PERMANENT PARK-AND-RIDE LOTS

A park-and-ride lot is a facility providing free parking for commuters in suburban and lower density communities. Direct transit service between the lot and a major activity center(s) is the fundamental component. The primary function of a park-and-ride lot is to serve a geographic draw area as a transfer center between automobile and public transportation modes and to accommodate other rideshare modes, such as carpools and vanpools.

General Policies

Entrance to the parking facilities is free at all times to persons accessing transit, carpools and vanpools.

The principal objective of park-and-ride lots is to provide parking and ensure that commuter access to public transportation is as inviting as possible. The most successful lots are those located close to major freeway interchanges upstream of transit destinations.

The use of lots by ridesharing vehicles for the purpose of forming carpools and vanpools is encouraged, except as specifically noted due to space limitations.

I. Location Considerations

- Permanent park-and-ride lots should be located at or near freeway interchanges: (1) to maximize the ability of subsequent transit service to compete timewise with the private automobile, (2) to intercept the greatest number of private automobiles before accessing the freeway, and (3) where service will be provided and is consistent with service planning objectives and service plans.

- Special high occupancy vehicle (HOV) or bus-only facilities/treatments such as exclusive lanes, signal preemption, and queue jumps should link the lot with the nearest freeway if it is not located at or near a freeway interchange.

- Lots should be located along corridors that experience significant perceived traffic congestion.

- Lots should be located prior to the point of the most serious traffic congestion (an HOV treatment through the point of congestion would be a further advantage).

- Lots should be located along customary travel corridors that do not require potential patrons to significantly alter their travel patterns to use the lot. This is consistent with the view that park-and-ride lots "intercept" commuter trips and avoid attracting "new" congestion to locations.

- Lots should be built in highly visible locations with good access. Directional signage in the general area may be helpful.

- Existing successful park-and-ride lots should be expanded, where possible, to provide additional capacity, especially if the expansion is made in concert with service improvements.

II. General Site Selection Considerations

In selecting a site for a park-and-ride lot, there are a number of considerations that must be taken into account. They fall into five major categories -- engineering, financial, environmental, land use and service/location.

A. Engineering

Engineering considerations include the usable site area, parking capacity, ease of access for both autos and buses, bus storage, topography, and development restrictions.

B. Financial

Financial elements include the costs of acquisition and development, easements, ULIDs, mitigation costs, and impacts on long-term maintenance. Relocation costs, if any, must also be considered.

C. Environmental

An appropriate environmental process is completed before a final site is selected. The principal environmental considerations include visual, traffic, noise, air and water quality impacts, surface water management, and drainage.

D. Land Use

Land use issues include zoning, comprehensive plan designation, development regulations, compatibility of the lot with adajcent land uses, and joint use potential.

E. Service/Location

Service and location issues include the site's ability to serve the draw area, directness of transit access from major travel corridors, the cost of providing the new service and the security of passengers and vehicles. A service plan should be developed for a new park-and-ride lot prior to commitment of budget for capital improvements

F. Security

Facilities should be designed with security of patrons and property in mind. Transit Security will be submitting comments on general security concerns at park-and-ride lots in the near future.

G. Joint Development Opportunities

Several steps can be taken to integrate park-and-ride facilities into the developed environment and provide some benefits to riders.

- Explore opportunities for shared parking, with non-competitive uses such as theaters, parks, etc.
- Orient park-and-rides to make connections to adjacent development -- retail, office, housing.
- Provide pedestrian connections to adjacent uses with sidewalks and signage.
- Determine if development is planned for land adjacent to park-and-rides and work with developers to integrate park-and-rides into the area.

III. Capacity

Park-and-ride lot capacity is initially determined by analyzing the present and projected population and travel characteristics of the area to be served and the use of other park-and-ride lots in the area. Lots usually have 300 to 600 stalls, but exceptions in both directions are possible. Land availability can be a factor affecting the ultimate capacity of any given lot. As a rule of thumb, one acre can accommodate 90 autos in a park-and-ride configuration. Capacity should also be sited in response to customer needs or demands.

IV. Means of Access

Patrons use five basic transportation modes to arrive at and depart from park-and-ride lots. These modes include walking, bicycle, bus, automobile and motorcycle. An automobile can be used in three different ways as a means of transportation to a lot. Patrons can carpool or vanpool, park their private auto at the lot, or be picked up or dropped off by private auto or taxi (drop-and-ride).

V. Prototype Layout

The following guidelines for park-and-ride lots are subject to adjustment based on site shape, topography and relationship to adjacent streets.

A. HOV Access

HOV access to park-and-ride lots should be developed to give equal priority to both transit and vanpool vehicles. If the lot has a flyer stop, the vanpool may enter on the HOV lane. A queue-jump HOV lane should be considered for egress from large lots. Entrance and exit roadways for HOVs should be located at least 150 feet from other intersections. The need for present or future signalization may increase this distance consistent with traffic engineering warrants of the local jurisdiction.

B. Bus Layover Area

The bus layover area should be located on the inbound roadway to the passenger loading area. Storage capacity should be provided according to the service plan developed for the lot. The minimum layover area should be designed to accommodate two articulated buses. Scheduling of timed transfer operations at some lots could increase the space required for bus loading or layover. The layover area can serve buses directly from the street or after unloading the passengers. This concept enables buses to drop off passengers, then circulate back to the layover area, and finally to pick up passengers at the loading area and proceed out of the lot.

C. Bus Loading Area

The bus loading area should be separated from roadways used by other vehicles. This area is accessed directly from the street and should be consistent with the capacity requirements of the service plan. Future growth and/or expansion of the lot should be taken into account. The minimum space should be able to accommodate one standard and one articulated coach.

D. Passenger Waiting Area

The passenger waiting area is located between the bus loading area and the vehicle parking area. Pedestrian access should be provided directly from the adjacent street sidewalk, the vehicle parking area, the disabled parking spaces for disabled people, the drop-and-ride spaces, and the bicycle parking area. At least one passenger shelter should be provided adjacent to each passenger loading area.

E. Parking for People with Disabilities

Parking for people with disabilities should be provided at the passenger waiting area on either side of the shelter.

F. Drop-and-Ride Parking

Parking for motorists waiting to pick up a passenger from the bus or rideshare vehicle should be provided at the passenger waiting area on either side of the shelter. Motorists can drop passengers off in the circulation aisle adjacent to the passenger waiting area. Drop-and-ride parking should not mix with the flow of buses.

The vanpool drop-and-ride or staging area should be located adjacent to the transit vehicle loading area out of the way of bus passengers and easily accessible by HOV lane.

G. Cycle Parking

Bicycle and motorcycle parking should be provided adjacent to the passenger waiting area and the adjacent street. This provides bicyclists with direct access from the street and motorcyclists with direct access from the parking area. Ample lighting and barriers should be provided to ensure that cycle parking does not pose a hazard to pedestrians.

H. Vehicle Parking

Park-and-ride parking aisles should be perpendicular to the passenger waiting area. Parking spaces should be at 90-degree angles and served by two- way aisles no more than 450 feet long. Bus patrons would have a maximum walk of 300 to 400 feet. This parking layout allows vehicles to circulate in the parking area away from the passenger waiting area. Motorists would approach a parking space generally driving towards the waiting area, park, and then continue walking in that direction to the passenger waiting area. The reverse movement would occur for people leaving the buses. This circulation pattern minimizes conflicts between pedestrians and motorists.

I. General Vehicle Access

Vehicles may access the parking area by at least one two-way driveway located away from the passenger waiting area. Vehicles can circulate within the lot away from the pedestrians, thereby minimizing conflicts between vehicles and pedestrians.

A sufficient number of entrances and exits should be provided so that the volume per lane does not exceed 250 vehicles per hour where sufficient street frontage exists. The number of entrances and exits should match circulation requirements. Wherever a park-and-ride lot has more than 300 parking stalls, at least two exits should be provided.

VI. Internal Circulation

A. General Guidelines

- The arrangement of parking aisles and stalls should minimize vehicle travel distances, conflicting movements, and the number of turns.
- Separation should be maintained between vehicle and pedestrian traffic.
- Circulation patterns should be simple and direct, allowing for easy driver orientation.
- Circulation patterns for arriving vehicles are more critical than for departing vehicles. Arriving vehicles are meeting scheduled bus departures. In the evening, departing passengers have fewer time constraints.
- The number of evening drop-and-ride vehicles is usually greater than in the morning.
- Access points should be located to minimize conflicts near the passenger shelter and waiting area.
- At-grade railroad crossings within lots are unacceptable.

B. Bus Circulation

- Bus travel time within the lot should not exceed two minutes and the bus circulation path should be as direct and short as possible. Bus turnouts immediately adjacent to public roads may be used as loading areas.
- Parallel type bus stops or sawtooth bus bays should be used in park-and-ride lots. Bus stops on adjacent public streets should use the "turn-out" designs to the standards of the agency having jurisdiction, or Metro's, whichever is greater. See additional guidelines under "Bus Loading Area."
- Access roads used exclusively by buses should be a minimum of 20 feet wide in each direction with minimum curb radius of 40 feet.
- Pedestrian entrance and exit points should be within the bus driver's field of vision.

C. Drop-and-Ride Circulation

Approximately 10 percent of the total number of vehicles using a park-and-ride lot could be drop-and-ride vehicles. The average waiting period in the evening for a drop-and-ride vehicle is 6 to 10 minutes. Space for drop-and-ride vehicles should be provided for approximately 1 to 1.5 percent of the lot's capacity.

D. Vanpool Circulation

A separate staging area/loading area/drop-and-ride area needs to be developed for vanpools adjacent to the transit vehicle loading area.

VII. Special Parking Needs

A. Parking for People with Disabilities

Parking spaces for patrons with disabilities should be located near the bus loading zone. The vanpool staging area will also require such parking. The following guidelines should be used in locating these spaces:

- A patron with a disability should not have to cross an access road enroute to the bus loading zone or vanpool staging area, nor should the person have to travel behind parked cars.
- Each parking stall should be 12 feet wide. Alternatively, stalls could be 8 feet wide with a 4-foot common walkway between them.
- Appropriate signing or pavement markings should indicate the restricted use of the space for persons with disabilities. Curbs to and from the bus loading area should be depressed for wheelchair users or have ramps.
- More detailed specifications for parking for people with disabilities can be found in the Washington State Code. See An Illustrated Handbook for Barrier-Free Design by Barbara Ellen and Bob Small.
- Local jurisdictions may also have their own standards for design of parking spaces for disabled people.

B. Rideshare Vehicle Parking

Remote/outer edge parking (away from the bus/vanpool loading zones) for carpoolers within a park-and-ride lot may be developed through site design. Elements such as access to/from the lot, security, etc. need to be considered to promote voluntary use of remote parking areas.

VIII. Pedestrian Facilities

A. Sidewalks

A route of travel accessible to wheelchair users should be provided through all park-and-ride lots. Pedestrian facilities must provide a means of safe access to bus loading zones and vanpool staging areas. A sidewalk should be located next to all curb-side parking lanes and to all loading zones.

Sidewalks should be a minimum of 5 feet wide for two-way pedestrian traffic. Parking areas should be designed so that vehicles do not overhang the sidewalk. Sidewalk design should be compatible with existing sidewalks in the area. Where sidewalks abut public roadways, the width should be in accordance with the local design standard. The minimum width of sidewalk adjacent to a bus or taxi loading zone should be 12 feet, or the adjacent sidewalk width plus 7 feet, whichever is greater; unobstructed space should be 8 feet from the curb.

B. Bridges and Tunnels

Construction of pedestrian bridges and tunnels should be avoided if another acceptable alternate design is feasible. Where tunnels are built, they should have a generous cross-section and be well-lighted. Tunnels should be placed so that continuous visibility is provided into the tunnel when viewed from the approaches; maximum consideration should be given to the safety of patrons and disabled users.

C. Walking Distances

The distance a pedestrian should have to walk from the car to the bus load zone should be a maximum of 800 feet.

D. Pedestrian Crossings

Pedestrian crosswalk markings should be placed to represent an extension of sidewalks and provide acceptable line-of-sight distances for pedestrian safety (refer to local jurisdiction standards). Crosswalk lines should ideally be located at intersections. Crosswalk lines should be used when sidewalks are present and if any of the following conditions exist:

- at signalized intersections across all approaches.
- at stop-controlled intersections across the controlled approaches.
- at any intersection across those approaches with a pedestrian volume exceeding 50 pedestrians in any hour.
- at any location where it is desired to encourage pedestrian travel.

- at any location where pedestrians could not otherwise recognize the intended place to cross a roadway.

E. Pedestrian Spaces

- The curb space immediately adjacent to the bus loading areas should be free of all street level obstacles. Except for bus stop signs, all street furniture and related pedestrian amenities should be set in a minimum of 8 feet from the curb. Street furniture should be placed to avoid blocking the operator's view of intending passengers or obstructing sight distance. Bus stop signs should have a minimum clearance of 7 feet and overhanging trees should be a minimum of 8 feet from the ground.

- Paving materials in pedestrian areas should provide good traction to reduce the risks of falling or slipping.

- Throughout the facility, pedestrian spaces should be well lit and have clear sight lines to promote a secure environment for the users. Passenger shelters should have clear side panels so passengers can be seen.

- Street furniture such as trash cans, benches, pay phones, light standards, shelters and information displays should be constructed of durable, vandal-resistant materials. Aesthetics and maintenance needs should be considered in the initial design. Every permanent park-and-ride lot should have a public pay phone.

- Tactile markings should be provided on the platform for people with visual impairments.

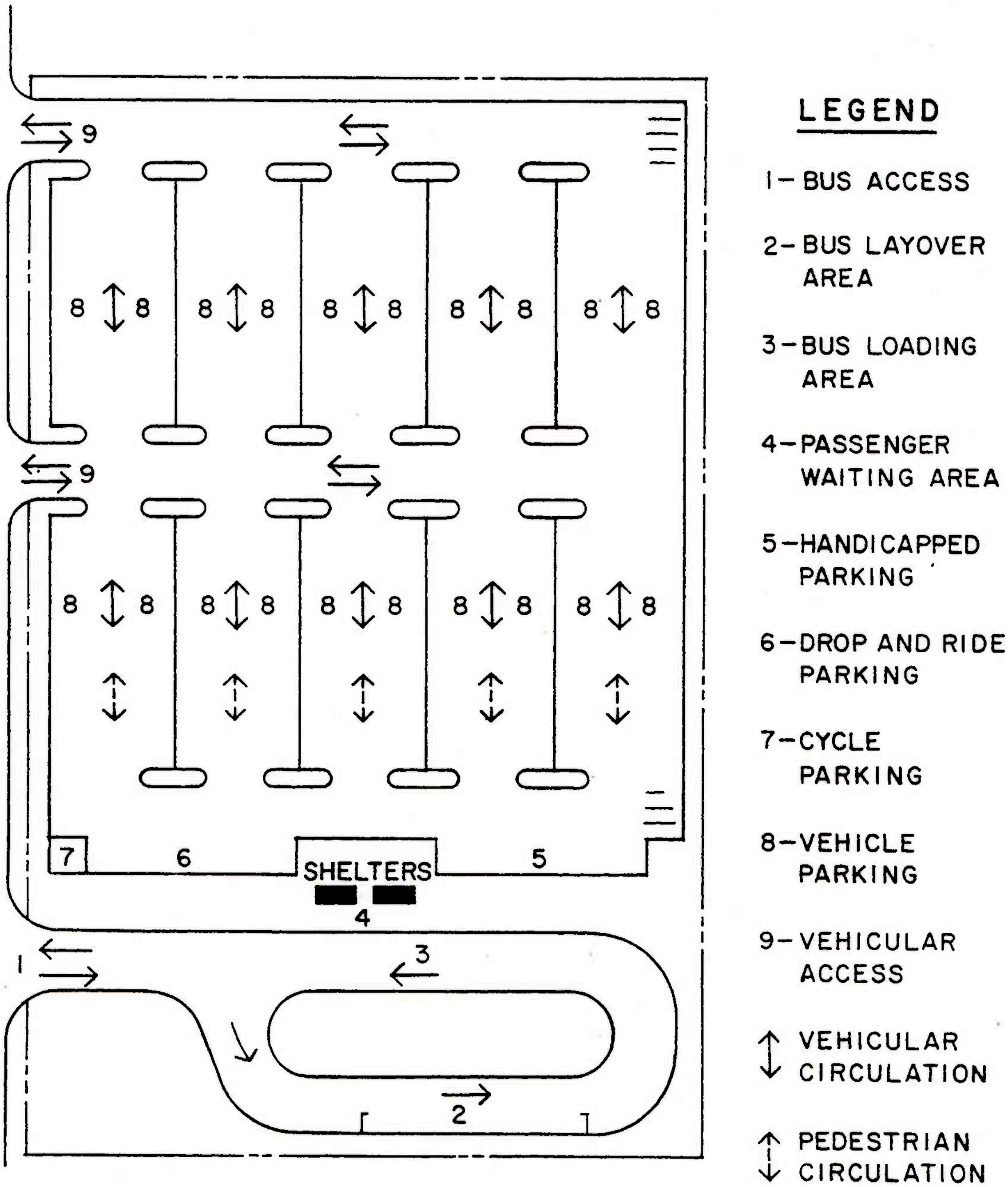


FIGURE 2-2A
Prototype Park-and-Ride Lot

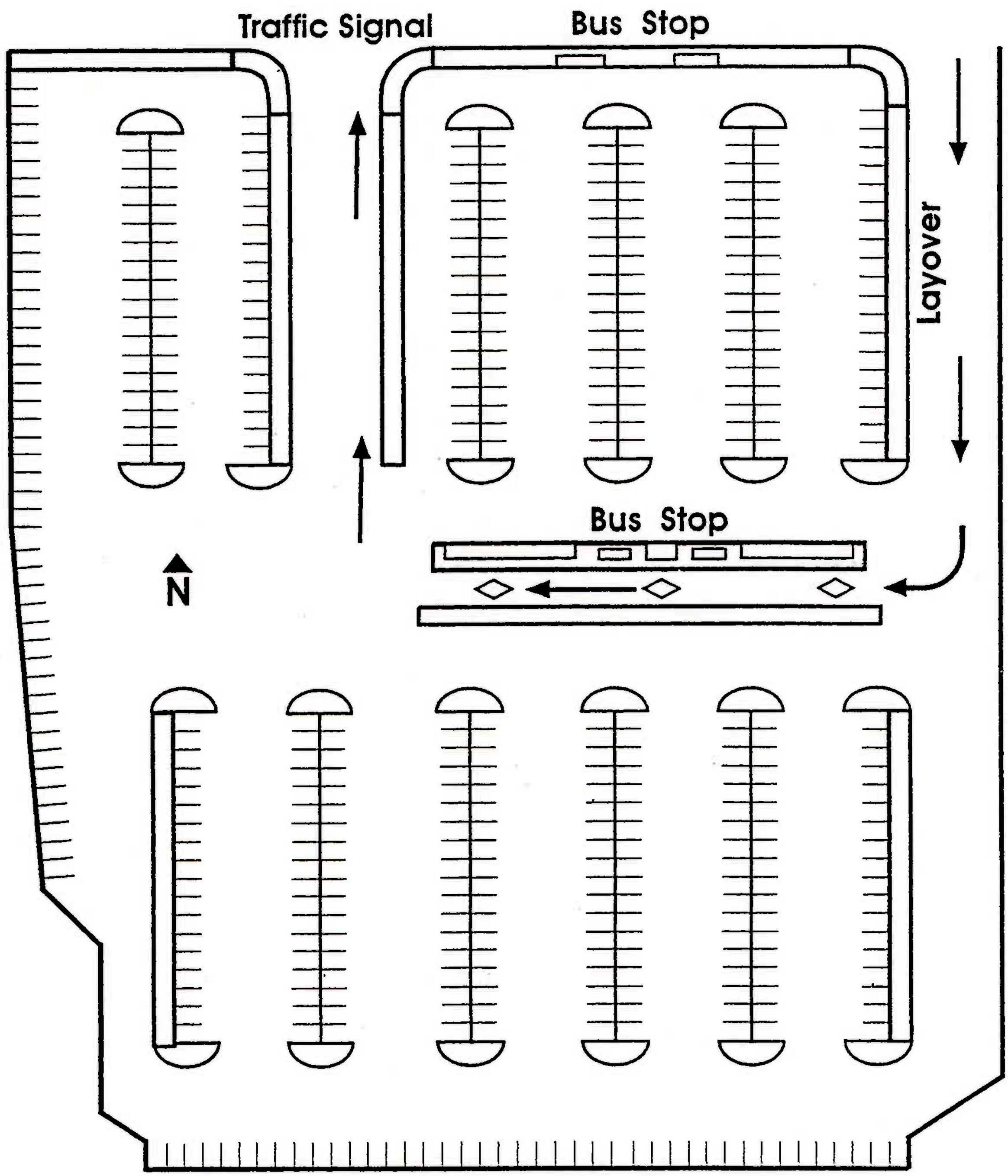


FIGURE 2-2B
Alternative Prototype Park-and-Ride Lot
(Based on S. Federal Way Park-and-Ride)

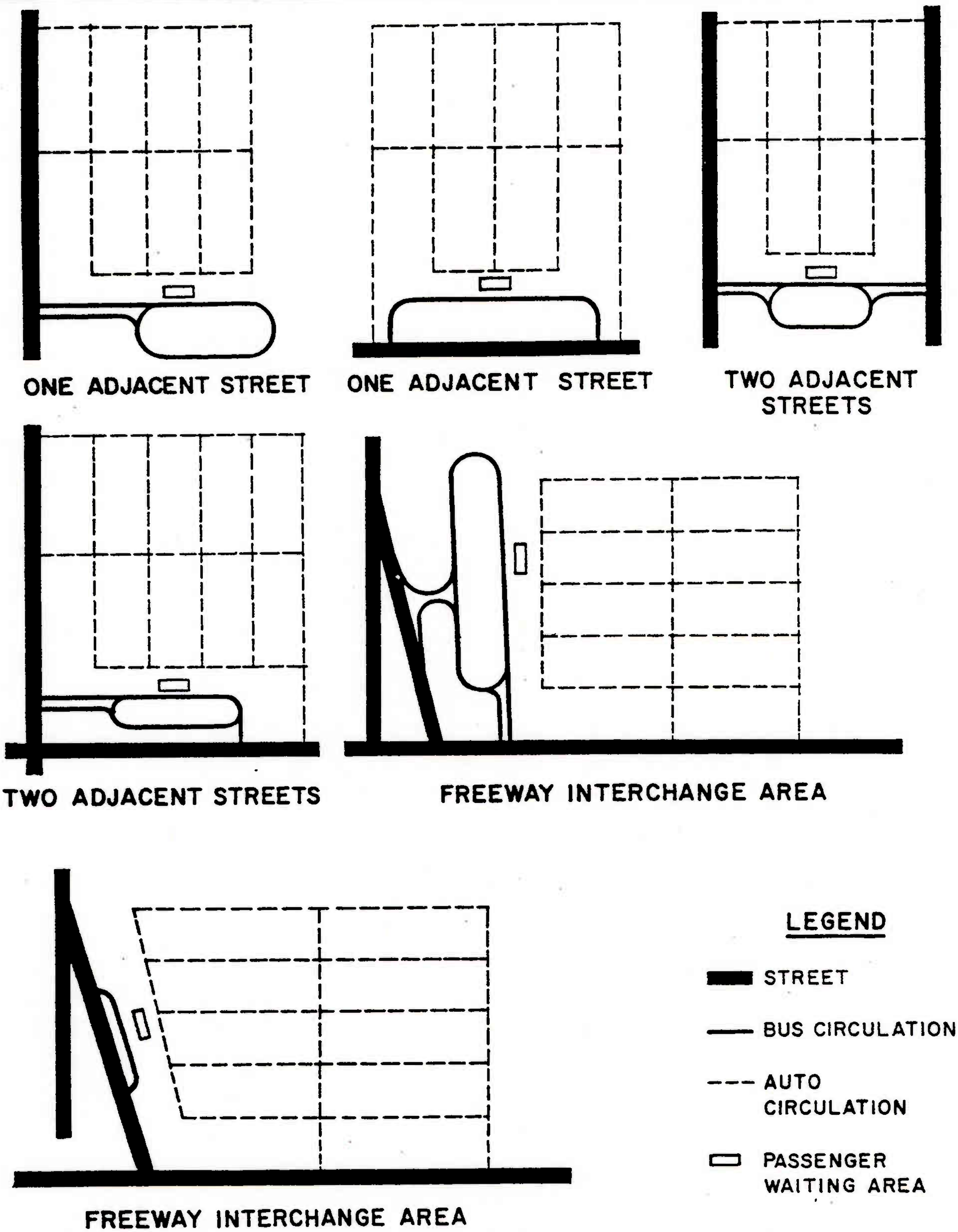


FIGURE 2-3

Application of Prototype to Varying Site Conditions

LEASED PARK-AND-RIDE LOTS

I. Reasons for Establishing a Leased Park-and-Ride Lot

- The lot is already being used as an unauthorized parking area by commuters.
- The site provides additional parking capacity for a nearby full permanent park-and-ride lot.
- It is unlikely that a permanent lot will be proposed in the general area.
- The lot provides capacity prior to building a permanent lot.
- The lot can be brought on line quickly at a low budget.

II. Site Evaluation Criteria

- Prime candidates for leased commuter lots are existing or developing large shopping centers, churches, skating rinks and theatres, etc.
- Lots can be either small lots with less than 100 stalls that are no more than 25% occupied on a weekday or larger parking areas that appear to have a block of 100 or more parking stalls consistently empty during weekdays.
- The site should provide quick, direct access to the commuting corridor. This is usually on the inbound side of a major arterial approaching an interchange that has high peak hour traffic levels.
- The site should be highly visible and accessible from as many directions as possible and should meet the standard design criteria referred to in the Park- and-Ride section.
- Sites with direct access to an HOV lane on metered ramps with HOV bypass are highly desirable.
- The site should not present a safety hazard for vehicles or pedestrians when cars enter and leave during peak hours.
- The site is usually located within a one-half mile radius of a major freeway interchange or commuter route.
- Areas with the greatest potential contain arterials or highways which funnel into the freeway interchange from areas of high to moderate residential density.

- The majority of lot users reside within a 4 to 6 mile half circle "upstream" -- in the direction opposite to the morning peak hour flow -- from the leased lot facility.

- There should be high peak hour occupancy counts within the corridor.

III. Contract/Lease Fees/Maintenance Terms

- The contract length varies, normally 3 to 5 years or longer.

- The property owner is held harmless.

- The lease fee is normally paid in the form of a maintenance fee, such as $1.20 per stall per month; however, this fee can vary.

- The lease fee covers maintenance and cleaning of the lot by property owner.

- Metro provides appropriate signage for the lot.

IV. Sizing of Leased Lots

- A leased lot normally has 100 or less stalls. In areas where demand is greater than 100 stalls, larger lots are obtained.

V. Restriction in Use

- The lots are normally available for use by commuters Monday through Friday only. Most lots have restrictions on hours of use; usually 6 a.m. to 7 p.m.

- Buses are normally restricted from entering the property.

VI. Signing

Four different types of signs are used in conjunction with leased park-and-ride lots. These signs are shown in Figure 2-4A and Figure 2-4B.

A. Location Sign

There is one type of location sign -- Park-and-Ride. Each contains telephone numbers for obtaining information about transit and ridesharing opportunities. The 24-inch by 36-inch aluminum sign is mounted on a single pole. All signage is approved for copy by the property owner.

B. Welcome Signs

These signs welcome commuters to the lot and identify the property owner as the provider of the lot.

C. Trailblazers

These signs are used to direct commuters to all commuter parking lots in the Metro service area. The standard green and white highway sign says "Commuter Parking" and displays a directional arrow.

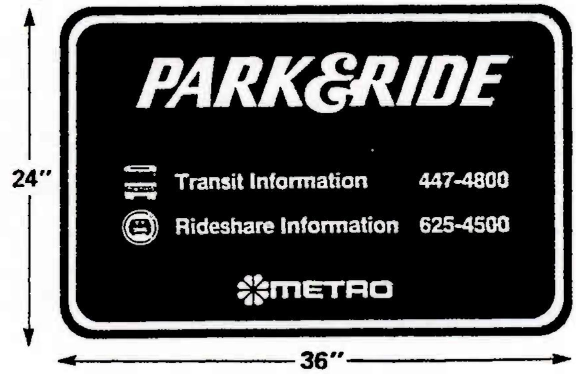
D. Parking Control Signs (Figure 2-4B)

These three signs identify where commuters may and may not park within the lot. Additional special signs can be used in specific situations as the need arises, although every effort is made to use the standard signs first. These signs cover parking days and hours..

PARK & RIDE LEASE LOT SIGNS

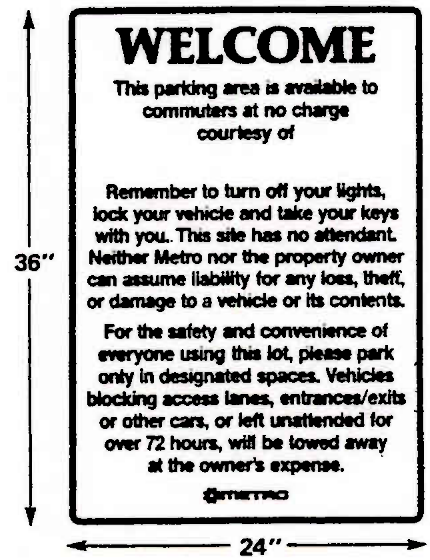
Name	Description
P–101	Park & Ride Sign w/Metro logo Transit and Rideshare Information Phone Numbers

LOCATION SIGN (Park & Ride)



Name	Description
P–201	Welcome Sign w/Blank space to insert name of party providing the lot; plus standard lot information

WELCOME SIGN



Name	Description
P–301	Commuter Parking Trailblazer with Carpool/Transit logos and two-way arrow. Green background with white letters
P–302	With Right Facing Arrow
P–303	With Left Facing Arrow
P–304	With Up Facing Arrow

TRAILBLAZER

FIGURE 2-4A
Signing Used at Leased Commuter Lots

X/SD01/28

Name	Description
P–401	Commuter Parking Only Internal sign with two-way arrow, white background with green letters
P–402	With Right Facing Arrows
P–403	With Left Facing Arrow

INTERNAL LOT SIGN

Name	Description
P–501	Church Parking Only Internal Sign with two-way arrow, white background with red letters
P–502	With Right Facing Arrow
P–503	With Left Facing Arrow

INTERNAL LOT SIGN

Name	Description
P–601	No Cummuter Parking Internal Sign with two-way arrow, White background with red letters
P–602	With Right Facing Arrow
P–603	With Left Facing Arrow

INTERNAL LOT SIGN

FIGURE 2-4B

Signing Used at Leased Commuter Lots

(continued)

BICYCLE PARKING FACILITIES

Bicycle parking facilities refer to devices located within a designated area which lock both wheels and the frame of a bicycle without the use of a cable.

General Policies

Normally six secure bicycle parking spaces should be provided at each park-and-ride lot. The number of bicycle parking spaces provided at transit centers, flyer stops, major bus stops, Metro transit bases, and commuter parking lots should be determined on a case-by-case basis.

Bicycle racks should be supplied at no cost to the user.

I. Location Considerations

At all facilities, consideration should be given to setting aside space for bicycle parking expansion.

Bicycle parking facilities should be placed in prominent and visible locations with maximum pass-by traffic, yet not directly in a pedestrian pathway.

II. Facility Components

A. Railing

In addition to bike racks, a railing should be installed so that cyclists may lock their bicycles with a self-provided cable or high security lock. The railing should surround the bicycle parking area to prevent pedestrians from tripping over low racks.

B. Foundation

A concrete pad of approximately 14 feet by 30 feet should be poured at all park-and-ride lots for installation of bicycle (and motorcycle) parking facilities, either when the facility opens or at some future point in time.

C. Lighting

The bicycle parking area should be lit to ensure that the environment is secure from theft and to light the way for safe access to the platform and cars.

III. Unit Selection Considerations

Bicycle storage units should be evaluated on the basis of the following:

- Independent strength of the rack and ability to withstand tampering.
- Ease of use.
- Ability to accommodate a high-security lock.
- Maintenance requirements.
- Ability to hold the bicycle upright without damaging any part of the bicycle.

MOTORCYCLE PARKING FACILITIES

Facilities for securing motorcycles are located within a specially designated area at Metro transit facilities.

General Policies

Normally six motorcycle parking spaces should be provided at new permanent park-and-ride lots. The number of motorcycle parking spaces provided at bus bases and at leased park-and-ride lots should be determined on a case-by-case basis.

I. Location Considerations

Space for motorcycle parking should be included within the same area designated for bicycle parking, whenever possible. The motorcycle parking facilities should be placed in a prominent and visible location with maximum pass-by traffic.

II. Facility Components

A concrete pad should be poured at all park-and-ride lots for installation of motorcycle (and bicycle) parking facilities, either when the facility opens or at some future time. Devices to secure motorcycles should be provided at each park-and-ride lot.

Section 3
HOV Facilities

HIGH OCCUPANCY VEHICLE (HOV) FACILITIES

High Occupancy Vehicle (HOV) facilities are those designed for the exclusive use of transit and ridesharing vehicles, i.e., carpools and vanpools.

Although HOV lanes are probably the most familiar type of treatment, there are a wide range of facilities that give priority, and consequently, timesaving advantages to transit and ridesharing vehicles. Ultimately, these advantages encourage mode shift. The development of such facilities can occur over a wide range of costs.

I. Guidelines for HOV Facilities

A. Economic Factors

- Economic guidelines are used to identify when and where transportation system changes and/or investments for various types of treatments are justified from the standpoint of costs and benefits.
- The project must allow more people to be moved during the specified time period than could be moved without the measure or must allow them to be moved faster.
- The evaluation is based on future design year demands, while considering base year conditions.
- The economic benefits realized by preferential users should equal or surpass the negative impacts on nonpreferential users.

B. Physical Factors

- Physical factors are used to identify specific design conditions of the roadway under which regular auto traffic flow can be reasonably and safely preempted for HOVs.
- Physical factors can be used to identify existing design year characteristics which may or may not allow HOV preferential treatments, i.e., availability of enough space within the right-of-way.

II. Types of Facilities

A. Low Cost Facilities (Up to $150,000)

1. Preferential Turns

   Preferential turns allow transit and/or HOVs to make turns at intersections where they are prohibited for general traffic. This allows transit operators to follow the most efficient route available and gives HOVs an advantage where congestion is a concern. These turns can be allowed by signing, or, in some cases, by special traffic signals.

2. Preferential Parking for Carpools and Vanpools

   The designation of priority HOV spaces within existing parking facilities often does not require any new design other than restriping some parking spaces.

   Walking distances from HOV parking spaces to transit stops, carpool staging areas, or activity center destinations should be minimized. Maximum walking distances of 600-1,000 feet are recommended.

3. Parking Prohibitions (bus loading lanes)

   Curb access demands are typically found from three sources -- parking, goods deliveries, and taxi pick up/drop off. One means of dealing with this problem is to restrict curb access to designated times, e.g., off-peak hours. This solution, typically employed on peak period HOV treatments, requires strict enforcement to remove illegally parked vehicles.

4. Corner Radius Work, Landing Pads, and Bus Pullouts

   Some low cost facilities (e.g., corner radius work, landing pads, and bus pullouts) are covered in the Transit Flow and Safety Program (TFASP) section beginning on page 4-1.

5. Concurrent Flow HOV Lane (on existing roadway or shoulder)

   Concurrent flow HOV lanes are lanes designated for HOVs in the normal or with-flow direction.

Following are some guidelines for concurrent flow HOV lanes on a surface street:

- Prohibit taxicabs and other vehicles from stopping in the curb lane to pick up and drop off passengers, or to make deliveries.
- Encourage strict parking enforcement and removal of illegally parked vehicles from the curb lane.
- Signing and markings should conform to the MUTCD (Manual on Uniform Traffic Control Devices) standards, but special supplemental signs should be used as needed.

- For inside concurrent flow lanes, left turns should be prohibited at selected locations, if not at all locations. Closing of non-signalized intersections by cones or other implements should be considered to stop vehicles from crossing the HOV lane.
- For a median lane HOV treatment, use of left-turning bays (closed off due to left turn restriction) have proven to be an effective area for enforcement vantage points and detention areas.
- Enforcement of parking and turning restrictions is essential and may require more attention than violations of the HOV lane itself.
- For a curbside lane HOV treatment, locations should be available or provided where officers can apprehend and issue citations to violators without encroaching onto the main roadway. The use of cross streets may be an appropriate detention area.
- For a curbside lane HOV treatment, the signing permitting right turns should specifically state the point at which a right-turning vehicle may enter the priority lane.
- Variable speed control signing on the HOV lane may be used to limit the speed differential between the HOV lane and general-use lanes. However, the effectiveness of the HOV lane may also be reduced.

6. Contraflow HOV Lanes (on an existing roadway or shoulder)

Contraflow HOV lanes are lanes designated for HOVs in the opposite direction to normal traffic flow. Design considerations for a contraflow HOV lane on a surface street are:

- Left turns should generally be prohibited along the contraflow lane operation unless separate turn phases are provided. Strict enforcement of any left-turn prohibition should be provided. Left-turn prohibitions with physical impediments should be used where possible. Enforcement on curbside contraflow lanes also needs to focus on parking restrictions.

- Geometric and/or traffic control techniques intended to eliminate or physically impede entering and exiting at intermediate intersections greatly enhances enforcement on contraflow facilities, and should be employed where possible.

- Overhead lane-use control signals and overhead signs should be used, especially where extensive visual clutter exists.

- If possible, curbside contraflow lanes should be wide enough for a bus to safely pass a disabled bus. Wide lanes enhance enforcement by providing 1) an enforcement vantage point, 2) a passing lane for violator apprehension, and 3) a detention/citation area.

- If possible, inside contraflow lanes on two-way streets should have a median from which enforcement officers can monitor the project's operation.

- It may be desirable to impose additional restriction on both contraflow lane and/or opposing lane traffic. Reduction of the speed limit and vehicle headways are the most common restrictions, although the effectiveness of the HOV lane may be diminished as a result.

7. Signal Priority - Signal Coordination

Traffic signal changes that provide priority for HOVs include signal preemption, separate HOV phases and signal offset adjustments.

Signal priority treatments for HOVs range from minor offset and phasing adjustments to more complex signal preemption techniques that would require changes in controller equipment and occasionally on-board bus equipment. The design of signal priority treatments should consider the following:

- HOV lane volumes
- Delay to non-HOV traffic
- Bus stop locations and spacing
- Type of signal control
- Variance in transit dwell times and run times

- Position of the intersection with respect to other signalized intersections.

Special signal phases for HOVs can be inserted into cycles with or without signal preemption. These priority HOV movements may be instituted as part of a "setback" technique or at independently selected locations.

8. Queue Jumping Lanes.

   Queue jumping lanes are provided for transit and HOVs in areas of congestion. They provide a separate lane for a short distance that allows them to bypass the queue and enter the flow of traffic just prior to the point of congestion -- such as a signalized intersection, narrowing of roadway, or merging traffic.

9. Separate Turn Lanes

   Separate turn lanes may be provided for HOVs at intersections for various reasons. One reason would be to allow transit to make left turns where they are prohibited for general traffic. Another reason would be to provide HOVs an advantage at highly congested intersections.

10. Ramp Control, Bypass Lanes

    The following are design issues concerning ramp treatment for grade- separated HOV facilities:

    - Ideally, ramp meter bypass (RMB) HOV lanes should be physically separated from the metered lane(s). This is particularly important at the ramp entry.
    - Where physical separation is not possible on a long ramp with sufficient storage capacity, RMB lane should begin after the entrance point so there is a single entry lane.
    - Sufficient merging distance should be provided so that HOVs and general traffic can merge together and assume the same speeds before merging on the freeway.
    - The intersection with surface streets is of particular concern for HOV ramps. This is especially true if the ramp is reversible. Hazardous maneuvers or conflicts with surface traffic should be minimized by proper geometric design or traffic controls.
    - A vantage point should be provided for a stationary officer to monitor the RMB lane out of view of the motorists. Adequate shoulders should be provided for apprehending and ticketing violators.

Use of an existing shoulder involves several design issues:

- A change in the geometrics of entrance and exit ramps as well as surface street intersections may be required.

- If the available weaving distance is too short, the shoulder lane may cause a reduction in capacity.

- Reconstruction of the shoulder subbase may be required if the shoulder pavement is not thick enough to handle heavy volumes of HOVs, especially buses.

- If sight distance is restricted, HOV speeds may need to be limited or the HOV lane width increased.

- The selection of right or left lanes as the HOV lane is important, particularly on non-separated RMB ramps. Consideration should be given to ramp access, ramp geometrics, position of signals, vis. a vis. the stopped queue and how the two lanes will merge.

B. Capital Intensive Facilities ($150,000 or more)

High-cost HOV treatments, such as exclusive busways, separate HOV roadways, and transit malls, are unlikely to be undertaken by most local government agencies or developers and will, therefore, not be covered in this document.

III. Design Guidelines for HOV Projects

A. Lane Width

The following lane widths are recommended for HOV facilities:

- Surface street facilities - 12 feet
- Grade separated facilities - 12 feet

Widths of less than 12 feet are not recommended where transit volumes are high. One design option on limited width facilities is to establish one wide lane (i.e., 12 feet or wider) for HOVs and reduce the width of the other lanes.

B. Signing

Roadside signs should be mounted on posts directly adjacent to HOV treatments. The sign wording must identify the lane that is restricted, the type of HOVs allowed, and the hours of operation.

On some HOV projects it has been found necessary to install supplemental overhead signing in order to make the HOV signing more visible, especially in the vicinity of intersections or interchanges. Reversible lane operations are typical candidates for overhead lane use control signals. Overhead MUTCD signs applied on contraflow lane treatments can be equipped with flashers to help warn opposing traffic. Occasionally variable message signs are used in lieu of standard overhead MUTCD signs. The messages can be changed or blanked-out during hours in which the HOV treatment is not operational.

The following table indicates the MUTCD standard for signing HOV facilities:

	Roadside	Overhead
Adverse warning	R3-10	R3-13
Restricted lane	R3-11	R3-14
End of HOV lane	R3-12	R3-15

C. Pavement Markings

1. Diamond symbol

The MUTCD recommends use of a diamond symbol to delineate an HOV lane. The diamond is to be $2\frac{1}{2}$ feet wide, 12 feet long, and formed by white lines at least 6 inches in width. This symbol should be placed coincidentally with the longitudinal center of each restricted lane. The MUTCD suggests spacing the diamond symbols as close as 80 feet apart for HOV lanes on surface streets.

2. Lane delineation

There are no specific MUTCD standards pertaining to HOV lane delineation. However, MUTCD standards relating to various types of lane delineation can be applied to HOV treatments. The following general guidelines for HOV lane delineations are based upon principles presented in MUTCD Sections 3A-5 through 3A-7 and 3B-1 and 3B-2.

- White Skip Line - Concurrent flow treatment where HOV lane operates only during limited hours.

- White Solid Line - Concurrent flow treatment where HOV lane operates on a 24-hour basis.

- Yellow Skip Line - Center line of two-lane, two-way exclusive HOV roadway where passing is permitted.

- Double Yellow Solid Line - Contraflow treatment where HOV lane operates on a 24-hour basis. Also as center line of two-way exclusive HOV roadway where passing is prohibited.

- Double Yellow Skip Line - Contraflow or reversible flow treatment where HOV lane operates only during limited hours.

- Yellow Solid Line plus Yellow Skip Line - Continuous two-way left turn lane. Also center line of two-way exclusive HOV roadway where passing is prohibited in one direction.

3. Word markings

The use of word markings on the pavement can often clarify an HOV treatment restriction, especially when used in conjunction with the diamond symbol. Word markings are not suggested on HOV treatments which operate during limited hours unless the designated hours are included in the message.

Textured pavements can be used on permanent all-day HOV treatments to provide added visibility to the projects. Most applications of textured pavement have been on transit mall projects. Textured pavements have also been used on median HOV lanes along surface streets.

D. Buffers and Barriers

Buffers are recommended for separation of HOV and non-HOV lanes when possible. They are particularly beneficial on contraflow treatments where HOVs directly oppose oncoming traffic. Buffers vary in width from 1 to 2 feet up to a full lane width. Stanchions and/or painted chevrons may also be used within the buffer area to discourage violators.

The use of stanchions can assist in delineating HOV lane treatments. Although they come in many forms -- rubber cones, plastic posts, or mechanical "pop- up" dividers, flexible plastic posts are the most common form of stanchion used on HOV projects.

Stanchions placed at 20 to 40 foot intervals are often used on contraflow projects where separation of opposing traffic flows is critical. This spacing is dependent upon vehicle speed. Stanchion spacings at transition points are usually smaller (10 feet) than corresponding stanchion spacing along the treatment itself. When used in concurrent flow projects to keep vehicles from weaving into and out of the HOV lane, stanchions should be placed farther apart (40 to 100 feet). Where possible, the stanchions should be placed within a buffer area to create a gap between vehicles and the stanchions.

E. Intersection/Interchange treatment

How to accommodate turns without adversely affecting HOV flow is a major design problem. On concurrent flow curb lane HOV treatments, non-HOV turns are usually permitted from the HOV lane at intersections.

Normally right turns are only permitted to enter the HOV lane within 100 feet or one block from an intersection.

Left turn restrictions on concurrent and contraflow inside lane treatments range from prohibitions of all left turns to joint use of median left turn bays by HOVs and non-HOVs. The use of special signal turn phases or setback techniques can aid HOVs and non-HOVs in making turns at heavily used intersections.

F. Grades

Loaded buses are severely affected on grades steeper than 6 or 7 percent. The ensuing bus speed reduction can adversely affect travel time for carpools as well as for the bus itself, which may be able to make better time on a more level, alternate route.

G. Transition Treatments

Transition treatments may consist of various combinations of signing, marking, movable barriers, geometric changes, or signalization. A series of advanced warning signs (e.g., one mile, one-half mile, 1000 feet, etc.) could be used where possible to allow HOVs and non-HOVs to safely move into the appropriate lanes. On surface streets, these signs should be placed at least one block before the HOV treatment.

In the case of 24-hour HOV lane restrictions, the use of striped or cross hatched pavement markings or arrows can help channelize traffic at the beginning of an HOV lane. The use of permanent transition markings is not recommended on limited-hour HOV treatments.

Section 4
Transit Flow and Safety Program - TFASP

TRANSIT FLOW AND SAFETY PROGRAM - TFASP

I. Program Definition

TFASP was developed to deal with bus zone and bus route-related problems that have occurred for decades but were often just left alone or given only a temporary repair. TFASP addresses the problems from a capital improvement stance versus a maintenance perspective because: (1) maintenance of the existing condition does not adequately address safety and access issues, and (2) the capital improvement approach recognizes that the existing level of improvement is inadequate for the requirements of current transit equipment.

The scope of the program improvements includes: passenger landing pads, bus pullouts, walkways, bus layovers/terminal improvements, wheelchair curb ramps, corner radius adjustments, and street/traffic light improvements. Many sites involve several of these improvements. Sometimes the work done includes improvements outside of this scope that contributes to the overall improvement of the area and may fulfill jurisdictional requirements.

There are two processes for development and construction of TFASP improvements--one for internal development and construction and the other for working with local jurisdictions. Internally, sites needing improvement are determined by facility planners. A sketch is prepared which highlights the work needed at a specific location. This is forwarded to Metro Engineering staff to secure a field survey of the exact conditions. A preliminary site plan of proposed improvements is prepared and forwarded to the appropriate jurisdiction for review/approval. When sufficient sites have been gathered together, permits are secured, and contract documents are developed. The work is advertised for bids, leading to construction.

The process for working with local jurisdictions also begins with planner input and site sketch preparation. A request is then sent (including the sketch) to the jurisdiction to see if the work can be completed by the jurisdiction and at what cost. The jurisdiction then either schedules the work utilizing its own forces or includes it within a contract for related work in the vicinity. Metro reimburses the jurisdiction by issuance of a purchase order prior to work being done.

The results achieved through TFASP work are: increased pedestrian and patron safety; improved vehicular safety (both auto and transit); faster bus speeds; improved public relations resulting from resolution of the problems; and improved inter-agency relations resulting from joint cooperation. The focus of these improvements is on safety for both patrons and pedestrians; whenever possible, an effort is made to make the site accessible to people with disabilities, as well.

II. Improvement Descriptions

A. Landing Pads

These are either asphalt or concrete and involve as much new paving as needed to result in a clear paved landing area measuring 10 feet in length (up and down the street) by 8 feet in width (perpendicular to the street). This provides enough length to allow drivers to make a smooth stop and also provides enough width to allow deployment of the wheelchair lift (4 feet out from the side of the bus) and maneuverability space for the wheelchair. Paving design is equivalent to sidewalks and walkways. (See Figure 5-1, Bus Loading Pad.)

B. Bus Pullouts

This is either asphalt or concrete paving along the shoulder of the street right-of-way (outside of the travel lane) designed to allow the bus to safely stop out of traffic. Amount of paving depends on site conditions and needs. Generally, the optimal measurements for a pullout are 70 feet to 110 feet in length and 10-12 feet in width. Pullouts often include such improvements as landing pads, walkways, curb ramps, and corner radius work. Pavement design is sufficient to handle 40 foot and 60 foot buses that are classed as "heavy weight vehicles." Specific design parameters used depend on requirements of the local jurisdiction; however, Metro's general concern is to meet or exceed a minimum standard of a compacted subgrade and 10 inches of ATB (Asphalt Treated Base) and 3 inches of Class B Asphalt overlay.

Bus pullouts should be provided only where buses, when stopping on the roadway, present a serious traffic or safety problem. This is because of the delay bus drivers encounter when trying to get back into the stream of traffic. The following is a list of conditions under which pullouts should be considered:

- Speed limit of 35 mph or more on a two-lane road; 40 mph on a four-lane road
- Poor sight distance (on curve or crest of hill)
- Long dwell time at bus zone (more than 30 seconds)
- High accident rate (rear-end collisions, sideswipes)
- Regular disabled stop
- No area to unload passengers safely

In order to improve system on-time performance and minimize merging conflicts, a traffic study should be conducted to determine if a pullout is warranted.

C. Layovers/Terminals

These are nearly identical with pullouts; however, the key difference is that the bus will be stopping for at least five minutes and as much as one