information provided in this synthesis should assist all groups in better meeting these demands.

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APPENDIX A

TELEPHONE SURVEY USED TO OBTAIN INFORMATION FROM REPRESENTATIVES OF TRANSIT AGENCIES AND STATE DEPARTMENTS OF TRANSPORTATION

Agency:____

Address:____

Contact Person:__________________________________

Telephone:______________________________________

Fax:____

Introduction

An NCHRP Synthesis is being prepared on the *Effective Use of Park-and-Ride Facilities*. In order to assist with the development of the Synthesis, a telephone survey is being conducted of selected transit agencies and state departments of transportation on the use of park-and-ride facilities. Your assistance is requested in answering a few questions related to planning, designing, and operating park-and-ride lots in your area. Also, any reports or written material you might have available to send would be appreciated.

General Information

1. First, we would like to obtain a general perspective on the use of park-and-ride lots in your area.

	Total	Formal	Informal/Shared or Joint Use
Number of park-and-ride lots:			
Number of spaces:			
General utilization:			

2. Breakdown by mode (bus, rail, etc., if possible):

3. Charge or free? Charge:__________

4. In general, what percentage of the system ridership uses park-and-ride facilities?__________

5. Is there a plan for the development of future park-and-ride facilities?__________

   If so, what are the number of lots and spaces?__________

6. How have park-and-ride facilities been funded (transit, DOT, private sector?) What are the current plans for funding future facilities?

Planning and Design

7. Does your agency have a standard procedure or manual for planning and designing park-and-ride facilities? Do you use any of the national guidelines (AASHTO, etc.)?

8. What demand model and procedure is used to estimate the anticipated demand for a park-and-ride lot? What has your experience been with the accuracy of this approach?

9. What design standards are used and what, if any, problems have been encountered with locating and designing park-and-ride facilities? How have these concerns been addressed?

10. Are formal agreements used with shared or joint use facilities?

Operations

11. What types of services are operated out of the facilities?

12. Do you allow carpool formation in the lots or are they oriented primarily to bus/rail transfers?

13. What problems, if any, have you had with safety and security issues? How have these been addressed from both an operations and design standpoint?

14. Are any supporting services (convenience stores, day care, etc.) provided at the lots? What has been the experience with these types of services? Are any planned in the future?

15. What other issues or concerns have there been with the use of park-and-ride facilities in your area?

16. In general, what do you see as the future role of park-and-ride facilities within your area?

Thank you for your assistance with this survey. We would be interested in obtaining any additional information you might have on park-and-ride facilities in your area. These can be sent to Katherine F. Turnbull, Texas Transportation Institute, Texas A&M University, College Station, TX 77843-3135.

APPENDIX B

DESIGN CRITERIA FOR PARK-AND-RIDE LOTS USED BY METRO TRANSIT IN OKLAHOMA CITY, OKLAHOMA

Metro Transit—Oklahoma City, Oklahoma

Service

____ Accessibility into parking lot from arterial
____ Maintenance
____ Public Restroom Facilities
____ Safety
____ Handicap Accessibility
____ Signal Interrupt
____ Must be located on south side of NW Expressway
____ Must be located between Council and Portland

Physical Elements

____ Area designation: Signage
____ Adequate turning radius for bus
____ Infrastructure in good condition
____ Shelter provision
____ Proper drainage
____ Landscaping
____ Visibility
____ Signalization

Land Use

____ High level of activity
____ Variety of Land Uses
____ Amenity rich (Number of stores and services)

Target Pool

____ Commercial strip
____ Single family/low density (2-5/acre)
____ Single family/high density (6-8/acre)
____ Multiple family/high density (apartment complex)

Distance Factor

____ Passenger should travel no more than 2 miles from home to access service
____ High density areas should be given priority consideration when locating park-and-ride lots

APPENDIX C

AASHTO PARK-AND-RIDE SITE PRIORITY RATING FORM

															SITE	
															Within Dense Corridor	Location Criteria
															Transit Service Potential	
															Proximity to Freeway Bottleneck	
															Visibility of Site	
															Distance to CBD or Activity Center	
															Access Convenience	
															Other P/R Competition	
															Local Traffic Circulation	
															Commuter Driving Distance	
															Congestion—Site to Freeway	
															Bike Route Access	
															TOTAL POINTS	
															Impact on Local Community (Adjacent)	Site Considerations
															Number of Parking Spaces	
															Expansion Potential	
															Parking Capacity—Adjacent Streets	
															Parking Security	
															TOTAL POINTS	
															Land Cost	Economic Considerations
															Ease of Land Acquisition	
															Development Cost	
															TOTAL POINTS	
															GRAND TOTAL	
															Driving Cost	Potential Users Cost
															Parking Cost	
															Transit Cost	
															TOTAL COST	
															Driving Time	Potential Users Time
															Waiting Time	
															Transit Time	
															Walking Time	
															TOTAL TIME	

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Robert M Smith
Research & Asst Matls Engr
Idaho DOT
3311 W State St
P O Box 7129
Boise ID 83707-1129