

12.0 DESIGN GUIDELINES FOR PUBLIC TRANSPORTATION

- **General**

The Oregon Department of Transportation is committed to providing a multi-modal transportation system. As a part of this system, public transportation priorities need to be examined during all phases of a project. Project teams should work with the local transit agency and other local agencies during the planning and preliminary design process to ensure early consideration of transit needs, to ensure an integrated transportation system, and to ensure that design conflicts are resolved early.

Consultation with the local transit provider is critical to ensure appropriate placement and design of transit facilities. Each public transportation provider has unique needs which should be identified and addressed by the project development team. The project leader should involve the Region Traffic Engineer and landscape architectural staff when necessary.

This section of the Highway Design Manual provides guidance to designers for integrating good public transportation design practices into projects. This is especially important in urban settings. The best practices outlined in this section are intended to provide consistent guidance for all designers. ODOT, as well as local agencies and developers. The designs provide a basis for designers to develop interaction with local stakeholders during project development.

The design criteria are consistent with American Association of State Highway and Transportation Officials (AASHTO) standards. As with all engineering designs, they must be applied using sound engineering judgment. The objective is to ensure efficient, cost-effective facilities that meet the needs of the traveling public, transit agencies, and the community.

12.1 DESIGN CONSIDERATIONS

Public transportation designs must consider a variety of issues:

Yield to Bus Law--ORS 811.167 gives a bus the right of way after stopping to receive or discharge passengers, if it is displaying a standardized sign that flashes "YIELD." This law influences the decision of the local jurisdiction and ODOT to construct either bus pull-outs or curbside stops.

Bus Priority System--ORS 184.616, 184.619 and 810.260, 815.445, and OAR 734-020-0300 through 0330 relate to the use of signal preemption devices and traffic control signal operating devices. These systems can provide arriving buses the capability to alter the timing (but not the sequence) of green intervals. The preemption standards consider the safety and efficiency of

emergency, bus, and general traffic operations, and the requirements for traffic signal maintenance. Any signal design in a project area with existing or future transit facilities needs to consider the impacts of these laws. Discussions with the local transit agency will result in identifying the need for bus priority signalization. The installation of a bus priority system must be approved by the State Traffic Engineer. Future amenities such as lighting and bus arrival displays that may require additional design elements such as conduit or pedestal locations should be considered in transit designs.

Americans with Disabilities--Public transportation provides service to persons with disabilities. Designs need to address the requirements of people who have mobility, vision, or hearing impairments. Designs must comply with the requirements of the Americans with Disabilities Act (ADA) of 1990.

Safety and Personal Security--Design considerations include safety elements such as pedestrian access, passenger visibility, and traffic impacts, and personal security elements such as lighting, nearby development, and open areas. Passenger safety and personal security play significant roles in attracting transit ridership.

Local Differences—Each local jurisdiction or public transit operator has different requirements. All new public transportation facility designs should be coordinated with the local stakeholders to ensure they are compatible with the local transportation system.

Modal Connectivity--Public transportation designs need to consider connections to other modes. For example, park-and-ride designs should be reviewed for transit accommodations; bus stop locations should consider connections to light rail and intercity facilities; and pedestrians and bicyclists should have safe, accessible routes to bus stops.

Urban vs. Rural Design--Public transportation facility designs for rural areas will have needs that vary greatly from the urban system needs. Roadway width, design speeds, and bus stops without curbs and/or sidewalks are just a few examples of the issues that may differ between urban and rural settings.

12.2 BUS STOPS

The spacing, location, and design of bus stops significantly influence transit system performance and ridership. Bus stops should utilize sites which maximize transit efficiency, encourage safe pedestrian crossings, offer proximity to activity centers, minimize the disruption to other street traffic, satisfy the general spacing requirements, and provide convenient connections to other modes. Appropriate transit facilities should be incorporated into the design of transportation projects. The following location guidelines and design standards are intended to provide guidance to designers and planners.

12.2.1 BUS STOP LOCATION SELECTION

Bus stop locations are generally determined by the local transit agency and are based on goals to meet the needs of the passengers and maximize passenger convenience. Bus stop spacing affects overall travel time, and therefore, demand for transit. Bus stops should be spaced to minimize pedestrian walking distances near major passenger generators. Table 12-1 lists some typical bus stop spacings.

**Table 12-1
Typical Bus Stop Spacing**

Area	Spacing Range (feet)
CBDs and STAs ¹	330 – 1000
Urban/Developed Areas, CCs, and UBAs ²	650 – 1300
Urbanizable/Suburban Areas	740 – 2300
Unincorporated Communities/Rural Lands	As Needed

¹Central Business Districts (CBDs) and Special Transportation Areas (STAs)

²Commercial Centers (CCs) and Urban Business Areas (UBAs)

The location of the bus stop must address both traffic operation issues and passenger accessibility issues. If possible, the bus stop should be located in an area where typical improvements, such as a bench or shelter, can be placed in the public right of way. Bus stop location should consider potential ridership, traffic and rider safety, and bus operation elements that require site-specific evaluation. Significant emphasis should be placed on factors affecting personal security; well-lit open spaces visible from the street create a safer environment for waiting passengers. Elements to consider in bus stop placement include the following:

Use:

- Proximity to major trip generators;
- Presence of sidewalks, crosswalks, and curb ramps;
- Connection to nearby pedestrian circulation system;
- Access for people with disabilities; and
- Convenient passenger transfers to other routes.

Traffic and Rider Safety:

- Conflict between buses and other traffic;
- Passenger protection from passing traffic;
- All weather surface to step to/from the bus;
- Open and lighted spaces for personal security and passenger visibility; and
- Street illumination.

Bus Operations:

- Adequate curb space for the number of buses expected at the stop at one time;
- On-street automobile parking and truck delivery zones;
- Traffic control devices near the bus stop, such as signals or stop signs;
- Volumes and turning movements of other traffic, including bicycles;
- Width of sidewalks;
- Pedestrian activity through intersections;
- Proximity and traffic volumes of nearby driveways;
- Street grade;
- Ease of re-entering traffic stream; and
- Proximity to rail crossings.

Bus stops are generally located at intersections where they may be placed near-side or far-side. They may also be placed mid-block. In general, a near-side stop is preferred on two lane streets where vehicles will not pass around a stopped bus. In the case of a street with wide shoulders or multiple lanes where vehicular traffic may pass uncontrolled around the bus, a far-side stop is preferred for sight distance issues. In the case of a street with wide shoulders or multiple lanes where vehicular traffic is controlled by a signal, the bus stop may be located either near-side or far-side. Stops should be placed to minimize the difficulties associated with lane changes and weaving maneuvers on the approach to a left turn. Where it is not acceptable to stop the bus in traffic and a bus pullout is warranted, (see following discussion, “Guidelines for Special Treatments”), a far-side or mid-block stop is generally preferred. As with other elements of the roadway, consistency of stop placement lessens the potential for operator and passenger confusion. In order to minimize conflicts and maintain sight distance, bus stops should not be located close to driveways. Table 12-2 presents a comparison of the advantages and disadvantages of each bus stop type.

**Table 12-2
Advantages and Disadvantages of Far-side, Near-side, and Mid-block Bus Stops**

FAR-SIDE STOP	
Advantages	Disadvantages
<ul style="list-style-type: none"> • Minimizes conflict between buses and right turning vehicles traveling in the same direction • Minimizes sight distance problems on approaches to the intersection • Encourages pedestrians to cross behind the bus • Minimizes area needed for curbside bus zone • If placed just beyond a signalized intersection in a bus pullout, buses may more easily reenter the traffic stream • If a pullout is provided, vehicle capacity through intersection is unaffected 	<ul style="list-style-type: none"> • If bus stops in travel lane, could result in traffic queued into intersection behind the bus (pullout will allow traffic to pass around the stopped bus) • If bus stops in travel lane, could result in a high rate of rear-end accidents as motorists fail to anticipate stopped traffic • May cause passengers to access buses further from crosswalk • May interfere with right turn movement from cross street
NEAR-SIDE STOP	
Advantages	Disadvantages
<ul style="list-style-type: none"> • Minimizes interference when traffic is heavy on the far side of an intersection • Allows passengers to access buses close to crosswalk • Driver may use the width of the intersection to pull away from the curb • Allows passengers to board and alight when the bus is stopped for a red light • Provides the driver with the opportunity to look for oncoming traffic, including other buses with potential passengers 	<ul style="list-style-type: none"> • Stopped bus may interfere with a dedicated right turn lane • May cause sight distance problem for cross-street traffic and pedestrians • If located at a signalized intersection, and if the shoulder width at the stop is such that buses will exit the traffic stream, a traffic queue at a signal may make it difficult for buses to re-enter the traffic stream • Prohibits through traffic movement with green light, similar to far-side stop without a bus pullout • May cause pedestrians to cross in front of the bus at intersections
MID-BLOCK STOP	
Advantages	Disadvantages
<ul style="list-style-type: none"> • Minimizes sight distance problems for vehicles and pedestrians • May result in passenger waiting areas experiencing less pedestrian congestion • May be closer to passenger origins or destinations on long blocks • May result in less interference with traffic flow 	<ul style="list-style-type: none"> • Requires additional distance for no-parking restrictions • Increases walking distance for patrons crossing at intersection, or requires special features to assist pedestrians with mid-block crossing

Source: Adapted from the Guidelines for Planning, Designing, and Operating Bus-related Street Improvements. Texas Transportation Institute.

- **Roundabouts**

A roundabout is a form of intersection design and control which accommodates traffic flow in one direction around a central island, operates with yield control at the entry points, and gives priority to vehicles within the roundabout. The placement of bus stops near roundabouts should be consistent with the needs of the users and the desired operations of the roundabout. As with the locating of bus stops at other types of intersections, pedestrian crossings of the roundabout legs should be minimized. A bus stop is best situated:

- On an exit lane, in a pullout just past the crosswalk; or
- On an approach leg 65 feet upstream from the crosswalk, in a pullout; or
- On an entrance leg, just upstream from the crosswalk where the traffic volume is low and the stopping time is short. This location should not be used on two-lane entrances (a vehicle should not be allowed to pass a stopped bus in the interest of pedestrian crossing safety).

Information on roundabout design can be found in Section 9.5.

12.2.2 BUS STOP LAYOUT AND DELINEATION

The bus stop must be clearly delineated to ensure that other traffic will not use the stop area and to give bus operators direction on where to stop the bus. For curbside stops, the bus stop zones (no parking designation) should be a minimum of 100 feet for near-side stops and 80 feet for far-side stops. Curbside mid-block stop zones should be a minimum of 150 feet. Bus stop zones are lengthened 20 feet for articulated buses. Bus stop zones may be shortened significantly with curb extensions as discussed in Section 12.2.3. Designs should be coordinated with the local jurisdiction and transit agency.

More than one bus may occupy a stop at a given time. The number of bus-loading positions required at a given location depends on 1) the rate of bus arrivals, and 2) passenger service time at the stop. Curb space for one bus will typically be adequate for up to 30 buses per hour. If passenger service time is more than 30 seconds per bus and bus arrivals exceed 30 buses per hour, then more than one loading/unloading position will likely be required. Bus stop area should be lengthened by 50 feet for each additional single unit bus and 70 feet for each additional articulated bus.

12.2.3 GUIDELINES FOR SPECIAL TREATMENTS

- **Bus Pullouts**

Bus stops may be designed with a pullout, which allows the transit vehicle to pick up and discharge passengers in an area outside the traveled way. Bus pullouts are provided primarily on high-volume and/or high-speed arterials. Since most ODOT facilities have a roadway classification of arterial, bus pullouts should be considered at all stops on state highways. Lower

vehicle speeds, greater public acceptance of delay, development intensity and limited right of way may make pullouts inappropriate in some urban situations. Bus pullouts are frequently constructed at bus stops with a high number of passenger boardings such as large shopping centers, factories, and office buildings.

Well placed, carefully designed bus pullouts offer safe passenger loading and unloading with minimal delays to both transit and other roadway traffic. While serving as a bus stop, they may also be used simultaneously as a schedule layover area. Table 12-3 lists the advantages and disadvantages that should be considered in the decision to provide a bus pullout:

**Table 12-3
Advantages and Disadvantages of Bus Pullouts**

Advantages	Disadvantages
<ul style="list-style-type: none"> • Allows traffic to proceed around bus, reducing delay for other roadway traffic • Assists in maximizing the vehicle capacity of the roadway • Defines bus stop • Passenger loading and unloading may be conducted in a more relaxed manner • Less potential for rear-end accidents 	<ul style="list-style-type: none"> • More difficult to reenter traffic, increasing bus delay and slower average travel time for bus • Uses additional space, may require additional right of way • May increase rates of sideswipe accidents • Cost • Impacts transit operation times

The Yield to Bus Law, ORS 811.167, gives a bus the right of way when pulling away from a bus stop when it is displaying a standardized sign that flashes “YIELD.” This law should improve the operational problem of buses re-entering the traffic stream.

A bus pullout is most appropriate when one or more of the following situations exist:

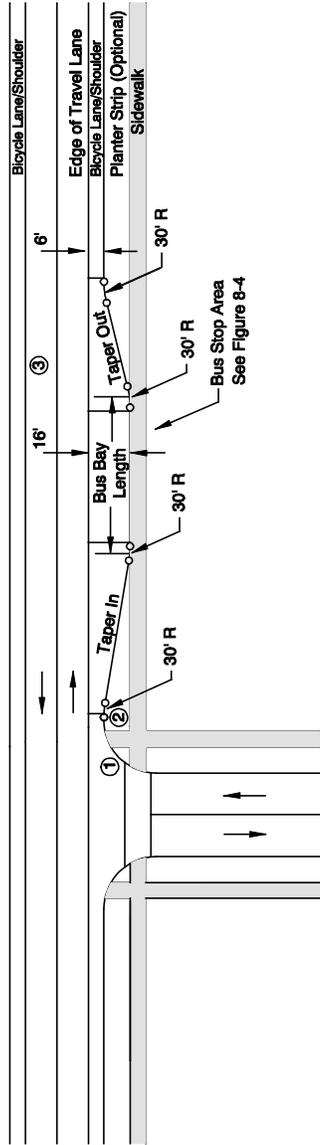
- Average vehicle speed exceeds 40 mph;
- Traffic in the curb lane exceeds 250 vehicles during the peak hour;
- History of a high rate of accidents, particularly rear-end accidents;
- More than 5 bus stops per hour;
- Passenger boardings exceed 30 boardings per hour; or
- Transit provider desires an area for dwelling time.

Multilane, one-way streets may have sufficient gaps in the traffic stream to allow all other traffic to pass around a stopped bus. Bus pullouts are generally not appropriate on these roadways.

When a bus pullout is justified, it should be placed to allow buses to easily reenter the traffic flow. The design of a bus pullout should allow through vehicle and bicycle traffic to flow freely without the obstruction of stopped buses. They should generally be placed on the far-side of a signalized intersection so that the signal can create gaps in traffic. Typical dimensions for a bus pullout are shown in Figure 12-1. The bay length should be increased by 50 feet for each additional single unit bus expected to concurrently use the pullout. Due to the highly concentrated loadings, bus pullouts should generally be constructed of plain doweled concrete pavement.



BUS PULLOUT DETAILS



DATA TABLE

Design Speed (mph)	Taper In	Taper Out	Bus Bay Length*	
			40-ft Bus	60-ft Bus
< 45	6:1	4:1	60'	80'
≥ 45	8:1	6:1	60'	80'

* Based on one bus.

For each additional single unit (40') bus, add 50'
 For each additional articulated (60') bus, add 70'.

- ① Intersection should be designed for the appropriate design vehicle. When appropriate, use two-centered curve to minimize intersection area.
- ② A short tangent section (+/- 30') may be added between the curb return and the entrance taper at intersections with right-turning buses.
- ③ May be reduced to 14' if bicycle lane/shoulder is less than 6'.

Note: Bus stops with pullouts should be located on the far-side of the intersection or at mid-block locations. In areas of special need, they may be placed on the near-side of a signalized intersection in conjunction with a queue jump signal phase.

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HIGHWAY DESIGN MANUAL
 BUS PULLOUT DETAILS

Figure: 12-1 2002

Figure 12-1
 Bus Pullout Details

- **Curb Extensions**

A curb extension may be constructed along streets with on-street parking in areas with high pedestrian use such as downtown shopping districts and central business districts. Curb extensions may be designed in conjunction with bus stops to facilitate bus operations and passenger access. The combination of curb extension and pullout can make design a challenge, particularly the drainage design. The placement of a bus stop on a curb extension should follow the same guidelines as those previously stated (a near-side stop is preferred on two lane streets where vehicles will not pass around a stopped bus. In the case of a street with wide shoulders or multiple lanes where vehicular traffic may pass uncontrolled around the bus, a far-side stop is preferred for sight distance issues). A bus stop on the near-side of a single lane entrance into an uncontrolled intersection should completely obstruct the traffic behind it. Where it is not acceptable to have stopped buses obstruct a lane of traffic, and a bus pullout is justified according to the previously established criteria, a bus stop may be placed far-side in the parking strip just beyond the curb extension. It may be appropriate to place a bus stop on a far-side curb extension at an uncontrolled intersection if the warrants for a bus pullout are not met and its placement will not create undue traffic hazards.

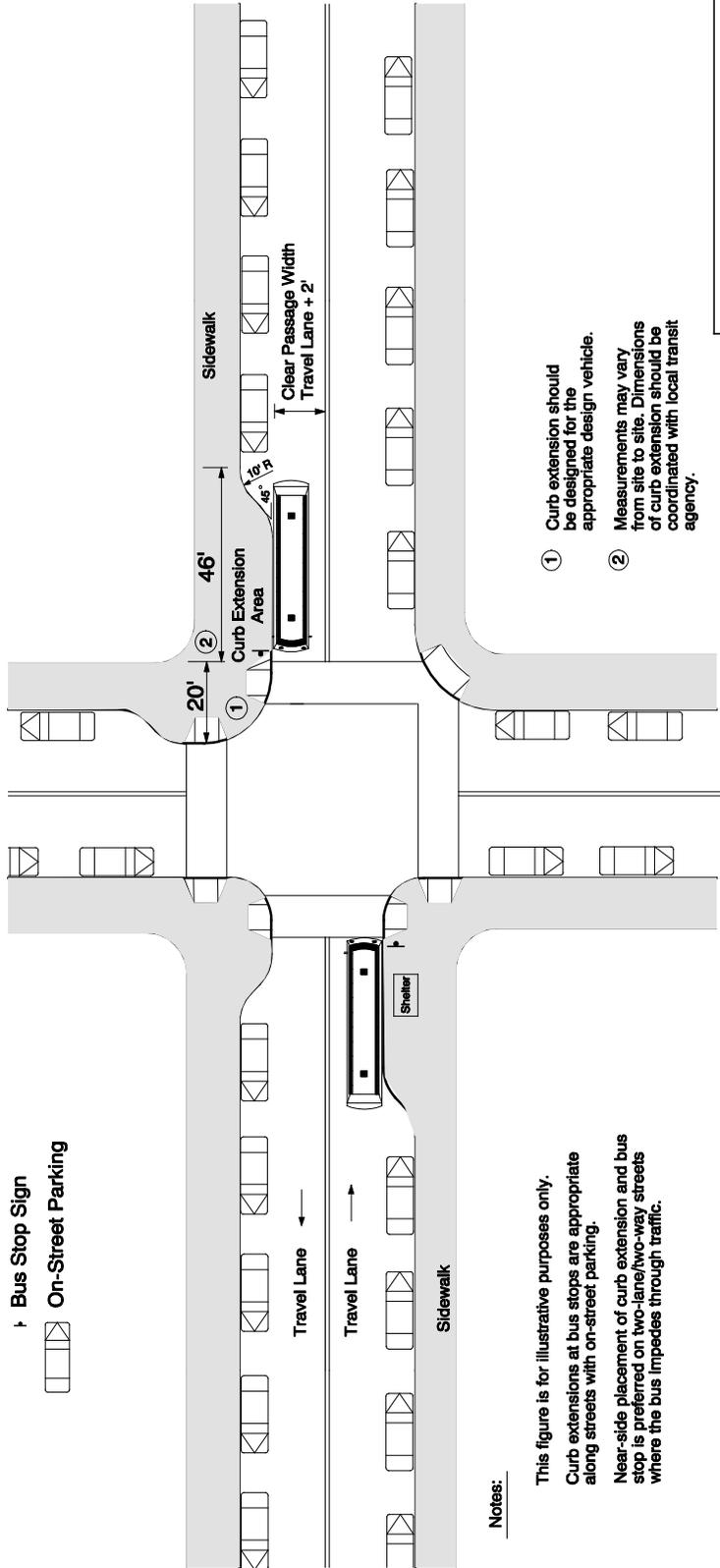
Near side curb extensions are usually about the width of the parking lane and of sufficient length to allow passengers to use the front and back doors of a bus. Typical dimensions of curb extensions with near side bus stops are shown in Figure 12-2. Besides reducing the pedestrian crossing distances, curb extensions with near side bus stops can reduce the impact to parking (compared to typical bus zones), mitigate traffic conflicts between autos and buses merging back into the traffic stream, make crossing pedestrians more visible to drivers, and create additional space for passenger amenities such as a shelter and/or a bench.

In areas where curb extensions are desired, but it is not acceptable to have the bus stop in the travel lane, a far side pullout area can be created in the parking strip as shown in Figure 12-3. This location and design, which is generally preferred for low-speed, high volume, four lane roadways, eliminates the safety hazard of vehicles passing the bus prior to entering the intersection.



Legend

- ↑ Bus Stop Sign
- On-Street Parking



Notes:

This figure is for illustrative purposes only.
 Curb extensions at bus stops are appropriate along streets with on-street parking.
 Near-side placement of curb extension and bus stop is preferred on two-lane/two-way streets where the bus impedes through traffic.

- ① Curb extension should be designed for the appropriate design vehicle.
- ② Measurements may vary from site to site. Dimensions of curb extension should be coordinated with local transit agency.

State of Oregon Department of Transportation
HIGHWAY DESIGN MANUAL NEAR-SIDE BUS STOP WITH CURB EXTENSIONS
Figure: 12-2 2003

**Figure 12-2
Near-Side Bus Stop with Curb Extensions**

12.3 PASSENGER ACCESSIBILITY AND OTHER AMENITIES

12.3.1 SIDEWALKS

At transit stops, sidewalks should be provided at a minimum to the nearest intersection or to the nearest section of existing sidewalk. It may also be necessary to wrap a sidewalk around a corner to join an existing sidewalk on a side street. If a transit route does not have complete sidewalks, it is still important to provide a suitable area for waiting pedestrians. Projects should be considered that provide sidewalks on transit routes, for continuous access to all stops.

12.3.2 PROVIDING FOR THE DISABLED

Transit ridership is usually made up of a higher than usual proportion of disabled users as many disabled people cannot drive. It is therefore critical that all transit stops be fully accessible. The two primary groups for whom this is an issue are the mobility and the vision impaired. Both require a continuous, level passage free of obstructions. This passage should be a minimum of 5 feet wide, with a 6.5 feet vertical clearance, with a minimum allowable passage of 3 feet wide in constrained areas.

At the transit stops, ADA requires an 8 foot by 5 foot landing pad at bus entrances and exits. To avoid the choppy affect this creates at permanent bus stop locations, it may be preferable to construct a continuous 8 foot wide sidewalk the length of the bus stop, or at least to the front and rear bus doors (see figure 12-4).

At stops in uncurbed areas, the shoulder should be 8 feet wide to provide a landing pad. Uncurbed areas can also have an impact on wheel chair lifts. The designer should contact the local transit service for any unique transit needs in rural areas.

12.3.3 AMENITIES FOR WAITING PASSENGERS

Transit ridership is enhanced by the provision of pleasant and comfortable places for waiting passengers. Protection from the elements, seating, and personal security are key to a pleasant waiting experience. The following amenities are recommended to be placed where feasible and cost effective. The local transit agencies typically have guidelines for amenities and should be contacted to determine which amenities should be included in the project.

- **Bus Shelter**

A standard-size bus shelter requires a 6 foot x 10 foot pad. The shelter should be placed at least 2 feet from the curb when facing away from the street and at least 4 feet when facing towards the street. The adjacent sidewalk must still have a 5 foot clear-passage. Orientation of the shelter should take into account prevailing winter winds. Sidewalks separated from the roadway with a planter strip offer a unique opportunity to provide a bus shelter out of the path of passing pedestrians.

- **Signing**

Appropriate directional signing can help people find major transit stops such as intercity bus stops, transit centers, and park-and-ride lots.

- **Seating**

Benches can make waiting more pleasant for transit passengers. Mobility impaired riders, in particular, may be unable to stand while waiting for the bus; seating may increase their ability to use fixed route service.

- **Shade**

The strategic placement of shelters and benches, and bus stops to allow for planting new trees or the use of existing trees can be crucial to public transportation passengers who prefer to wait in the shade on hot summer days. Deciduous shade trees which cast afternoon shade on the bus stop are generally most effective.

- **Garbage Cans and Other Amenities**

These improvements can make waiting more pleasant, increasing the likelihood that people will use transit as a mode choice.

- **Bicycle Parking**

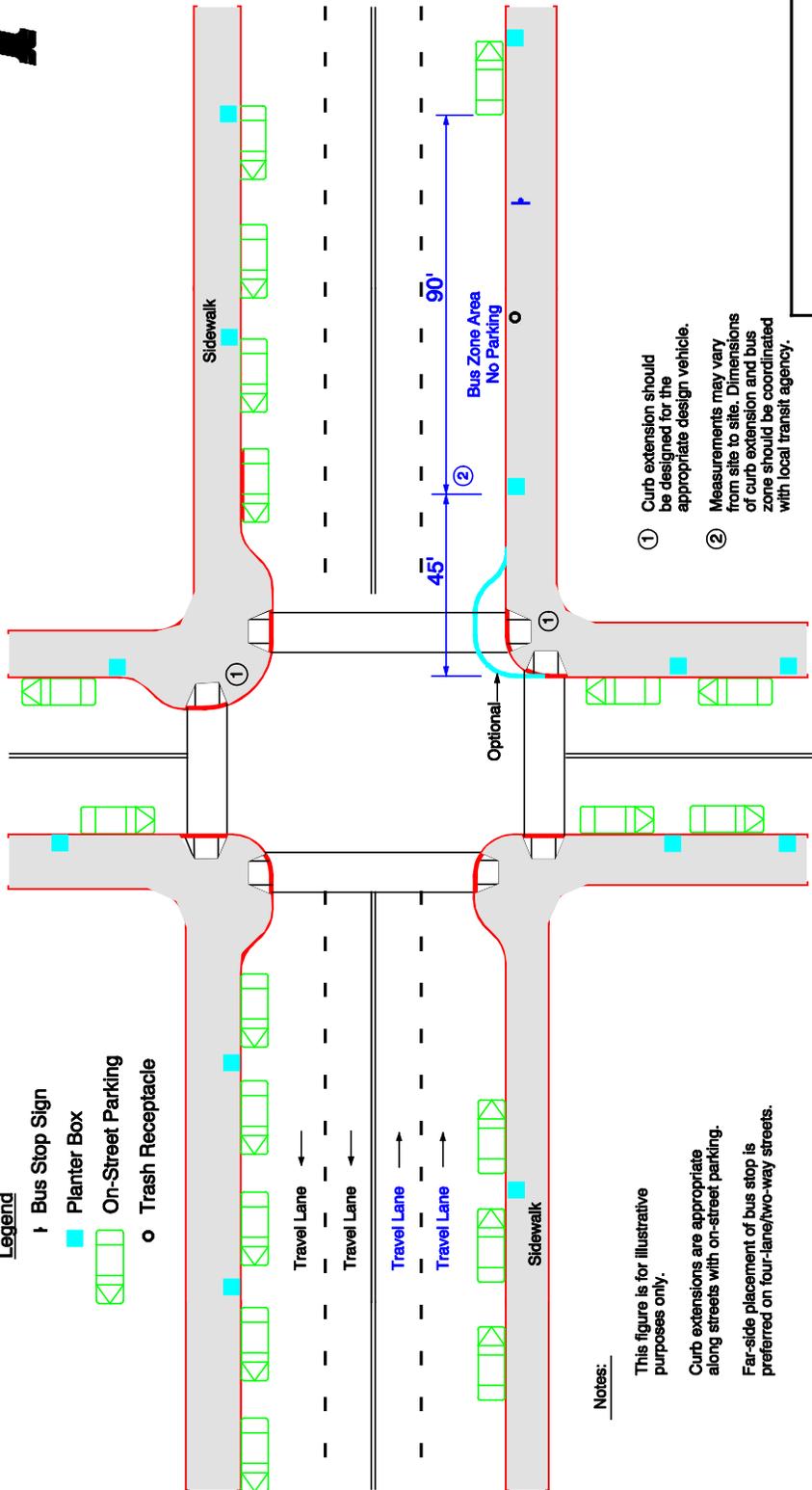
Bike racks or storage lockers should be considered at bus stops in urban fringe areas and park-and-ride facilities.

- **Future Amenities**

Work done for future amenity items such as lighting or bus arrival information should be coordinated with the local transit providers. It may be beneficial to install conduit for electrical or communication networks as part of the current project, eliminating the need to remove portions of roadway and sidewalk in the future.



- Legend**
- ↑ Bus Stop Sign
 - Planter Box
 - ▭ On-Street Parking
 - Trash Receptacle



Notes:

This figure is for illustrative purposes only.

Curb extensions are appropriate along streets with on-street parking.

Far-side placement of bus stop is preferred on four-lane/two-way streets.

① Curb extension should be designed for the appropriate design vehicle.

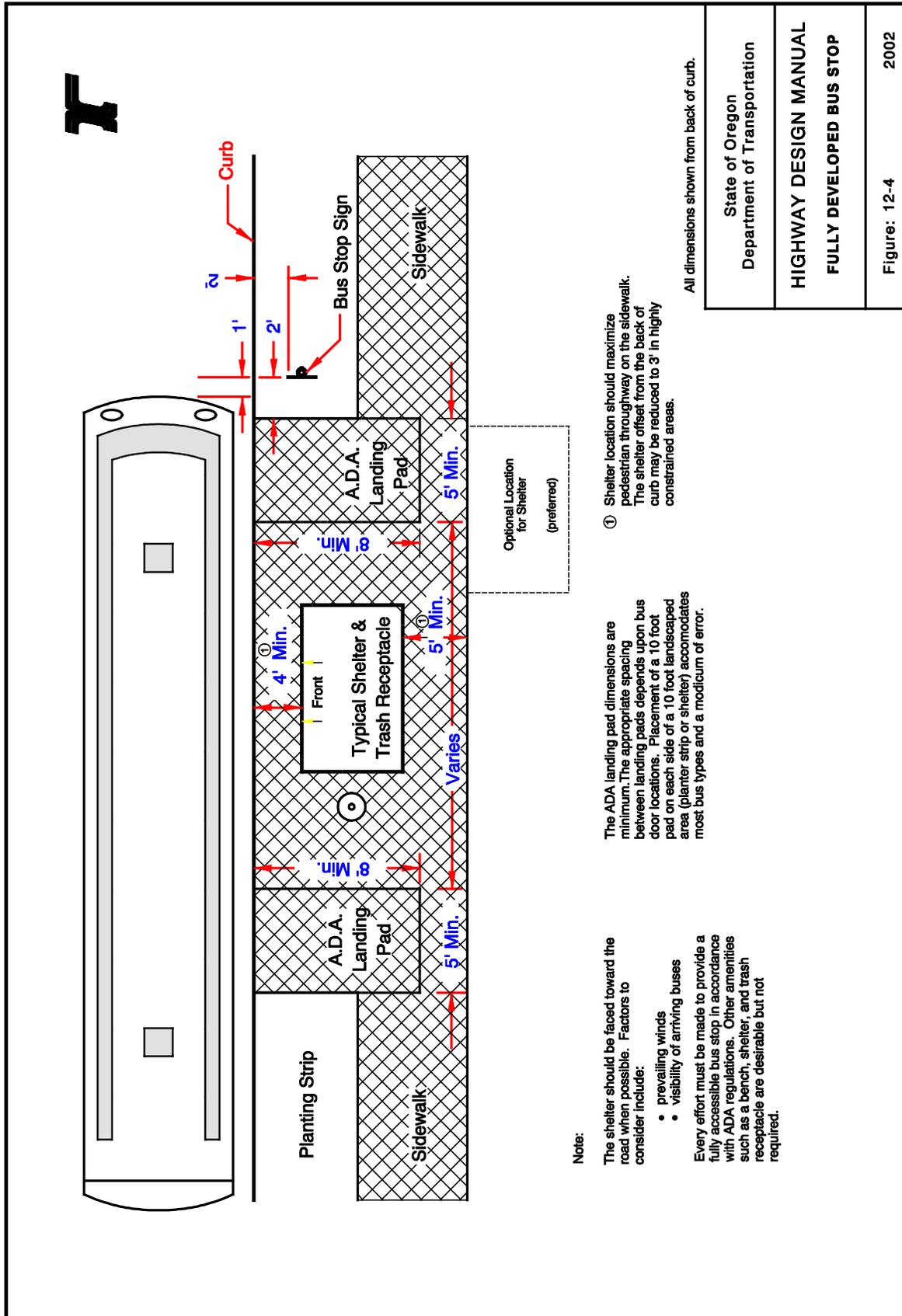
② Measurements may vary from site to site. Dimensions of curb extension and bus zone should be coordinated with local transit agency.

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HIGHWAY DESIGN MANUAL
FAR-SIDE BUS STOP WITH
CURB EXTENSIONS

Figure: 12-3 2002

Figure 12-3
Far-Side Bus Stop with Curb Extensions



Note:

The shelter should be faced toward the road when possible. Factors to consider include:

- prevailing winds
- visibility of arriving buses

Every effort must be made to provide a fully accessible bus stop in accordance with ADA regulations. Other amenities such as a bench, shelter, and trash receptacle are desirable but not required.

The ADA landing pad dimensions are minimum. The appropriate spacing between landing pads depends upon bus door locations. Placement of a 10 foot pad on each side of a 10 foot landscaped area (planter strip or shelter) accommodates most bus types and a modicum of error.

① Shelter location should maximize pedestrian thoroughway on the sidewalk. The shelter offset from the back of curb may be reduced to 3' in highly constrained areas.

All dimensions shown from back of curb.

State of Oregon Department of Transportation
HIGHWAY DESIGN MANUAL FULLY DEVELOPED BUS STOP
Figure: 12-4 2002

Figure 12-4
Fully Developed Bus Stop

12.3.4 SECURITY AND SAFETY

Safety is a concern for both the transit user and the operator. Examples of design features that can enhance or degrade personal security include:

Location: Stops should be placed in areas where passengers have safe and direct access to sidewalks, telephones, and nearby development.

Visibility: Waiting areas should be easily seen by nearby residences, businesses and passers-by.

Illumination: Waiting areas should be well-lit and open.

Soundwalls: Design features that can dramatically degrade both access and security are soundwalls or other similar structures which can isolate waiting passengers from the neighborhood. In general, there is no reason to locate transit stops adjacent to soundwalls or fences, as these preclude direct access from neighborhoods. Should this situation arise, the structure's design should consider breaks that allow for pedestrian access.

Landscaping: Street furnishings, trees, and bushes should be designed to provide an open area near the bus stop. Bushes and shrubbery should be smaller near a bus stop. Funding for landscaping and other amenities may need to come from different sources and should be discussed during project development.

12.4 ROADWAY AND INTERSECTION DESIGN FOR BUSES

The size and operating characteristics of all vehicles which regularly use the facility, including buses are to be considered in the design of roadways and intersections. The designer should contact the local roadway jurisdiction and transit agency to determine the appropriate design vehicle. Buses have unique operational characteristics including relatively low power-to-weight ratios, high axle loads, short wheel bases, and long overhangs that may necessitate special treatments. Roadway features such as intersection radii, curb type and height, lane width, and pavement thickness are to be designed to accommodate buses where necessary. Properly designed intersection features will maximize all vehicle type operations, reduce bus travel times, reduce vehicle conflicts, minimize pedestrian crossing distances, and improve the overall driving/riding experience of the roadway users.

12.4.1 GENERAL ROADWAY DESIGN FOR BUSES

While a roadway may be designed to accommodate large trucks, some design elements may be controlled by the unique needs of public transit. Some of these elements are:

Shoulder width: On roadways without curbs and sidewalks, the shoulder width at the bus stop should be 8 feet as required by ADA guidelines.

Right of way: The wheelchair landing pad at a bus stop must extend at least 8 feet beyond the curbline. Additional right of way may also be needed for a bus shelter (see Section 12.3).

Clearance: Overhead obstructions should be a minimum of 12 feet above the street surface, obstructions should not be located within 2 feet of the edge of the street to avoid being struck by a bus mirror.

12.4.2 INTERSECTIONS

Intersections should be designed for use by either a standard bus or an articulated bus. The turning and off-tracking characteristics of the two bus types are slightly different and must be accounted for in the intersection design. (The swept path of an articulated bus is about 1.5 feet wider than that for a standard bus for a right angle turn.) The overhang of buses is considerable and will affect the design corner radii, bus stop location, and placement of bus stop amenities. Street lighting, signals, signs, and other intersection furnishings should be placed clear of the turning paths of buses.

Curb radii design should minimize pedestrian crossing distance, while accommodating the off-tracking characteristics of the bus. Consideration needs to be given not only to buses on the mainline route, but also for buses entering and exiting the mainline roadway from a crossroad. In designing the curb radii for a bus entering a multi-lane road from a signalized crossroad, the design may allow for the bus to initially turn into the inside lane next to the median before returning to the outside lane or entering a bus pullout/stop area. This design will allow for a tighter curb radius or curb extension to be included (if appropriate) which will reduce pedestrian crossing distance while maintaining bus operation. It may be desirable at unsignalized intersections to design the curb radius so that the bus may enter a multilane roadway without encroaching upon the inside lane. At no time should the design encourage the vehicle to turn across opposing lanes. Appropriate curb radii in combination with usable shoulder width and number of cross street lanes are shown in Figure 12-5.

12.4.3 BUS PADS

Very concentrated loading coupled with the dynamic nature of braking place high demands on the pavement at bus stops. Some curbside stop areas may require strengthened pavement sections. On high to moderate speed roadways, these bus pads are generally placed outside of the travel lane. Roadway pavements need to be of sufficient strength to accommodate repetitive bus axle loads of up to 25,000 lbs. Due to the highly concentrated nature of the vehicle paths, consideration should be given to constructing bus pads with plain doweled concrete pavement (see Standard Drawing RD600 for PCC Pavement Details). Pavement designs should be coordinated with ODOT Pavement Services. The pavement section will depend on anticipated use and site-specific soil conditions.

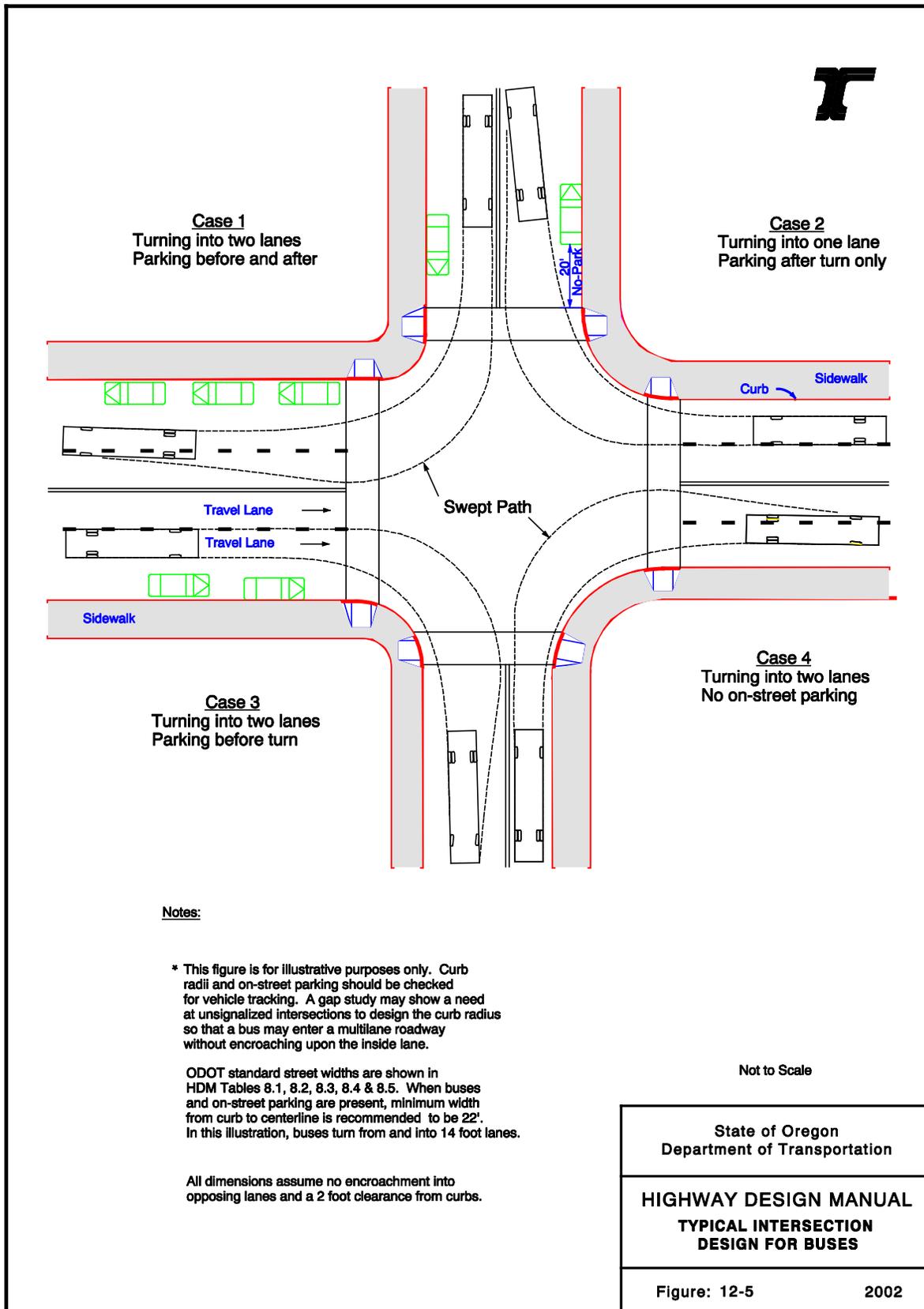


Figure 12-5
Typical Intersection Design for Bus
12-18

12.5 PARK-AND-RIDE FACILITIES

Park-and-ride facilities provide parking for people who wish to transfer from their personal vehicle to public transportation or carpools/vanpools. These facilities are one of many Transportation Demand Management (TDM) tools designed to increase highway efficiency, reduce energy demands, increase highway safety by reducing highway congestion, and provide commute options for the trip to work. Park-and-rides are frequently located near freeway interchanges, at train or transitway stations, or on express bus routes.

It is state policy to encourage the efficient use of the existing transportation system and to seek cost-effective expansion of the highway system's passenger capacity through development and use of park-and-ride facilities at appropriate urban and rural locations adjacent to or within the highway right of way.

Many park-and-ride facilities are located within urban areas and served by public transportation. Some smaller facilities may have only local transit service. Facilities placed in more rural areas may primarily serve carpools and vanpools. Park-and-ride facilities may be either shared use, such as at a church or shopping center, or exclusive use. Shared use facilities are generally designated and maintained through agreements reached between the local public transit agency or rideshare program operator and nearby businesses or churches. The possibility of meeting the needs of the community with a shared-use lot should be investigated before building an exclusive use park-and-ride lot.

The following guidelines are primarily intended for planning and design of the exclusive park-and-ride facility. If the facility is expected to be served by public transit, the project leader should involve the responsible local agency in the entire project starting with the initial needs assessment, and continuing through the planning and design phases of project development. In all cases, the local public transit agency and rideshare program operator should be involved. For areas served by public transit, projects without the support of the local public transit agency should be avoided.

Plans for new park-and-ride facilities should incorporate the design philosophies of this and other generally accepted sources such as AASHTO's *Guide for the Design of Park and Ride Facilities*. An inappropriately located or designed park-and-ride facility may be counter-productive in terms of visibility, image, and promotion of non-SOV (single occupant vehicle) travel.

12.5.1 NEEDS ASSESSMENT

The need for a park-and-ride facility may be identified in a region's transportation system plan (TSP), a transportation corridor plan, and possibly a transit agency's long range capital improvement plan. The expected demand for parking spaces at a proposed park-and-ride will be related to the quality of public transportation service, the number of commuters traveling the corridor, accessibility of the facility, the cost and availability of parking at the travelers'

destination, and a variety of economic factors and public attitudes. Local experience with park-and-ride facilities is often the most accurate gauge to sizing future facilities.

12.5.2 SITE SELECTION

Present and future needs are the main considerations in determining the location of a park-and-ride facility. If served by public transit, local transit authority input is critical to ensure that transit service and ridership are optimized with the project. As the necessary size of a park-and-ride facility is difficult to predict, the facility should be sited to allow for a conservative first phase with space available for later expansion. A number of site selection criteria should be considered in the site selection process, most notably:

- Input from local transit and rideshare program operators
- Local transit authority master plan
- Local or regional transportation plan
- Accessibility for transit and motorists
- Local public input
- Traffic impacts
- Commuter distance
- Local government zoning
- Environmental impacts
- Cost effectiveness
- Access by other modes of travel
- Visibility for passing motorist recognition
- Visibility for security
- Maintenance
- Existing right of way
- Shared use
- Future expansion flexibility.

Due to the substantial cost increase associated with buying or leasing property, government-owned right of way should receive prime consideration, assuming the other selection criteria are favorable. Sites with poor access for either transit vehicles or passing motorists should be avoided. It is likely that more users will be attracted by maximizing accessibility for inbound morning traffic than by improving the flow for exiting evening traffic. The selected site should not jeopardize the present and future integrity of the state highway or local transportation facility.

The alternative of a shared lot with off-peak demand, such as a church, movie theater, or shopping center should be explored. Shared lots can save the expense of building a new parking lot and increase the utilization of existing spaces. The site selection should consider the criteria listed above. If a shared use arrangement is agreeable with the lot owners, good pedestrian connections to the boarding areas should be provided.

ODOT frequently sells excess property, known as surplus property, upon completion of a project. All surplus property parcels should be evaluated for future use as a park-and-ride facility or carpool facility before disposal.

12.5.3 SITE DESIGN

Most facilities outside the Portland metropolitan area will require fewer than 300 spaces, and facilities in rural areas will generally not exceed the need for more than 100 spaces. Lots should be appropriately sized, and may be as small as only five spaces.

Some example layouts of park-and-ride facilities are shown in Figure 12-6. Design features must be in compliance with applicable design standards, specifications, operating standards, and any other local requirements that may apply. Design features such as the entrances and exits, internal circulation, shelter location, illumination, landscape preservation and development, and passenger amenities are generally site specific. Below are presented some design principles used to maximize the efficiency and usefulness of the facility.

- **Access**

A variety of transportation modes are used to arrive at and depart from park-and-ride facilities: private automobile, carpool/vanpool, bus or other transit vehicle, walking, bicycle, and motorcycle. These modes should be accommodated.

Often the most efficient access to a park-and-ride facility will be from an intersecting collector or local street. If the intersection is already signalized, excellent access may be available. If the park-and-ride warrants a signal at a later date, the accesses should be located with signal spacing and operations in mind. The Traffic Management Section should be contacted if signalization is anticipated. Due to cost considerations, sites that do not require signalization may be preferred.

Access to a park-and-ride should not increase congestion on the facility it serves. For this reason, it is not desirable to provide direct freeway access for private automobiles. However, direct access for transit vehicles may be desirable on freeway entrance ramps, provided that this access does not present safety and operational problems. Appropriate measures should be taken to avoid significant adverse impacts to adjacent neighborhoods and nearby streets. Ease of access, especially for the morning commuters, will encourage use of the facility. The appropriate ODOT access and spacing standards contained in the *1999 Oregon Highway Plan*, Appendix C should be followed.

When a facility has more than 300 parking spaces, multiple entrances and exits may be required. With facility sizes greater than 500 parking spaces, exits may warrant a traffic signal. Facilities having more than 1000 spaces may require access to two adjacent streets to avoid congestion.

The transit route from the freeway or arterial to a park-and-ride facility, internal circulation route, and return route should be designed to minimize transit travel time. Automobile traffic should not be in conflict with transit vehicles. It may be desirable to provide an exclusive entrance and exit for transit vehicles.

- **Internal Circulation**

Major circulation routes within a park-and-ride facility should be located along the outside edges of the parking area to minimize vehicle-pedestrian conflicts. The priority sequence for the design of the individual user modes should favor the high occupancy vehicles, namely the transit vehicles and carpool/vanpools. It is critical that facility layout and circulation patterns are coordinated with the local transit agency. Bus circulation routes should be designed to provide for easy movement, with efficient terminal operations and convenient passenger transfers. Personal vehicle traffic should be separated from bus traffic. Curb radii and driveway widths should be designed to accommodate the turning characteristic of the largest expected vehicle. The internal circulation should accommodate the needs of pedestrians and bicycles.

The passenger waiting areas should be easily accessed by transit patrons. Aisles should be aligned to facilitate convenient pedestrian movement toward the bus loading zone. Large facilities may require a central location for the passenger waiting area with parking for the various user modes surrounding the waiting area. In shared-use type facilities, the passenger waiting area should be placed away from the other activity centers to minimize the impacts of pedestrian, automobile, and bus traffic. Bicycle parking facilities should not conflict with passenger waiting areas.

- **Pavement, Drainage, and Landscaping**

Pavement design shall conform to state design specification for each of the functional areas of a facility. The surfacing type shall have the concurrence of the ODOT Pavement Services Unit. Asphalt concrete or portland cement concrete are the ideal surfacing options for all facilities officially designated for park-and-ride. If a facility is to remain unpaved, areas designated for handicapped patrons must meet ADA accessibility standards.

Adequate slope should be provided for surface drainage to prevent ponding of water. The recommended grade is 2 percent. Curb, gutter, and surface drains should be installed where needed.

A well-landscaped facility can enhance the appearance of a facility, improve public and neighborhood acceptance, and add to the feeling of security. Landscaping should be compatible with the surrounding area, and should not interfere with sight distance, vehicle operations, or access for potential users. Selective preservation of existing vegetation is often a cost-effective means to reduce environmental impacts and provide a pleasant environment for facility users. Landscaping should be designed so that security patrols can see into the facility from adjacent streets without entering. Landscape design should keep maintenance requirements to a minimum. Trees should generally be the dominant plant material as they provide shade and visual interest, reduce glare, and are less costly to maintain than shrubs and ground cover. See Section 12.3: Passenger Accessibility and Other Amenities. Funding for landscaping and other park and ride amenities will vary and should be discussed early on in project development and the establishment of local agency agreements.

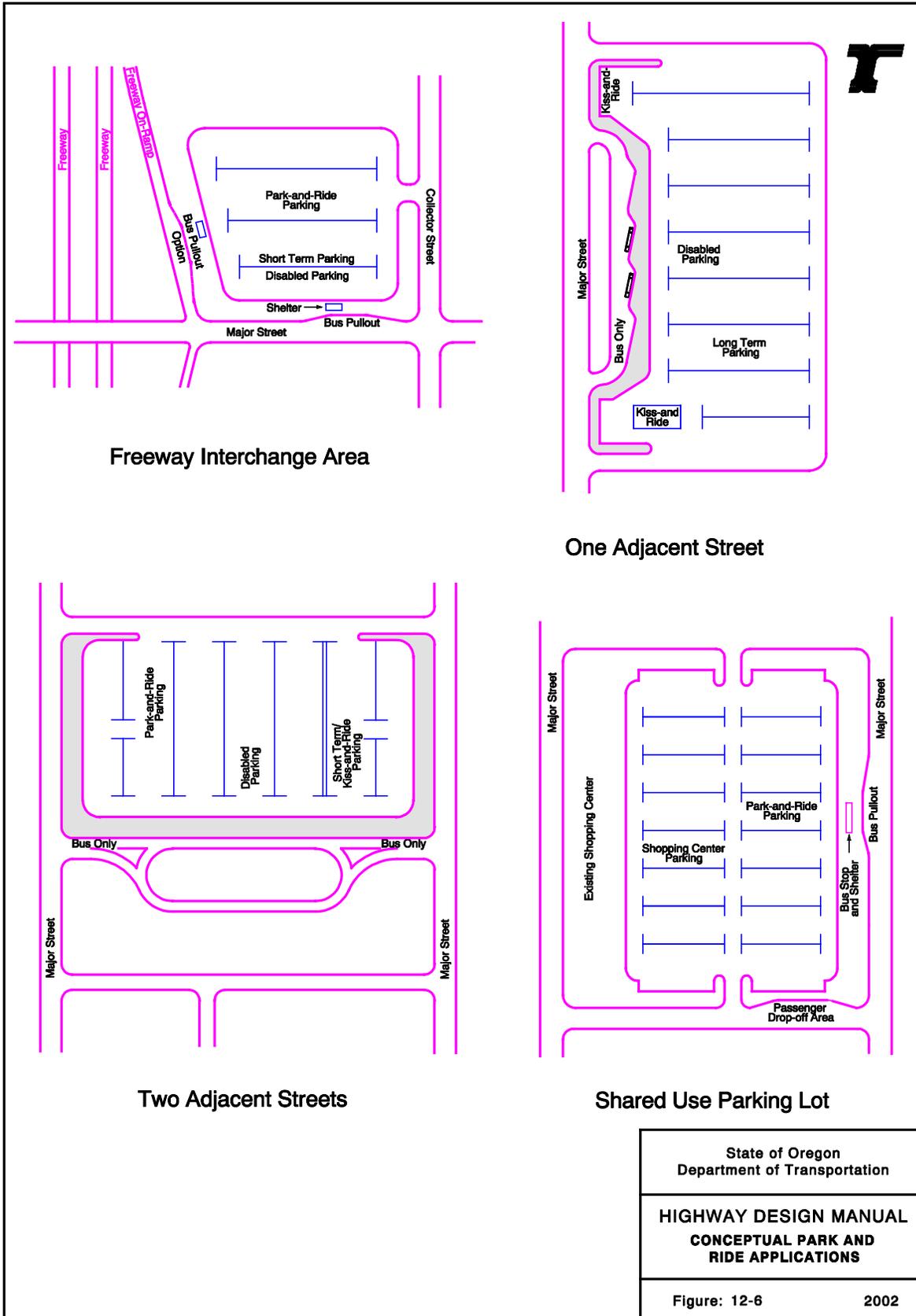


Figure 12-6
Conceptual Park and Ride Applications

- **Amenities**

Passenger amenities will vary depending upon the type of facility (e.g., exclusive or shared use), the anticipated patronage levels, local policies, and available funding. Amenities that are often found at park-and-rides include shelters, benches, telephones, trash receptacles, bus route information, and vending machines, and sometimes heated waiting areas, restrooms, and small convenience stores.

- **Lighting and Security**

Adequate lighting is important from a safety standpoint and as a deterrent to criminal activity in both the parking area and the shelters. Illumination should be considered for all park-and-ride facilities. Special emphasis should be given to bus loading and unloading areas. Future expansion plans and nearby development may influence the placement of the luminaire poles.

- **Signs and Pavement Markings**

Control of traffic movements can be greatly improved by proper pavement markings and signing. Reflectorized markings for center lines, lane lines, and lane arrows are necessary to guide or separate patron traffic and transit vehicles. Park-and-ride identification signs shall be installed. Guide signs may be placed to direct vehicles to parking areas, passenger drop-off and pick-up points, and waiting areas. Signs may also be necessary to designate bus-only lanes, no parking areas, and handicapped parking areas.

- **Bicycle Parking**

Almost all facilities will see some bicycle usage. At a minimum, bicycle racks should be provided. The provision of bicycle storage lockers will depend upon usage. The bicycle parking area should be relatively close to the transit loading area, separated from motor vehicles by a curb or other barrier, and have a direct route from the adjacent streets. The bicycle parking area should not conflict with passenger waiting and loading areas. For additional information on bicycle facilities, see Chapter 11.

- **Disabled Person Parking**

The number of disabled person parking spaces required for government buildings and publicly maintained or operated parking facilities, subject to ORS 447.233, shall conform to the following:

<u>Total Parking Spaces In Lot</u>	<u>Required Minimum Number of Accessible Spaces</u>
1 to 25	1
26 to 50	2
51 to 75	3
76 to 100	4
101 to 150	5
151 to 200	6
201 to 300	7
301 to 400	8
401 to 500	9
501 to 1000	2% of Total
1001 and over	20 plus 1 for each 100 over 1000

Exceptions to this requirement are:

1. Outpatient units and facilities: 10% of the total number of parking spaces provided serving each such outpatient unit or facility shall be disabled person parking.
2. Units and facilities that specialize in treatment or services for person with mobility impairments: 20% of the total number of parking spaces provided serving each such unit or facility shall be disabled person parking.

The dimensions and layout of disabled person parking spaces shall be as per Standard Drawing RD105. No ramp or obstacle may extend into the parking space or the aisle. Curb cuts and ramps may not be situated in such a way that they could be blocked by a legally-parked vehicle. Parking spaces and aisles shall be level with surface slopes not to exceed 2% in all directions.

- **Environmental Considerations**

The design of a park-and-ride facility should consider and address any environmental issues associated with the site. Possible environmental concerns may include stormwater runoff and water quality, wetlands, protected species, noise, visual, and traffic impacts. Landscaping and design treatments can help minimize these impacts.